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Phenology of Woody Plant Species in Olive baboon (*Papio anubis*) Habitat at the Southern Sector of Gashaka Gumti National Park, Nigeria

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Abstract

A study was carried out to determine the phenology of woody plant species in olive baboon (*Papio anubis*) habitat at the Southern Sector of Gashaka Gumti National Park (GGNP). Plant phenology has been mostly studied in the temperate zone. In contrast, tropical phenology has been relatively little studied. Line transect method was adopted for phenological study to determine seasonality of leaves, flowers and fruit production. Three (3) transects (designated 'A', 'B' and 'C') were cut through the home range of baboons. The transects measured 3.5 km, 3.5 km and 1.5 km in length respectively. A total of 899 woody plants and their associated lianas along the transects were permanently tagged with improvised metal markers. Results obtained indicated a total of 59 woody plant species. The families containing more species are: Moraceae (9), Combretaceae (5) and Caesalpinoidea (4). Flowering was highest during the wet season for both trees and vines. Fruiting was consistent throughout the year, though maximum fruiting was observed during the wet season. Leaf shedding occurred mostly during dry season. In terms of fruit colour, green fruits persisted year round with the ranges 35.85 – 85.58% in trees and 20.0 – 100% in vines. Unripe fruits were available throughout the year with a range of 39.62 – 93.02%. Most of the plant species recorded produce fruits that were eaten by baboons. It is recommended that efforts should be made to conserve the woody plant species, particularly, those that produce fruits as they may constitute some of the keystone resources in the park.

Keywords: Phenology, woody, baboon, habitat, species

Introduction

One of the most familiar of all natural phenomena is the cycle of events associated with the passage of seasons. Phenology is the study of the timing of life-history events. In plants, bud-burst, leaf-expansion, abscission, flowering, fertilization, seedset, fruiting, seed dispersal and germination all take place in due season (Fenner, 1998). Similarly, fruit ripening, colour change and leaf fall in autumn as well as the appearance and departure of migrant birds and the timing of animal breeding are all examples of phenological events (Morellato and Haddad, 2000).

Phenological studies are important to our understanding of species interactions and community function. It can inform about when certain food items are available for particular animals and help us better understand the potential effects of climate change on plants as well as animals (Bwindi Researchers, 2014). The study of phenological aspects of plants involves the observation, recording and interpretation of the timing of their life history events. Plant phenology contributes to our understanding of the effects of recent climate changes (Sparks *et al*., 1997) and can be a sensitive indicator of climatic change (Bertin, 2008).

Plant phenology has been most studied in the temperate zone. In contrast, tropical phenology has been relatively little studied (Newstrom *et al*., 1994). Precipitation influences the timing of various plant phenophases, especially in dry or seasonally dry habitats (Keatley *et al*., 2002). In seasonal climates, such as parts of the wet tropics, leafing is continuous on a community scale, though a wide range of behaviour is found between species. Lowman (1992)

found that flushing behaviour ranged from synchronous to continuous in different species and that there were large differences in longevity. Usually, leafing is linked with some climatic features such as rainfall (Fenner, 1998), temperature (Brooke *et al*., 1996) or photoperiod (Fenner, 1998). In many tropical deciduous forests, flushing takes place during the dry season (Tissue and Wright, 1995). For deciduous species, the timing of leaf fall is often linked with some change in environmental conditions such as water availability (Williams *et al*., 1997).

In most plant communities, at least some species will be in flower throughout the growing season, there is a tendency for peaks of flowering to occur. In wet tropical forests flower production may coincide with peaks of irradiance (Fenner, 1998). In the seasonally dry tropical forests, flowering is often concentrated in the transition from the late dry to the early wet season (Murali and Sukumar, 1994). In tropical communities, there are usually some species in fruits at any given time of the year and individual species tend to have longer fruiting periods, with a mean of more than 4.0 months (Fenner, 1998). Timing of fruiting may also be under some selective pressure to disperse seeds at the start of the rainy season to facilitate germination (Garwood, 1983).

This study attempted the investigation of phenology of woody plant species which can give an insight into the abundance and seasonal distribution of resources in the olive baboon habitat.

