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# POPULATION STATUS AND DISTRIBUTION OF FOREST ELEPHANTS (*Loxodonta cyclotis* Matschie, 1900) IN OKOMU NATIONAL PARK AND OMO FOREST RESERVE, SOUTH-WESTERN NIGERIA

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## *ABSTRACT*

***The study was carried out to determine the population status and distribution of forest elephants (Loxodonta cyclotis Matschie, 1900) in Okomu National Park (ONP) and Omo Forest Reserve (OFR), Nigeria. The Line Transect Survey Method, footprints analysis, trail cameras and in-depth discussion were used for data collection spanning between April 2015 and March 2016. Elephant densities were computed as described by Barnes and Jensen (1987), while the estimate of elephant numbers was extrapolated from the footprints diameter data. A mean density of 0.15 elephants/km$^2$ was obtained for the rainy season in ONP, while it was 0.08 elephants/km$^2$ during the dry season. In OFR, mean density was 0.14 elephants/km$^2$ for the rainy season, while it was 0.06 elephants/km$^2$ during the dry season. The estimate of elephant numbers revealed a total of 33 elephants comprising 24 adults (72.73%) and nine young ones (27.27%) in ONP. On the other hand, OFR support about 28 elephants consisting of 22 (78.57) adults and six young ones (21.43). Elephants were more randomly distributed during the rainy season than the dry season in the two study sites. However, within the two sites, the animals were restricted to few areas of the forest complex. The main factors contributing to the distribution of elephants in the study area are water and food availability, human disturbance and settlement camps. With the continued habitat alteration and anthropogenic pressure, especially in OFR, the population status of elephants remains a matter of significant concern***.

**Keywords:** forest elephants, dung counts, footprints analysis, population status, Nigeria

## INTRODUCTION

The African forest elephant (*Loxodonta cyclotis* Matschie, 1900) is one of the world's largest terrestrial mammals. It was once considered a subspecies, *Loxodonta africana cyclotis*, of the African elephant, together with the African bush or savanna elephant, *Loxodonta africana africana*. However, genetic study and DNA tests have confirmed they are separate species which diverged from each other an estimated two to seven million years ago (Rohland et al., 2010; Maisels et al., 2013). Thus, the African forest elephant is taxonomically and functionally unique. It is distinguished from its savanna counterpart by its small size, darker colour and characteristic rounded and small ears, unlike the "map of Africa" shape of the savanna congener. It also has an almost straight, harder and downwardly pointing tusk while the savanna elephant has upwardly curved and softer tusks. The African forest elephant body is more compact and nearly straight compare to the slenderer body of its savanna counterpart with a concave back. The forest elephant has a low carriage of the head, which is higher in the savanna elephant. Contrary to the savanna elephants, the forest elephants have five toe-nails on their forefoot and just four on their hind foot (Grubb et al., 2000; Morgan and

Lee, 2003).

The African forest and savanna elephants are also distinguishable in their behaviour and ecology. The former occurs in moist semi-deciduous and rainforest while the latter is found in arid woodland and savanna. In addition, the forest elephant usually has a nuclear family of 2 to 4 individuals, while savanna elephant family groups can extend up to 14 (Sukumar, 2003). Unlike the savanna elephants, African forest elephants do not usually interact with other family groups. The male tends to be solitary and only associate with other elephants during the mating season. They (the males) have a dominance hierarchy based on size. The African forest elephant is mostly a browser and frugivore rather than the grazing and browsing habit exhibit by the savanna elephant. The elephants play significant role in seed dispersal and maintaining plant diversity (Campos-Arceiz and Blake, 2011). They are sometimes the only disperser of some tree species, such as *Balanites wilsoniana* and *Omphalocarpum* spp. The rate of seed germination of many forest plant species increases significantly after passage through an elephant's gut (Beaune et al., 2012).

