STATUS OF THE FOREST ELEPHANT IN THE NORTHWESTERN FOREST BLOCK LIBERIA

April 2021

by

ELRECO
Elephant Research and Conservation

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Elephant Crisis Fund

FORESTRY DEVELOPMENT AUTHORITY

BORN FREE

EXECUTIVE SUMMARY

A nationwide Forest Elephant status survey in Liberia's two remaining forest blocks is one priority action defined in Liberia's National Elephant Action Plan and part of ELRECO's long-term Forest Elephant Conservation Project, which was started in December 2018. Target areas for the nationwide survey were determined by relevant criteria such as available recent elephant records, potential suitable habitats and logistic considerations. A 40 x 40 km grid was superimposed on the map of the two remaining forest blocks, and 33 grid cells were identified to be included in the status survey, 12 in the Northwestern (NW) and 21 in the Southeastern (SE) Forest Block. Data were mostly collected by field surveys, and amended by desktop research and compilation of elephant data from conservation partners. Field survey techniques comprised focus group interviews in minimum one target community per grid cell and subsequent rapid field assessments. Data recording included all types of elephant signs, dung sampling for genetic analysis, and measurements of dung boli size and footprints.

The status survey was started in December 2018 in the Northwestern Forest Block, which was completed by January 2021. Interview surveys were conducted in 19 communities, and rapid field assessments carried out in 28 different forest sites. The results show that elephants are widely distributed across the entire landscape and hence stress the importance of the NW Forest Block for elephant conservation in Liberia. Especially the Protected/Proposed Protected Areas are important key habitats, and the Foya-Gola belt was identified as a high priority area for long-term conservation efforts, as well as a suitable site for monitoring and research. However, since elephants migrate and do also occur outside (P)PAs, it will be crucial to maintain the connectivity between all the identified key sites. Several corridors are suggested.

Signs of Forest Elephants were found in all type of habitats, including Primary/Old Secondary Forest, Young Secondary Forest, Post-cultural Secondary Forest, Swamp, Clearings, Riverine Forest and cultivated areas, at elevations ranging from 110 to 1049 meters above sea level. The study further found that the Forest Elephant population of the NW Forest Block is intact and reproducing. Age and size class distribution correspond to the natural population structure of a long-living and slow-reproducing species. At this stage it is assumed that there are seven subpopulations roaming in the Northwestern Forest Block, with a total population estimate of 350-450 elephants. The analysis of migration patterns indicates that elephants spread out more and come closer to human settlements in the rainy season, while in the dry season they seem to stay deeper inside the forest. Driving factors most likely are spatial and seasonal availability of water and food resources, combined with a natural tendency to avoid humans.

The major direct threats to Forest Elephants in the NW Forest Block are human encroachment and disturbance of elephant habitats, and the resulting Human-Elephant-Conflicts (HEC). HEC is a dominating topic in the overall perception of elephants among local people, and needs thorough investigation. A lot of communities reported of HEC, mostly crop-raiding. In total twelve HEC hotspots, i.e. main conflict areas comprising several communities, were identified in the NW, whereof three areas do only have minor issues, but the remaining nine regions are

more seriously affected in terms of HEC frequency and extent. In general it can be said that (i) the closer the settlement and/or farms to the forest and (ii) the higher the human impact inside the elephants' original habitat, the more likely conflicts with elephants will emerge. The HEC assessment further showed that affected communities do not have much knowledge of suitable conflict mitigation methods, and usually people stay passive, run away from their farms or even give up farming. No active farm guarding is practiced in any of the hotspots. Consequently, HEC cause a lot of anger and frustration among local people, leading to a very negative attitude towards elephants and elephant conservation, sometimes to such an extent that people threaten to kill the crop-raiding elephants. This situation needs to be quickly addressed and mitigated, starting with a training of affected communities in suitable, community-based, i.e. cheap, simple and instantly applicable mitigation methods. On a medium and long-term perspective, a set of further well-established mitigation measures needs to be introduced and tested for effectiveness in the different HEC sites, and a training ground and HEC mitigation demonstration site shall be established.

Killing of elephants, which was identified as a third main serious threat to the Forest Elephant in NW Liberia, is not only an issue in the context of HEC, but elephants are still poached and killed for ivory. At least 18 elephants have been killed in Liberia since October 2018, ten in the NW and 8 in the SE, and those are just the known cases. Although usually action is taken by the responsible government authorities, results are still poor and not satisfying. This threat has to be urgently eliminated by appropriate measures such as effective law enforcement, consolidation of regular, well-equipped ranger patrols and awareness campaigns.

ACKNOWLEDGEMENTS

The status survey would not have been possible without the support of a range of partners. We would like to acknowledge the valuable contribution and cooperation of authorities, donors, organizations, the local communities and individuals involved in this project.

First, we would like to express our profound gratitude to the Born Free Foundation and the Elephant Crisis Fund for funding this work and recognizing the urgency of Forest Elephant Conservation actions in Liberia.