Materials and Methods

The Study Area

This study was carried out in Gashaka- Gumti National Park (GGNP), located between $6^{o}55^{1} – 8^{o} 05^{1}$N and $11^{o}11^{1}$ -$12^{o}13^{1}$ E in the North-Eastern Nigeria. GGNP was established in 1991 and represents Nigeria's largest national park covering about 6,600 km^2 (Dunn, 1998). It is known for its exceptionally high biodiversity and represents an important conservation area (Oates *et al*., 2004). The vegetation is a mosaic of Southern Guinea savannah-woodland, open (montane) grassland, lowland forest, swamps and montane forest (Warren, 2003) and it is home to a highly diverse number of small and large mammals, including nine primate species (Foster, 1998). The park harbours extensive mountainous areas. Altitude ranges from 350m to over 2,400m above sea level. The rainy season begins in March or early April and ends in mid-November (Dunn, 1993).

Study Design

Investigation of phenology of woody plant species to determine seasonality of leaves, flowers and fruit production in the habitat was carried out using the transect method as described by Ganzhorn (2003); Buba, (2013) and Ebua *et al*. (2013). Information obtained on plant cycles was useful in determining food availability for baboons. Three (3) transects were cut through the home range of the baboons. The transects were determined in such a way as to incorporate sections of different elevations as well as varying types of habitat. The transects were named alphabetically, viz; 'A', 'B' and 'C'. The transects measured 3.5 km, 3.5 km and 1.5 km in length respectively, totalling 8.5 km. The distance between transects was about three kilomteres. The transect width was 4 metres. A total of 899 woody plants with a circumference of at least 30 cm at breast height with 84 associated woody climbers (lianas) were permanently tagged with metal 'markers'. The tagged woody plants and the associated lianas were subsequently identified by resource persons from the Research Unit of the National Park. In addition, identification manuals were used for identification of the plants.

Data Collection

The tagged trees and the associated lianas/creepers were monitored twice a month for the presence of leaves, flowers and fruits as outlined by Buba (2013). Data regarding fruits such as colour, location (ground, canopy or both) and ripeness were obtained. In addition, feeding remains on the ground were noted, and where possible, the frugivores or fruit eaters were identified. This was done by observing the footprints of the animals and the bite marks on the fruits eaten.

Data analysis

Data on the forest composition, flowering, fruiting and leaves shedding patterns of woody plant species and vines (lianas) in the baboon habitat were analyzed using descriptive statistics (percentages, tables and charts).

Results and Discussion

Species list of woody plants in olive baboon (Papio anubis) habitats

A total of 899 woody plants were enumerated in Olive baboon (*Papio anubis*) habitat, belonging to 59 species distributed among 27 families. The families with the highest number of species include Moraceae (nine species), Combretaceae (five species), Caesalpinoideae (four species), while Euphorbiaceae, Leguminosae, Fabaceae and Rubiaceae had three species each. The results further indicated that *Uapaca togoensis*, *Crossopteryx febrifuga* and *Parinari excelsa* were the commonest tree species along the transects, having 190 (21.13%), 116 (12.90%) and 61 (6.79%) respectively. On the other hand, the least abundant (least common) tree species were *Sterculia cordifolia*, *Steganotaenia araliacea* and *Velantus* species. Each of them appeared once on the transects, having 0.11% each.

Phenology of woody plant species in the study area

The results presented in Figure 1 indicated a distinct seasonal flowering pattern, with minimal flowering during the dry season (November – February) for both trees and vines, while maximum flowering occurred during the rainy (wet) season months (April – August) for trees and April to June for vines. Tree and vine flowering were consistent throughout the year. This is in agreement with Wright and Van-Schaik (1994) who reported that in most plant communities, although at least some species will be in flower throughout the growing season, there is a tendency for peaks of flowering to occur. Murali and Sukumar (1994) also reported that in the seasonally dry tropical forests flowering is often concentrated in the transition from the late dry to the early wet season. However, the findings on the flowering pattern of trees and vines contrasts with the report by Buba (2013) who reported maximum flowering in trees and vines during the dry season months at Kwano forest. The differences in the findings may probably be as a result of variation in vegetation types. The result in Figure 2 indicated variations but consistent fruiting throughout the year with relatively lower levels in the months of February and March for trees. For the vines, there was a marked maximum fruiting during the wet season (April – September), with minimal production between October and December and complete absence of fruits in the months of January and February. This is in accord with Jordano (1992) who reported that in tropical communities, there are usually some species in fruit at any given time of the year.