In spite of their uniqueness and key role in forest ecosystems, African forest elephant populations have depleted over the years owing to a number of factors including ivory poaching and trade across their range, habitat loss through the conversion of land to agriculture and increasing competition for resources with growing human populations (Maisels et al., 2013). In Nigeria, forest elephants have become extinct in many areas while the remnant fragile population remain at high risk of total extirpation. As human populations increases rapidly, the elephant range is constantly being broken up into small fragments traversed by roads, human settlement and infrastructures thereby bringing elephants into conflict with humans. Presently, very few forest areas still contain elephants. These have been the subject of relatively few studies. Hence, there is very little information available as to the distribution and sizes of forest elephant populations in Nigeria. This lack of knowledge of the population size and status of forest elephants in the country is a major obstacle in determining appropriate conservation needs and measures in the areas where they occur (Ikemeh, 2009). Therefore, this study was initiated to determine the population status and distribution of elephants in Okomu National Park (ONP) and Omo Forest Reserve (OFR) within the rainforest of south-western Nigeria. This is with a view to assisting people in management to make strategic decisions for effective conservation of the animal. A better understanding and knowledge of elephant abundance and distribution will make it possible to develop a coherent strategy for their conservation and management.

## MATERIALS AND METHODS

### Study area

The study sites were Okomu National Park (ONP) and Omo Forest Reserve (OFR) within the rainforest of south-western Nigeria (Figure 1). Okomu National Park (ONP) is located on longitudes $5^{o}00$'E - $5^{o}30$'E and latitude $6^{o}00$'N - $6^{o}30$'N covering an area of about 182km$^2$. It is set within the 1,082km² Okomu forest reserve in Ovia south-west Local Government Area of Edo State. Initially managed as a wildlife sanctuary by the Nigerian Conservation Foundation, it was gazetted as a national park in May 1999 and administered by the Nigerian National Parks Service (Ezealor, 2002). The park holds a small fragment of the rich forest that once covered the region, but which has continued to shrink owing to numerous encroachments on it. It is characterized by a mosaic of swamp-forest, high forest, secondary forest, and open scrub. It serves as habitat for many endangered species of flora and fauna including the forest elephant, *Loxodonta cyclotis.* About 50,000 people in 45 villages live in and around the park. It is continuously threatened by large-scale illegal logging, the expansion of large rubber and oil-palm plantations nearby, as well as incursions by a growing human population involved in farming and hunting.

Omo Forest Reserve (OFR) was gazetted in 1925 as part of the old Shasha forest reserve of south-western Nigeria. It is located between longitudes $4^{o}19$' - $4^{o}$ 40'E and latitudes $6^{o}$ 35' - $7^{o}$ 05'N in the Ijebu East and North Local Government Areas of Ogun State. It covers an area of about 1,305 km$^2$ forming common boundaries with Osun, Ago-owu and Shasha forest reserves in Osun State and Oluwa forest reserve in Ondo State, all

of which also share some common natural endowments (Amusa, 2015). The forest reserve is inhabited by people of several ethnic groups, the dominant one being the Yoruba of the Ijebu extraction. The forests harbour one of the last remaining populations of elephant, chimpanzee and white throated monkeys in the south-western part of Nigeria. Interventions from the government and various conservation agencies in order to mitigate threats to the rich biodiversity of the reserve have become inevitable. These interventions involved establishing a wildlife sanctuary, covering an area of about 30,000ha ≈ 23% of the forest reserve, and eviction of illegal settlers within the reserve.