We are very grateful to our national partner, the Forestry Development Authority Liberia, especially to the Honorable Managing Director Mr. C. Mike Doryen, Mr. Joseph J. Tally (Deputy Managing Director of Operations), Mr. Blamah Goll (Technical Manager Conservation Department) and Mr. Abednego Gbarway (Wildlife Manager Conservation Department), for their excellent cooperation and ongoing support of all our project activities.

We also would like to thank conservation partners for a fruitful collaboration and mutual assistance, particularly Fauna and Flora International Liberia, the Liberia Chimpanzee Rescue and Protection, the Royal Society for the Protection of Birds, the Society for the Conservation of Nature of Liberia and the Wild Chimpanzee Foundation.

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A number of additional persons facilitate and support ELRECO’s work who cannot be listed all by name in this context, but our warmest thanks go to all of them as well.

ACRONYMS

ELRECO:	Elephant Research and Conservation
FDA:	Forestry Development Authority Liberia
FFI:	Fauna and Flora International
GoL:	Government of Liberia
HEC:	Human-Elephant-Conflict
IUCN:	International Union for the Conservation of Nature
LCRP:	Liberia Chimpanzee Rescue and Protection
MIKE:	Monitoring the Illegal Killing of Elephants
NEAP:	Liberia National Elephant Action Plan
NW:	Northwestern Forest Block Liberia
PA:	Protected Area
PPA:	Proposed Protected Area
RAS:	Rapid Field Assessment Site
RSPB:	Royal Society for the Protection of Birds
SCNL:	Society for the Conservation of Nature of Liberia
SE:	Southeastern Forest Block Liberia
UoL:	University of Liberia
WCF:	Wild Chimpanzee Foundation

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1. Introduction

In 2017, the Government of Liberia endorsed the Liberia National Action Plan (NEAP), a 10-year strategy for the protection and sustainable conservation of the Forest Elephant (*Loxodonta cyclotis*) in Liberia and transboundary areas. In 2018, Elephant Research and Conservation (ELRECO) together with the Forestry Development Authority Liberia (FDA) started the Forest Elephant Conservation Project Liberia, a long-term project that focuses on the implementation of priority actions set out in the NEAP. One priority under NEAP Objective 5 *"Strengthen knowledge of elephant status and management"* is to conduct a nationwide elephant status survey in Liberia's two remaining forest blocks, i.e. in the Northwest (NW) and the Southeast (SE) of the country (Figure 1), in order to provide a consolidated database about the species' occurrence, spatial and seasonal distribution, population densities, threats, areas of Human-Elephant Conflicts, ivory trade and identify critical habitats and key populations for long-term elephant monitoring and research programmes. Since the NW had been more neglected in terms of general conservation activities in the past, and according to FDA more HEC cases are reported from that area than from the SE, the Forest Elephant Conservation Project started the status survey in the NW Forest Block, which meanwhile has been completed. This report presents the results of the Forest Elephant status in the Northwestern Forest Block of Liberia.