The results on leaf shedding pattern (Figure 3) showed clearly that the majority of the trees shed their leaves during the dry season; mostly in February (16.73%), March (9.37%) and January (4.08%). However, negligible shedding of leaves occurred in some rainy season months. Shedding of leaves in vines were not recorded during the wet season months of July, August and October. However, minimal shedding were recorded in September (1.33%), November (2.67%), May (6.58%) and June (5.33%). This findings agrees with Williams *et al*. (1997) and Lieberman and Lieberman (1984) who reported that the timing of leaf fall is often linked with some changes in environmental conditions such as water availability and temperature. Also, Tissue and Wright (1995) also reported that in many tropical deciduous forests, flushing takes place during the dry season, well before the arrival of the rains.

The colour of fruits produced by the fruiting trees (Figure 4) shows that green fruits were available year round, ranging from 35.85% - 85.58%, followed by yellow fruits (0.37% - 46.95%) which was also available throughout the year except in September. Black fruits were least available (0.43% - 8.84%). Green fruits were the most abundant and available year round (20.00% – 100.0%) in vines as presented in Figure 5, followed by brown colour fruits (0.0 – 66.67%). Black fruits were least abundant (5.56 – 8.33%).

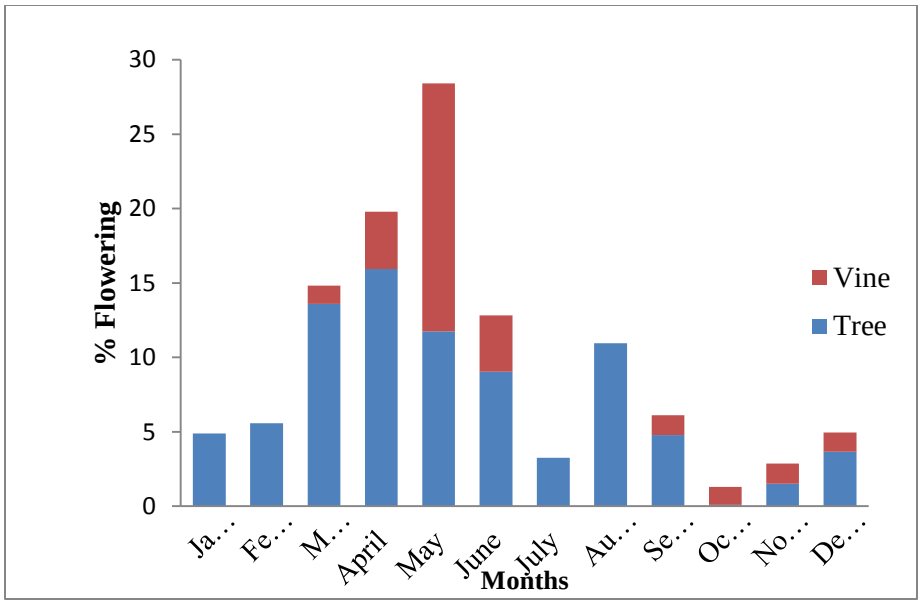

Figure 1: Seasonal Flowering Pattern of Trees and Vines in the Study Area
Source: Fieldwork (2015).