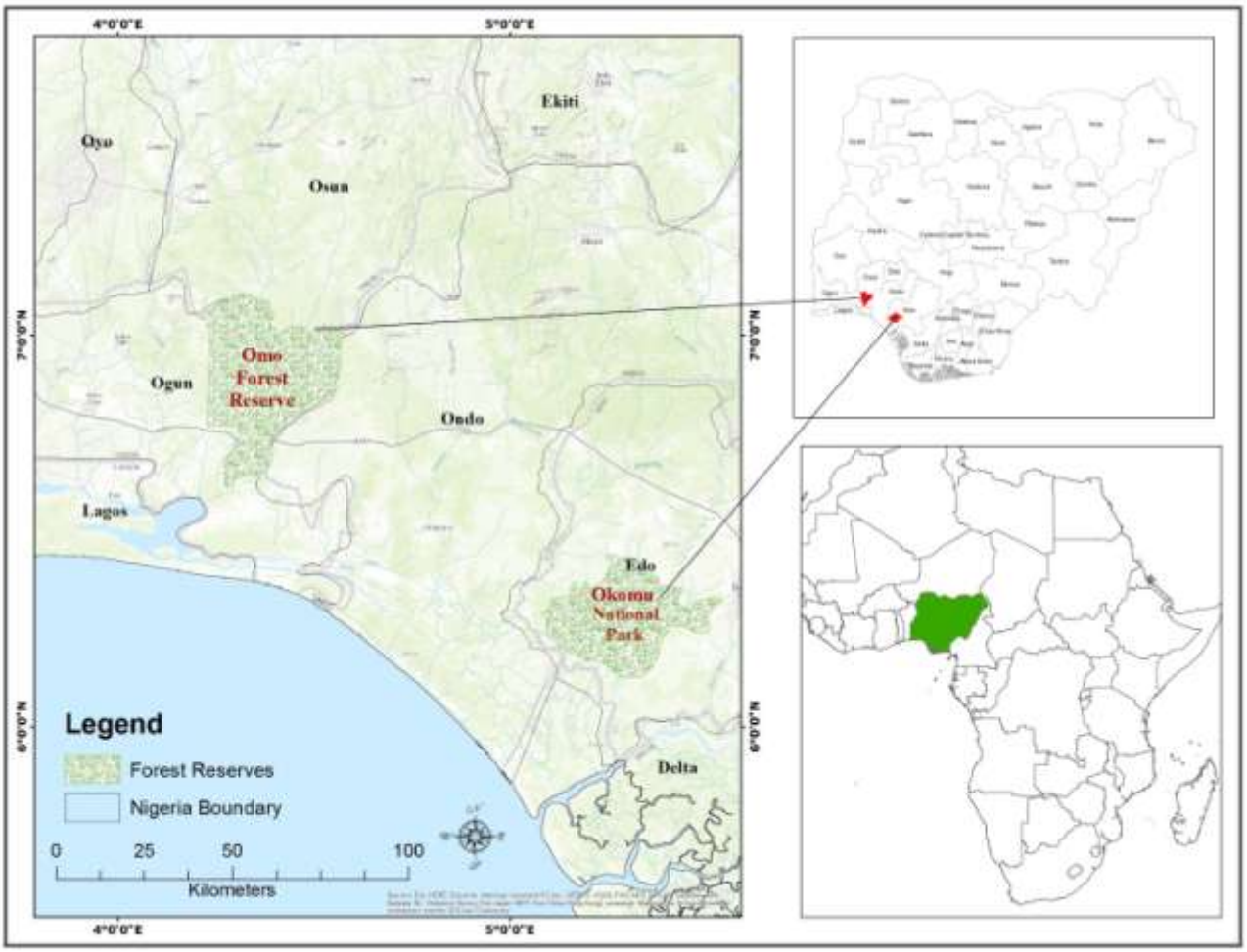


**Figure 1:** Map of the study area showing Okomu National Park and Omo Forest Reserve

**Data collection**

Field surveys on determining population size and spatial distribution of the forest elephants were carried out for both the wet and dry seasons in ONP and OFR between April 2015 and March 2016. The Line Transect Survey Method (Barnes and Jensen, 1987) was used. There were two important aspects to the data collection: One was the finding and recording of dung piles along transect lines; and the other was the regular checking of a number of dung piles to measure decay rate (Plates 1 and 2). As each pile of dung along the transect was found, its state of decay was categorized according to the MIKE 'S System' for dung-pile classification (Hedges and Lawson, 2006). The data collection protocol also involved recording habitat-related data such as land cover, land use information and threats. Direct observations of elephants were aided with the mounting of trail cameras (Plates 3 and 4).