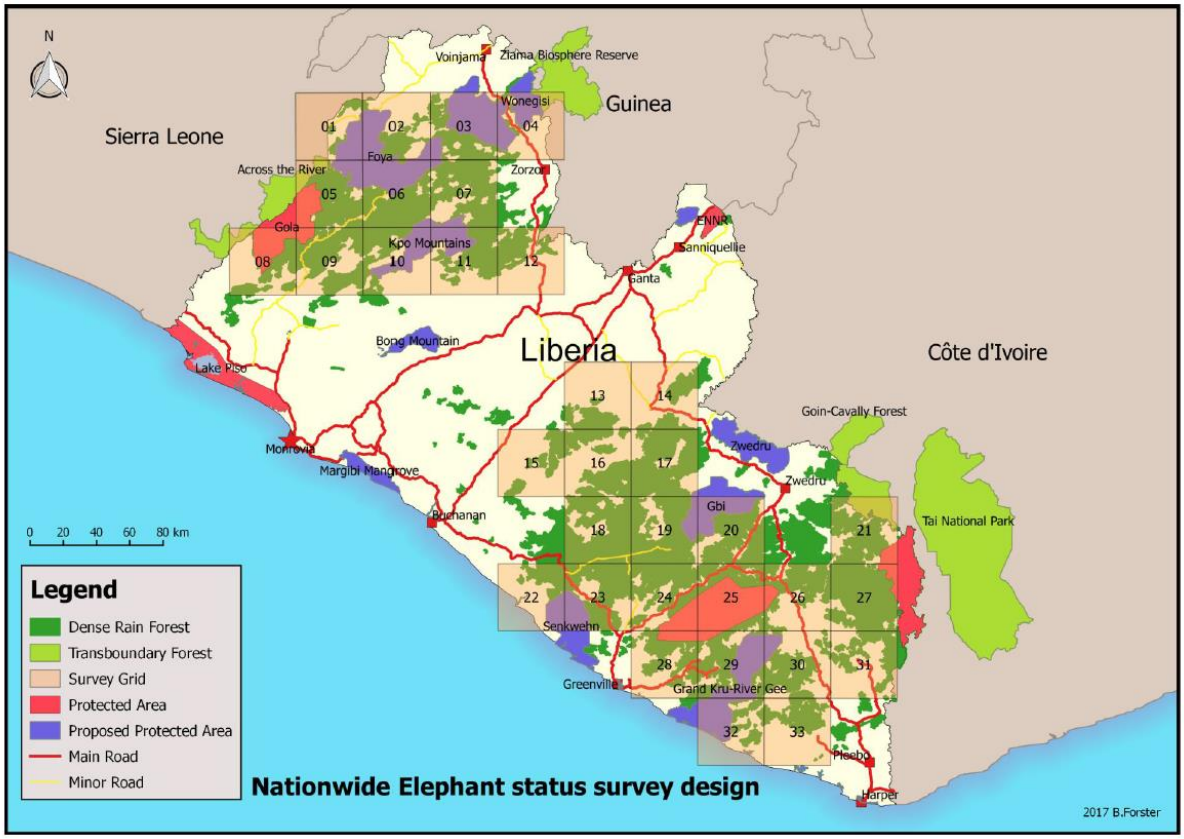


Figure 1. Nationwide elephant status survey design.

2. Methodology

2.1 Determination of survey areas

Based on the information ELRECO gathered for the NEAP, and amended by additional elephant data, a map for the nationwide survey was developed, matching recent elephant records with potential suitable habitats. Taking several criteria into account such as elephants' potential range, communities' catchment areas, vegetation coverage, implementation feasibility and logistics, a 40 x 40 km grid was superimposed and 33 cells have been identified to be included in the nationwide elephant status survey: 12 in the Northwest and 21 in the Southeast (Figure 1).

2.2 Data Collection Methods

Desk study

ELRECO works closely together with other relevant institutions and organizations to continuously gather as much updated information on elephants (occurrence, seasonal migration, conflicts etc.) as possible. Besides FDA, partners include for example Fauna and Flora International (FFI), Liberia Chimpanzee Rescue and Protection (LCRP), the Royal Society for the Conservation of Birds (RSPB), the Society for the Conservation of Nature of Liberia (SCNL) and the Wild Chimpanzee Foundation (WCF), who all work in different forest areas in Liberia and among others also collect biodiversity data. Although their surveys might not specifically target elephants they contain valuable records and information relevant for the status review.

Field Surveys

Field surveys primarily focused on those areas that were neglected in past (elephant) surveys, that were currently not covered by any other conservation activities and/or for which elephant data, be it outdated or recent, were totally lacking. Three data recording techniques were used in the field surveys:

(a) Focus Group Interviews

In each 40 x 40 km grid cell one to three target communities were identified for carrying out interviews with a selected focus groups, i.e. preferably long-term residents familiar with the area, who likely would have a good knowledge about the forest and the wildlife. The number of selected communities per grid cell depended on how much information was already available for the respective grid cell from the desk study, as well as the number and size of potential elephant habitats left in that cell. Focus groups comprised between minimum six and maximum 16 persons of different age and gender. Interviews followed a standard questionnaire, developed by ELRECO, that covered most critical information about elephants' latest occurrence, numbers, seasonal movements, habitat types, conflicts and hunting. Further, some general socioeconomic data about the community were collected, e.g. number of households, dependency on forest resources, main income resources etc., which was

important for the factor analysis to determine key habitats for long-term elephant conservation in Liberia (see also Section 2.4 Data Analysis).

The interviews represented also the initial step towards the development of Human-Elephant-Conflict mitigation measures, which so far had been poorly studied in Liberia. The nationwide status survey includes the identification of communities that suffer from Human-Elephant-Conflicts by providing important baseline data on details such as frequency, type, severity and extent of incidents. This information will guide on further steps to be taken with ongoing NEAP implementation to help affected communities addressing this issue in the long-term.

(b) Rapid Field Assessments

Based on the initial information gathered from the interviews, rapid field surveys were conducted for ground-truthing. Especially in those areas that according to the interviews still held elephants, the information needed to be verified in the field, based on either direct observations or indirect, preferably fresh or recent signs such as footprints, dung-piles, feeding sites, elephant pathways etc.. Rapid assessments were carried out in all areas where elephants still occurred within the past 12 months. The assessment approach followed the "Fecal concentration (FC) Survey Technique", as recommended by the CITES MIKE Programme as a relatively quick and easy pilot survey method to assess elephant distribution and relative abundance in areas with little or no information from previous systematic studies (HEDGES & LAWSON 2006). In a FC Survey surveyors search for elephant dung-piles in places where they are likely to be found (so called "hotspots", based on the information provided by the interviewees) rather than in randomly placed plots or along pre-determined recce lines following a set compass bearing. The data collection protocol included all type of elephant signs, the age of the sign, number of individuals, habitat type, elevation and GPS coordinates. All dung-piles were counted, the circumference of intact boli measured and samples taken from fresh (not older than 48 hours) or reasonably fresh (not older than 2 weeks) dung-piles, following MIKE's Dung Survey Standards Protocol (HEDGES & LAWSON 2006, see *c)* below). The age class and decay stage of dung-piles was determined by MIKE's standard elephant dung classification scheme. In addition, the size of footprints, i.e. the length of the hind foot (alternatively of the forefoot if a distinct hind food print was not available) was recorded at random, as these data allow inference on the elephant's size and age, and thus provide important demographic information.