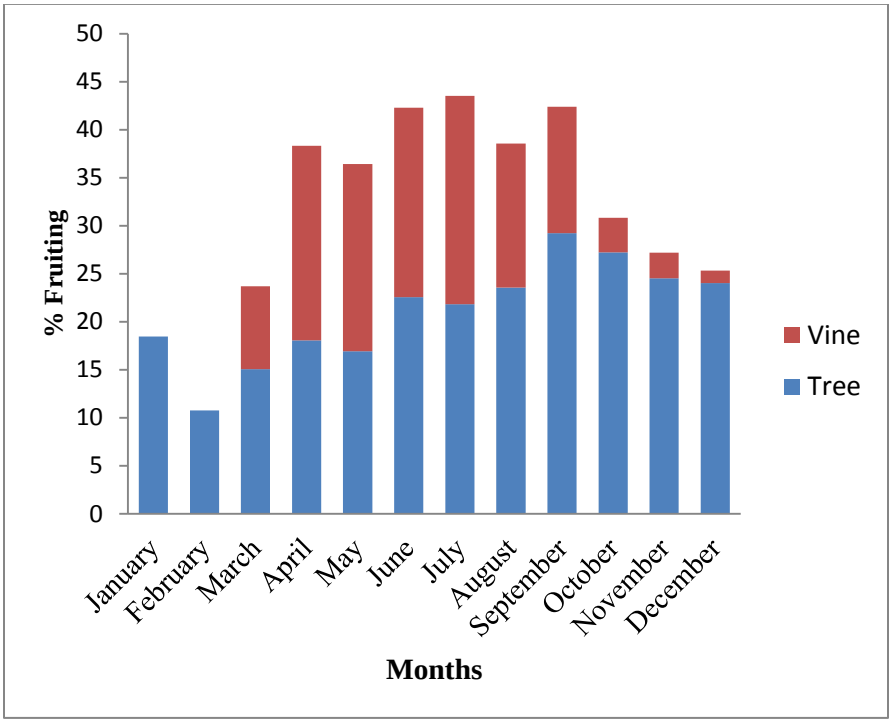

Figure 2: Seasonal Fruiting Pattern of Trees and Vines in the Study Area
Source: Fieldwork (2015).

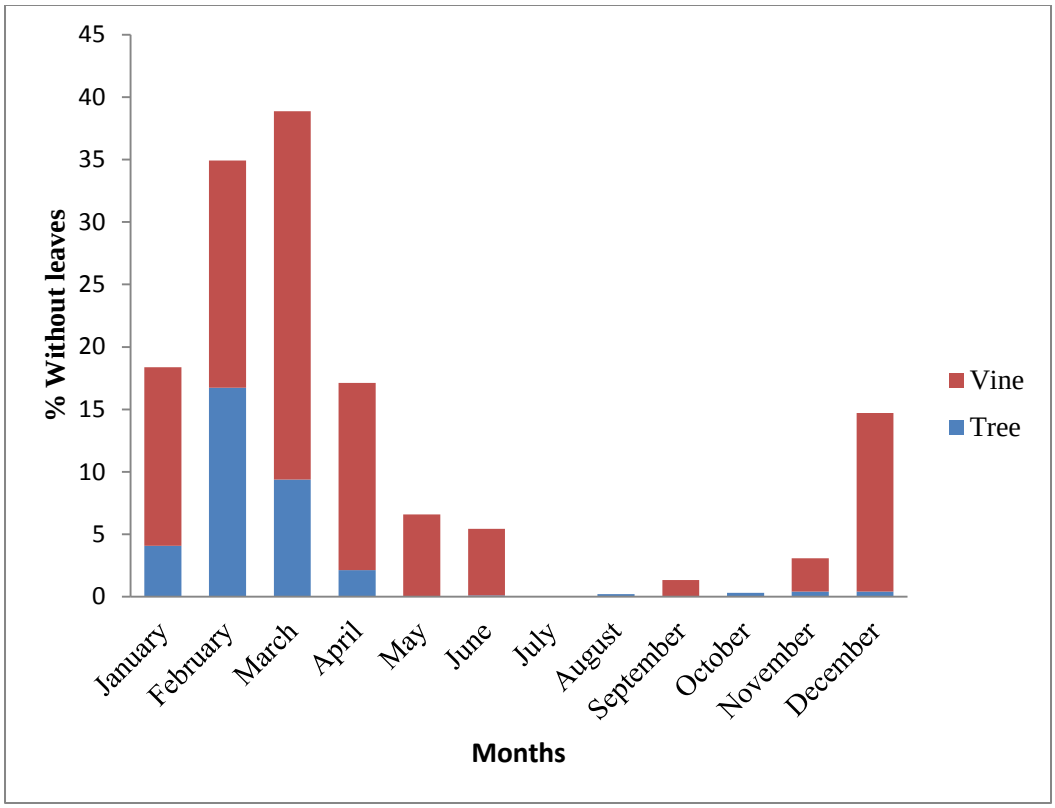

Figure 3: Seasonal Leaves Shedding Pattern in Trees and Vines in the Study Area.
Source: Fieldwork (2015).