3km line transects which totals to thirty-eight and forty in ONP and OFR respectively were used to sample elephant dung in both raining and dry seasons. In ONP, the survey area was stratified based on low (Compartment 1), medium

(Compartment 2) and high (Compartment 3) dung-pile densities following the evaluation of the Park rangers. On the other hand, stratification for dung-pile survey in OFR was based on the elephants' use of habitat and extent of human disturbance in the forest reserve. Thus, data were collected from areas designated as (1) elephant sanctuary (Erin camp), (2) farmland and (3) settlement camps. The line transects were randomly placed within the sampling strata. The distance along the transects and perpendicular distance were recorded for each elephant dung pile observed. Also, elephants' footprints diameter, dominant vegetation and land features were recorded.

In addition to the line transect survey method, discussions were also held with rangers and elders from surrounding communities in the study area to obtain information about past/present elephant population status, distribution, movement and human-elephant interactions.

**Data analysis**

Elephant densities were calculated using the formula below as described by Barnes and Jensen (1987).

$$E = (Y * r)/D$$

Where:

E = Elephant density; Y = Dung pile density; r = Daily rate of dung pile decay and;

D = Defecation rate or number of dung piles produced per elephant per day

Dung pile density was estimated as:

Y = number of dung/sample area

The mean dung decay rate was estimated as:

$$r = \ln (N_o) - \ln (N_t)/t$$

Where: *No* is the initial number of dung monitored; *Nt*is the number of dung left after *t* days and;

*t*is the number days

The mean dung pile decay period for the two sites was estimated at 63 days with only five dung piles remaining intact at the end of the survey. The percentage for the daily decay rate of elephant dung was estimated at 0.009. The defecation rate was assumed to be 17 defecations per day (Wing and Buss, 1970).

Elephant population age structure was estimated indirectly from measurements of hind-foot print length and bolus circumference (Plates 5 and 6), (Western et al., 1983; Jachman and Bell, 1984;). Foot print lengths less than or equal to 23.7 cm are grouped under calf, between 23.8 to 30.20 as juvenile, between 30.3 to 38.5 as intermediate, 39.6 to 45.1 as sub-adult male or adult female and greater than or equal to 45.2 as adult male only. The estimate of elephant numbers was extrapolated from the footprints diameter data.

**Plate 1:** Elephant dung pile along transect line in Okomu National Park

**Plate 2:** Checking of dung pile to measure decay rate in Omo Forest Reserve

**Plate 3:** Mounting of trail camera along elephant routes in Okomu National Park

**Plate 4: Mounting of trail camera along elephant routes in Omo Forest Reserve**

**Plate 5:** Measurements of hind-foot print length of elephants in Okomu National Park

**Plate 6:** Measurements of hind-foot print length of elephants in Omo Forest Reserve

## RESULTS AND DISCUSSION

### Elephants dung counts

Tables 1-4 show the dung-pile survey information obtained on population status of elephants in ONP and OFR for both rainy and dry seasons. In ONP, dung densities of 166/km$^2$, 300/km$^2$ and 383/km$^2$ were recorded in Compartments 2, 1 and 3 respectively during the rainy season (Table 1). On the other hand, the dry season survey revealed dung densities of 50/km$^2$, 175/km$^2$ and 200/km$^2$ in Compartments 3, 1 and 2 respectively (Table 2). In OFR, dung densities were 250/km$^2$, 266/km$^2$ and 300/km$^2$ during the rainy season (Table 3) and 100/km$^2$, 133/km$^2$ and 138/km$^2$ during the dry season in settlement camps, farmland and elephant sanctuary respectively (Table 4). The mean dung density in ONP during the rainy season was 283/km$^2$, while it was 141.67/km$^2$ during the dry season. In OFR, mean dung densities were 272/km$^2$ and 123.67/km$^2$ for rainy and dry season respectively.

Whereas there was consistency in dung encounter rate across sampling strata in OFR for both rainy and dry seasons, the same cannot be said of ONP. During the rainy season, elephants were more in Compartment 3 of ONP, while they were also more in the elephant sanctuary of OFR during the period. In the dry season, elephants were more in Compartment 2 of ONP and remained so in the elephant sanctuary of OFR in the same period. Overall, more elephant dungs were encountered during the rainy season than dry season at the two study sites with ONP having a higher encounter rate. Elephant dungs were found in Compartments 36, 62, 82, 84, 90, 97, lake 94, and Oba bush within ONP with high dung densities recorded in Compartments 62, 82, 84, and lake 94. In OFR, elephant dungs were observed in Erinmogan, Sojukorodo, Apora, Abeku and Erin camp (elephant sanctuary). Dung densities were high in Abeku and Erin camp (elephant sanctuary) within the reserve.