(c) Dung Sampling

Elephant dung records were taken whenever encountered throughout the whole field survey, not only in the hotspot areas but anywhere found in the forest, following ELRECO's Dung Sampling Protocol that was developed in accordance with MIKE's *Dung Survey Standards for the CITES MIKE Programme*. This includes a standard system for the evaluation of dung decay stages (the MIKE 'S System' for dung-pile classification), a clear definition of terms (e.g. dung-pile, boli, freshness, intactness, coherent fragments etc.) and guidelines for correct dung sampling and boli measurement. Dung samples of fresh (less than 48 hours) or reasonably

fresh (less than two weeks old) dung were collected for later genetic analysis and the establishment of a genetic database of the Forest Elephant population of Liberia, which will not only provide valuable information about the species' population size and relationships, but also amend and consolidate demographic data gathered from the rapid assessments. Dung samples were preserved in 98% ethanol, and of some dung-piles a second sample was taken and stored in *Isohelix Buccal-Prep DNA* Buffer to test for its effectiveness. The latter is easier to handle, store and transport than ethanol, but it is more expensive and not available in Liberia, and as it's a relatively new method it is recommendable to compare its preservation qualities with those of ethanol, before probably switching to buffer storage only in the future.

2a. Focus group interview in a local community

2b. Rapid field assessment data collection

2c. Fresh elephant dung

2d. Dung sampling

2e. Field team on a rapid assessment trip

2f. Camp life on rapid assessments

Figure 2 a-f. Field survey methods.

Field surveys were carried out by a core team, comprising two staff of ELRECO as team leaders and technical managers, as well as two field assistants, usually one from FDA and one student or graduate. In addition, six to eight persons from the respective local communities were hired as trackers, porters and camp managers for the rapid field assessments, which typically lasted between three to six days per site.

2.3 Survey Effort

The nationwide survey in the NW started in December 2018. Field surveys mostly took place in the dry seasons, between November and April 2018/2019, 2019/2020 and 2020/2021. 19 interviews were conducted, and 28 sites visited for rapid assessments (Figure 3, Table 1 and 2). Four areas (R16, R22, R24 and R26) were surveyed by motorized field trips along roads through potential elephant habitats only, with stopping in villages along the road and asking people about any known elephant presence in the recent past. If negative, which was the case for all four sites, no further assessment was carried out inside the forest. The number of days spent in the forest per survey depended on the abundance of elephant signs and varied between three and eight days per site. In total 121 field days were spent in the 28 different rapid assessment sites. For maximum effectiveness and in order to survey a large area per site, the field team usually worked in two groups, i.e. Team A and Team B, each comprising one team leader, one field assistant and two to three local community members. The size of surveyed area inside the forest ranged between minimum 14 km² (R11) and maximum 81 km² (R10) per site, and in total was 881 km² (calculation see Section 2.4). The number of expedition days of all field trips, including travel, interview, preparation and survey days was 171 days.

Supplementary to the interviews and rapid assessments, the field team collected additional data when traveling between sites, by stopping in settlements adjacent to some fragmented forest patches that were not main target sites for the field surveys, such as for example the area north of Vahun in Grid Cell 01, or the two forest fragments east of the main road from Gbanga to Zorzor (Grid 12 and above) (Figure 3). Moreover, a detailed assessment of potential elephant corridors between the Proposed Protected Areas Wologizi and Wonegizi (Grid Cell

03 and 04) was carried out in December 2019. The data set was further amended by biomonitoring data of partner organizations (D01-04 in Figure 3).