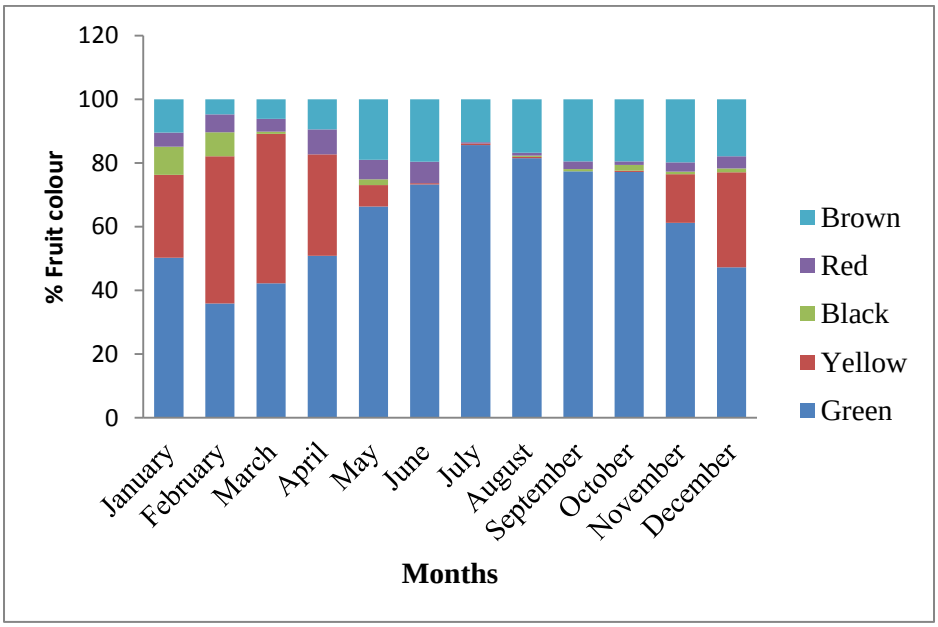

Figure 4: Tree Fruit Colour Pattern in the Study Area.
Source: Fieldwork (2015).

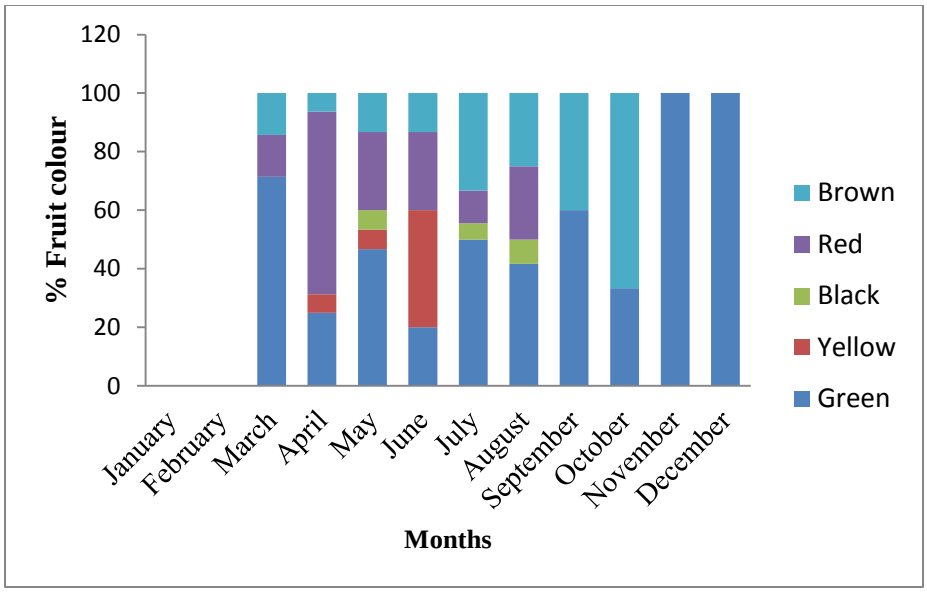

Figure 5: Vine Fruit Colour Pattern in the Study Area.
Source: Fieldwork (2015).

The results of tree fruits ripeness is presented in Figure 6. The results showed that a relatively higher number of the fruiting trees had unripe fruits throughout the year. The lowest was 39.62% in February, while the highest was 93.02% in July. Ripe fruits availability was highest in February (60.38%) while the lowest was in July (6.98%). The fruit ripeness pattern of vines (Figure 7) showed that unripe fruits were available almost all year round. Unripe fruits were most abundant in November (100.0%) and December (100.0%), but least abundant in October (33.33%). On the other hand, ripe fruits were available during the wet season months (March – October), with the highest in October (66.67%) and the lowest (22.22%) in July.