**Table 1:** Rainy season dung-pile survey of elephants in Okomu National Park

| Transect location | No. of transects | Transect length (km) | Sampled area | Number of dung | Dung density/km$^2$ | Elephant density/km$^2$ |
|---|---|---|---|---|---|---|
| Compartment 1 | 6 | 18 | 0.04 | 12 | 300 | 0.16 |
| Compartment 2 | 4 | 12 | 0.03 | 5 | 166 | 0.09 |
| Compartment 3 | 9 | 27 | 0.06 | 23 | 383 | 0.20 |
| Total | 19 | 57 | 0.13 | 40 | --- | --- |
| Mean | --- | --- | --- | --- | 283 | 0.15 |

**Table 2**: Dry season dung-pile survey of elephants in Okomu National Park

| Transect location | No. of transects | Transect length (km) | Sampled area | Number of dung | Dung density/km$^2$ | Elephant density/km$^2$ |
|---|---|---|---|---|---|---|
| Compartment 1 | 6 | 18 | 0.04 | 7 | 175 | 0.09 |
| Compartment 2 | 4 | 12 | 0.03 | 6 | 200 | 0.11 |
| Compartment 3 | 9 | 27 | 0.06 | 3 | 50 | 0.03 |
| Total | 19 | 57 | 0.13 | 16 | --- | --- |
| Mean | --- | --- | --- | --- | 141.67 | 0.08 |

**Table 3:** Rainy season dung-pile survey of elephants in Omo Forest Reserve

| Transect location | No. of transects | Transect length (km) | Sampled area | Number of dung | Dung density/km$^2$ | Elephant density/km$^2$ |
|---|---|---|---|---|---|---|
| Elephant sanctuary | 13 | 39 | 0.08 | 24 | 300 | 0.16 |
| Farmland | 4 | 12 | 0.03 | 8 | 266 | 0.14 |
| Settlement camp | 3 | 9 | 0.02 | 5 | 250 | 0.13 |
| Total | 20 | 60 | 0.13 | 37 | | |
| Mean | --- | --- | --- | --- | 272 | 0.14 |

**Table 4:** Dry season dung-pile survey of elephants in Omo Forest Reserve

| Transect location | No. of transects | Transect length (km) | Sampled area | Number of dung | Dung density/km$^2$ | Elephant density/km$^2$ |
|---|---|---|---|---|---|---|
| Elephant sanctuary | 13 | 39 | 0.08 | 11 | 138 | 0.07 |
| Farmland | 4 | 12 | 0.03 | 4 | 133 | 0.07 |
| Settlement camp | 3 | 9 | 0.02 | 2 | 100 | 0.05 |
| Total | 20 | 60 | 0.13 | 17 | | |
| Mean | --- | --- | --- | --- | 123.67 | 0.06 |

**Estimated elephant populations**

In ONP, a mean density of 0.15elephants/km$^2$ was obtained for the rainy season, while it was 0.08 elephants/km$^2$ during the dry season. In OFR, mean density was 0.14 elephants/km$^2$ for the rainy season, while it was 0.06 elephants/km$^2$ during the dry season. These findings show that there were more elephants in the study sites during the rainy season. Elephant densities were higher in compartment 3 of ONP (0.20 elephants/km$^2$) and the elephant sanctuary of OFR (0.16 elephants/km$^2$) during the rainy season. The estimate of elephant numbers (Table 5) extrapolated from the footprints diameter data revealed a total number of 33 elephants comprising 24 adults (72.73%) and nine young ones (27.27%) in ONP. On the other hand, OFR support about 28 elephants consisting of 22 (78.57) adults and six young ones (21.43). The mounted trail cameras captured a herd of five and fourteen elephants at two different instances in ONP and a group of four elephants comprising three adults (2 males and 1 female) and one young one (the sex of which could not be determined from the camera) in OFR.