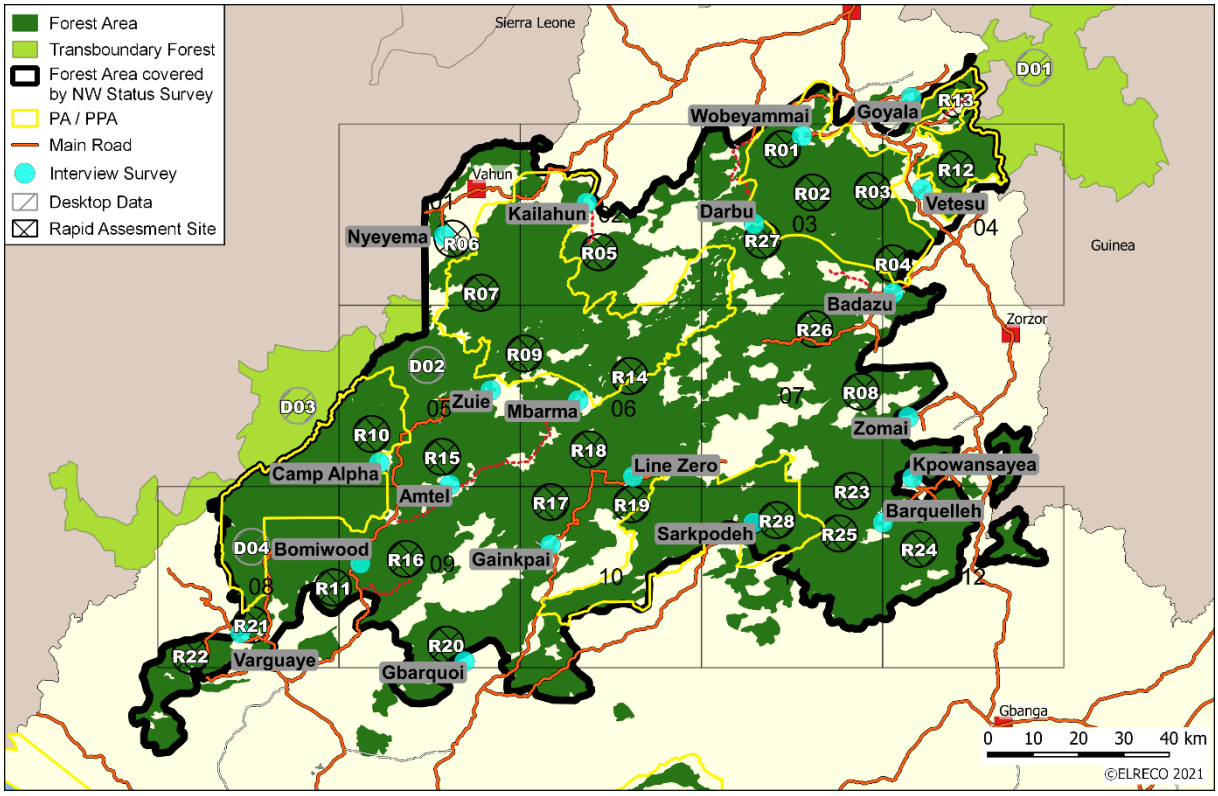


Figure 3. Survey effort of the Forest Elephant status survey in the Northwestern Forest Block December 2018 – January 2021. R01 etc.: Rapid Assessment Sites; D01 etc.: Data from Desktop Study

Table 1. Focus Group Interview Surveys (I01 etc.: Interview Survey 01 etc.)

No.	Date	Grid No.	Forest/Area	Community	Participants
I01	05.12.2018	3	PPA Wologizi NE	Wobeyammai	9
I02	11.01.2019	4	PPA Wologizi SE	Badazu	16
I03	04.03.2019	2	PPA Foya NE	Kailahun	10
I04	10.03.2019	1	PPA Foya NW	Nyeyema	10
I05	18.03.2019	7	Belle Forest	Zomai	10
I06	08.04.2019	5	PPA Foya SW	Zuie	10
I07	14.04.2019	5	Gola NP East	Camp Alpha	10
I08	21.04.2019	9	Gola Forest	Bomiwood	13
I09	23.11.2019	4	PPA Wonegizi SW	Vetesu	15
I10	29.11.2019	4	PPA Wonegizi NW	Goyala	10
I11	15.02.2020	6	PPA Foya South	Mbarma	13
I12	25.02.2020	5/9	Gola Forest	Amtel	16
I13	09.04.2020	10	Belle National Forest	Gainkpai	10
I14	19.04.2020	6/10	Belle National Forest	Line Zero	9
I15	26.04.2020	9	Kpo Forest	Gbarquoi	6
I16	02.11.2020	7/12	Belle National Forest	Kpowansayea	10
I17	08.11.2020	11/12	Belle Forest / Kpo	Barquelleh	8
I18	12.12.2020	3	Wologizi Mountain	Darbu	9
I19	09.01.2021	11	Belle Forest / Kpo	Sarkpodeh	12

Table 2. Rapid Field Assessments (R01 etc.: Rapid Field Assessment Site 1 etc.)