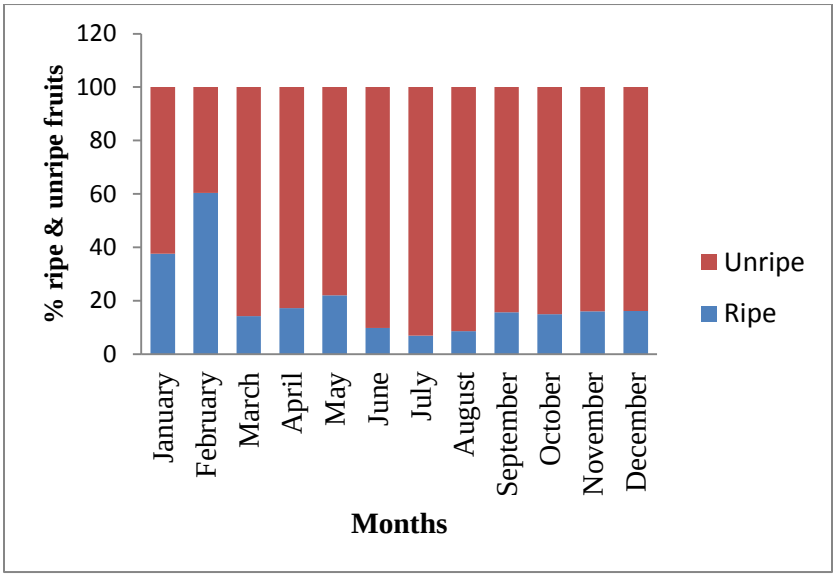

Figure 6: Tree Fruits Ripeness Pattern in the Study Area.
Source: Fieldwork (2015).

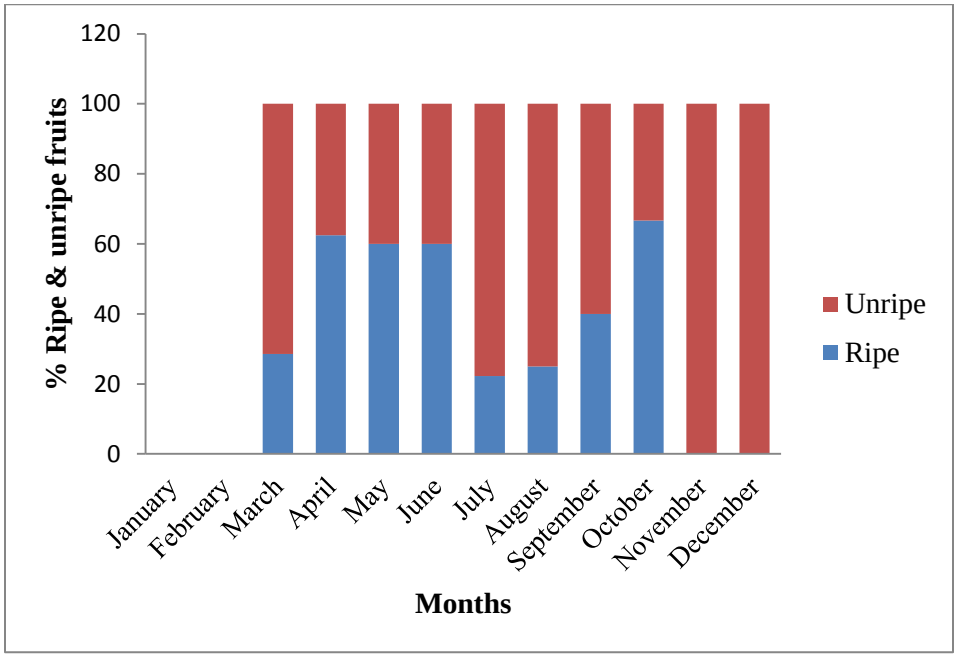

Figure 7: Vine Fruits Ripeness Pattern in the Study Area.
Source: Fieldwork (2015).

Conclusion

It can be concluded that the species richness in terms of woody plants is relatively high in the study area. A total of thirty woody plant species produce fruits that are consumed by olive baboons and fruits are available year round which have the potentials to support the populations of olive baboons (*Papio anubis*).

Recommendation

Based on the findings from this study, it is recommended that the high species richness of the woody plants should be preserved through enhanced strategies for protection of the olive baboon habitat. This will go a long way in ensuring adequate supply of fruits that form the bulk of olive baboon diet.

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