**Table 5:** Estimated elephant populations in Okomu National Park (ONP) and Omo Forest Reserve (OFR)

| Site | No. of adults | Percentage | No. of young | Percentage | Total count | Percentage |
|---|---|---|---|---|---|---|
| ONP | 24 | 72.73 | 9 | 27.27 | 33 | 100.00 |
| OFR | 22 | 78.57 | 6 | 21.43 | 28 | 100.00 |

**Distribution of elephants**

Elephants were more randomly distributed during the rainy season than the dry season in the two study sites. However, within the two sites, the animals seem to be restricted to certain areas of the forest complex. The distributions of elephants for rainy and dry seasons in the two locations are shown in Figures 2 and 3. The main factors contributing to the distribution of elephants across the seasons in the two sites could be attributed to water and food availability, human disturbance and settlement camps. This observation is similar to the findings of Enawgaw (2012) who studied the distribution, abundance and age structure of elephants in Omo national park, Ethiopia. However, a number of identified threats including poaching, logging, forest clearance for agriculture and illegal settlement camps may also explain why elephants are confined to narrow bands within the study sites. Though there was no encounter of elephant carcass and Park Authorities believe that the last hunting of elephants in ONP was in 2000, illegal hunting of other wild animals was very rampant and posed a general threat. In OFR, a poacher with an automatic riffle killed an elephant in 2013 after he encroached the elephant sanctuary. In addition, logging, farming activities and illegal settlement camps were common in the reserve (Table 6).