No.	Date	Grid No.	Forest/Area	Community	Survey Days	km²
R01	06.12.-10.12.18 18.12.18	3	PPA Wologizi NE	Wobeyammai	6	45
R02	11.12.-17.12.18	3	PPA Wologizi Central	Bedeseba	7	41
R03	05.01.-10.01.19	3	PPA Wologizi East	Luyema	6	27
R04	12.01.-17.01.19	4	PPA Wologizi SE	Badazu	6	32
R05	05.03.-09.03.19	2	PPA Foya NE	Kailahun	5	35
R06	11.03.-12.03.19 17.03.19	1	PPA Foya NW	Nyeyema	3	26
R07	13.03.-16.03.19	1	PPA Foya West	Jawajei	4	56
R08	19.03.-21.03.19	7	Belle Forest	Zomai/Fassala	3	21
R09	09.04.-12.04.19	5/6	PPA Foya SW	Zuie	4	31
R10	15.04.-20.04.19	5	Gola NP East	Camp Alpha	6	81
R11	22.04.-24.04.19	8/9	Gola Forest	Bomiwood	3	14
R12	24.11.-28.11.19	4	PPA Wonegizi Central	Vetesu	5	22
R13	30.11.-07.12.19	4	PPA Wonegizi North	Goyala	8	55
R14	17.02.-24.02.20	6	PPA Foya South	Mbarma	8	61
R15	26.02.-28.02.20	5/9	Gola Forest	Amtel	3	40
R16	03.03.-04-03.20	9	Gola Forest	Bomiwood Junct.	2	0
R17	10.04.-14.04.20	10	Belle National Forest	Gainkpai	5	27
R18	15.04-18.04.20	6	Belle National Forest	Konesu Junction	4	32
R19	20.04.-24.04.20	10	Belle National Forest	Line Zero	5	37
R20	27.04-30.04.20	9	Kpo Forest	Gbarquoi	4	31
R21	10.06.-12.06.20	8	Gola NP West	Varguaye	3	22
R22	09.06.20	8	Gold Mountain	Buginda	1	0
R23	03.11-06.11.20	7/11	Belle National Forest	Kpowansayea	4	47
R24	07.11.20	12	Lofa South	Galai	1	0
R25	09.11.-12.11.20	11	Belle Forest /Kpo	Barquelleh	4	33
R26	13.11-14.11.20	7	Sing Logging	Balagwalzu/Wolo	2	0
R27	13.12.-17.12.20	3	Wologizi Mountain	Darbu	5	41
R28	11.01.-14.01.21	11	Belle Forest /Kpo	Sarkpodeh	4	24
				Total:	**121**	**881**

2.4 Data Analysis

Surveyed area of Rapid Field Assessment Sites

The survey effort per Rapid Field Assessment Site is expressed as surveyed area in km², which was calculated with QGIS 3.16 based on the GPS tracks recorded by the field teams. The application tool *Grid Creator* was used to superimpose a grid layer of 1 km² sized squares over the entire RAS, and subsequently counting each grid square that was intersected by the GPS tracks. The size of one square was set at 1 km² to account for species-specific parameters, such as body size, ranging behavior, and extent of visible impact elephants leave in visited areas (modeled after the study of MOSSBRUCKER et al. 2015).

Relative Abundance

Relative Abundance is expressed as dung-piles/km².

Population Structure

Demographic parameters of elephants such as size and age class can be derived among others from footprint size and dung bolus size (e.g. LEE & MOSS 1995; TYSON et al. 2002; MORRISON et al. 2005; SHRADER et al. 2006; HEDGES et al. 2013, HEMA et al. 2017). The length of a (hind) foot, multiplied by 5,50 (females) and 5,80 (males), respectively, or 5,65 in case of unknown sex, approximately corresponds to the elephant's shoulder height. As a reference point for the interpretation of the results, the sparse data available in the literature list the maximum shoulder heights of African Forest Elephants between up to 2,40 m for females and up to 3 m for males (GRUBB et al. 2000), but they likely might also be lower (e.g. 2,16 - 2,80 m, MORGAN & LEE 2003; TURKALO & BARNES 2013). Data on the relation between shoulder height and age class are typically available for African Savanna Elephants (LINDEQUE & JAARSVELD 1993; LEE & MOSS 1995; SHRADER et al. 2006) and Asian Elephants (e.g. VARMA et al. 2012). Similarly, dung bolus size has been allocated to age classes mostly for African Savanna Elephants and Asian Elephants; however, there are also few data for African Forest Elephants (e.g. MORGAN & LEE 2003). Based on those data available from different resources, the following main age categories were applied in this study:

Age Class	Approximate Age	Shoulder height	Mean Dung Bolus Circumference
Neonates and Infants	0 – 5 years	< 1,20 m	< 30 cm
Juveniles	5 – 12 years	1,20 – 1,80 m	30 – 35 cm
Subadults and Adults	> 12 years	1,80 – 2,40 m	> 35 cm
Large old bulls	> 45 years	> 2,40 m	

Determination of priority areas for the long-term conservation of elephants in Liberia

Being a migratory species, adaptable to a variety of habitat types as long as they contain sufficient water bodies, it is anticipated that elephants do not only occur inside designated Protected Areas (PA) or Proposed Protected Areas (PPA), but also range outside. Liberia currently holds five PAs and eleven PPAs; it is estimated that 39% of predicted suitable elephant habitat lie within these PAs and PPAs, respectively (FREEMAN et al. 2018). The nationwide survey reveals remaining elephant hotspots in Liberia, and in case important areas should lie outside of Protected Areas, a plan needs to be put in place how to manage those areas with regard to existing land-use planning. Therefore it is crucial to identify those sites at an earliest stage as possible, to leave enough time for necessary interventions.

After every field survey elephant data were plotted on an updated forest cover and vegetation map to identify the hotspots, i.e. areas that still hold high numbers of elephants. Further, throughout the study additional information about identified and assumed elephant seasonal migration routes and potential corridors that could connect isolated populations were added

to that map. The next step was a Factor Analysis to determine the suitability of the identified key elephant areas for long-term conservation under consideration of relevant criteria such as human population density, economic interests and sociocultural aspects. Up-to-date shapefiles of present and future forest concessions, logging and mining concessions as well as human population and demographic data were gathered from partners and relevant institutions to match these layers with the hotspot map.

Genetic analysis of dung samples

There is no wildgenes laboratory in Liberia, so ELRECO established a cooperation with the Institute for Zoo and Wildlife Research (IZW) in Berlin, Germany, who will be responsible for the genetic analysis of the dung samples.

3. Results

3.1 Forest Elephant Occurrence and Distribution

Figure 4 shows the presence and absence of elephants in the Northwestern Forest Block. It must be understood that the elephant symbols do not reflect different elephant groups, i.e. the map does not provide information on Forest Elephant density and population size, but shows the areas where elephant signs were recorded. Most of the predicted target areas of the nationwide survey still contained elephants, which stresses the importance of the Northwestern Forest Block for the survival of this species. Elephants are widely distributed across the whole landscape, both inside and outside of Protected/Proposed Protected Areas, respectively. The species inhabits all PAs and PPAs, namely the Gola National Park, Foya, Wologizi, as well as the northern and central parts of Wonegizi, and the eastern part of Kpo Mountain PPA. Elephants do also occur in the transboundary forests adjacent to Wonegizi in Guinea, and adjacent to Gola NP in Sierra Leone, respectively. Its presence was further confirmed outside of (P)PAs, in the wider Gola NP area, the central area between Foya and Kpo Mountain PPA, between Foya and Wologizi, as well as in the eastern parts of the NW Forest Block. Elephant signs were also found in two forest fragments at the edge of the Forest Block, i.e. the one in the far northwest adjacent to Foya PPA, and another in the south, respectively.

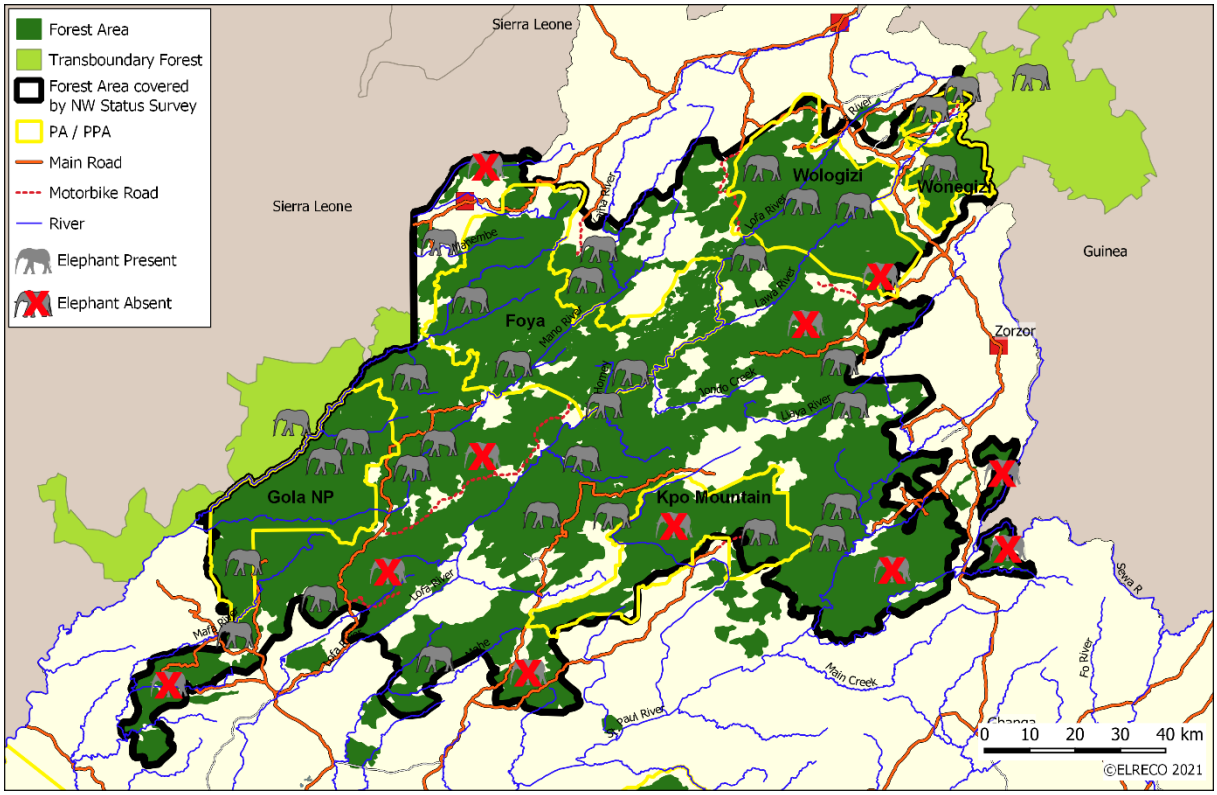


Figure 4. Presence of Forest Elephants in the Northwestern Forest Block.