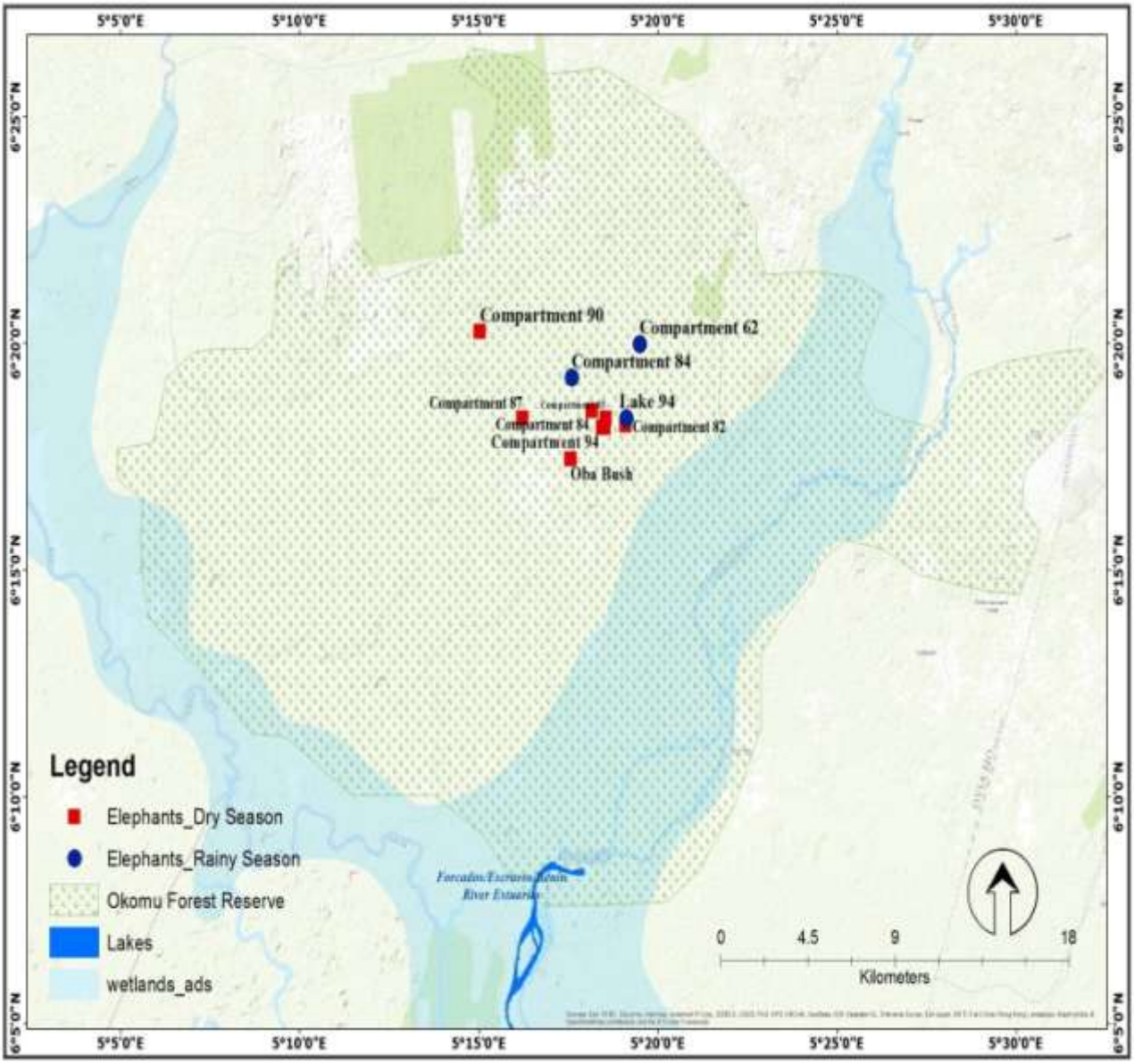


**Figure 2:** Map of Okomu National Park showing the distribution of elephants for dry and rainy season

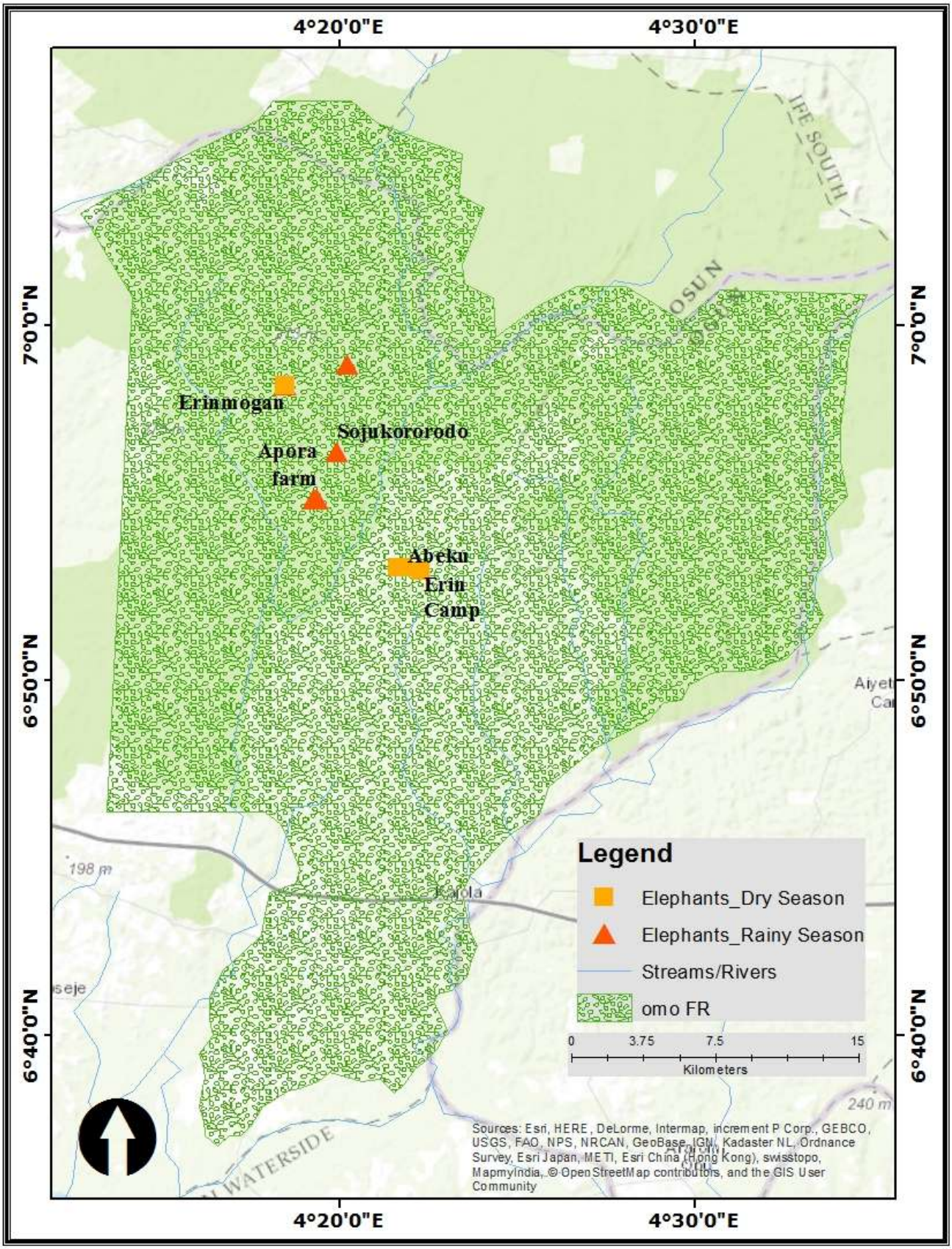


**Figure 3:** Map of Omo Forest Reserve showing the distribution of elephants for dry and rainy season

**Table 6:** Identified threats to elephant populations in Okomu National Park (ONP) and Omo Forest Reserve (OFR)

| **Identified threats** | **Frequency** | | **Percentage** | |
|---|---|---|---|---|
| | ONP | OFR | ONP | OFR |
| Poaching/hunting | 5 | 4 | 100.0 | 40.0 |
| Logging | --- | 4 | --- | 40.0 |
| Farming | --- | 1 | --- | 10.0 |
| Settlements | --- | 1 | --- | 10.0 |

There is a dearth of published information to compare findings on elephant estimates in ONP. However, when compared with findings in OFR, it can be surmised that the outlook for forest elephants in the park appeared to be positive. Whereas this study did not investigate elephants range and how large an area of forest is needed by the elephant population, studies of Asian elephants in Malaysian rainforests indicate ranges of only 59km$^2$ in secondary forest and 167km$^2$ in primary forest (Sukumar, 1991). It is therefore, likely that the range will be smaller in secondary forest such as ONP owing to wider availability of low-level vegetation and fast growing, more digestible species. In the same vein, the estimated number of elephants in OFR still compare with the earlier data in the study site. Egarr (1996) reported densities of 0.07/km$^2$ and 0.13/km$^2$ for dry and wet season respectively, while Ikemeh (2009) reported an elephant density of 0.75/km between September 2007 to April 2008 corresponding to dry season in the area. However, destruction of natural habitat and ever-increasing human population with an increasing demand for land has undoubtedly contributed to persistent low population status of the animal. Interventions from the government and various conservation agencies led by the Nigerian Conservation Foundation (NCF), involving establishing a wildlife sanctuary might have helped in stabilising the elephant population in the reserve.

## CONCLUSION

A small population of elephants exist in both Okomu national park (ONP) and Omo forest reserve (OFR) of south-western Nigeria. The elephants were more randomly distributed during the rainy season than the dry season. The main factors contributing to the distribution of elephants could be attributed to water and food availability, human disturbance and settlement camps. The outlook for forest elephants appeared to be positive, particularly in ONP. The park has remained a protected area capable of harbouring a significant elephant population. However, with the continued habitat alteration and anthropogenic pressure in OFR, the population status of elephants remains a matter of significant concern. There is need for constant sensitization, support and empowerment of local people through community initiatives outside protected areas in the landscape to ensure they participate in the conservation and protection of elephants and other natural resources. There is need to carry out a ground survey and re-demarcate the core elephant habitats in the study area, especially within OFR. If protection is adequate, the future of elephants in the study area seems assured. Continued data collection will help elucidate patterns and provide new data set for evaluation.

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