On the other hand, elephants do not occur (any longer) in those isolated patches that are cut off from the overall forest contiguity by main roads, namely the one north of Foya, and the two fragments in the east at the border to Guinea, as well as in several other parts of the NW Forest Block. In part, the absence of elephants in certain areas, e.g. like in southern Wonegizi or the western area of Kpo Mountain PPA, can be explained by the existence and course of mountain ranges in the NW, as shown in Figure 5. Prominent ranges include the Ziama Massif in Guinea that extends into southern Wonegizi, the Kpo Mountain Chain, and the Wologizi Mountain Range in the north of the PPA that continues stretching over a large distance into the southwest, forming the watershed between Lofa and Mano River.

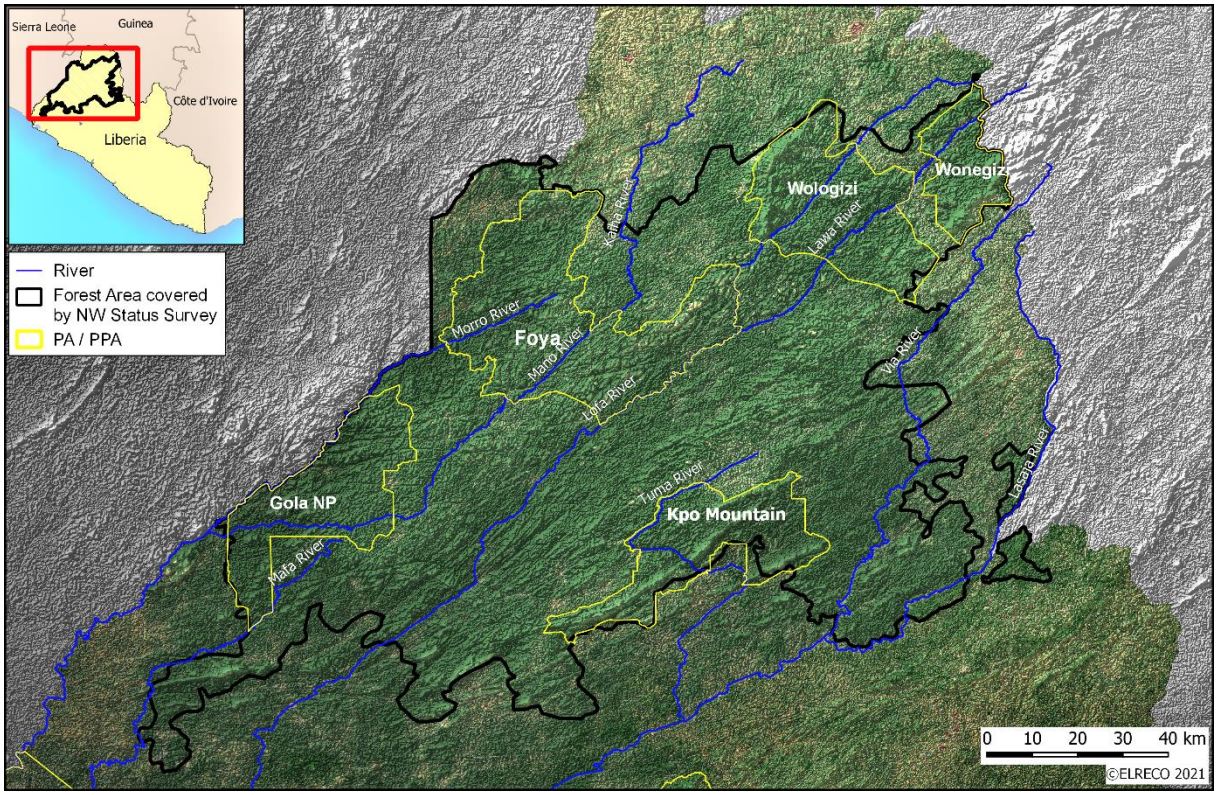


Figure 5. Hillshade Map of the Northwestern Forest Block.

The presence of elephants was confirmed by a variety of signs, such as dung, footprints, roads, feeding sites, tree marks, mud wallows and mineral digging sites (Figure 6). Several times the teams came very close and could hear and smell the elephants, but no direct observation was possible. Elephant signs were found in all kind of habitat types, including Primary/Old Secondary Forest, Young Secondary Forest, Post-cultural Secondary Forest, Swamps, Clearings, Riverine Forest and cultivated areas, at elevations ranging from 110 to 1049 meters above sea level.

Figure 7 shows the actual range of Forest Elephants in the Northwestern Forest Block.

Figure 6. Elephant signs: Footprints, feeding site (upper row), tree rubbing mark, dung, road (lower row).

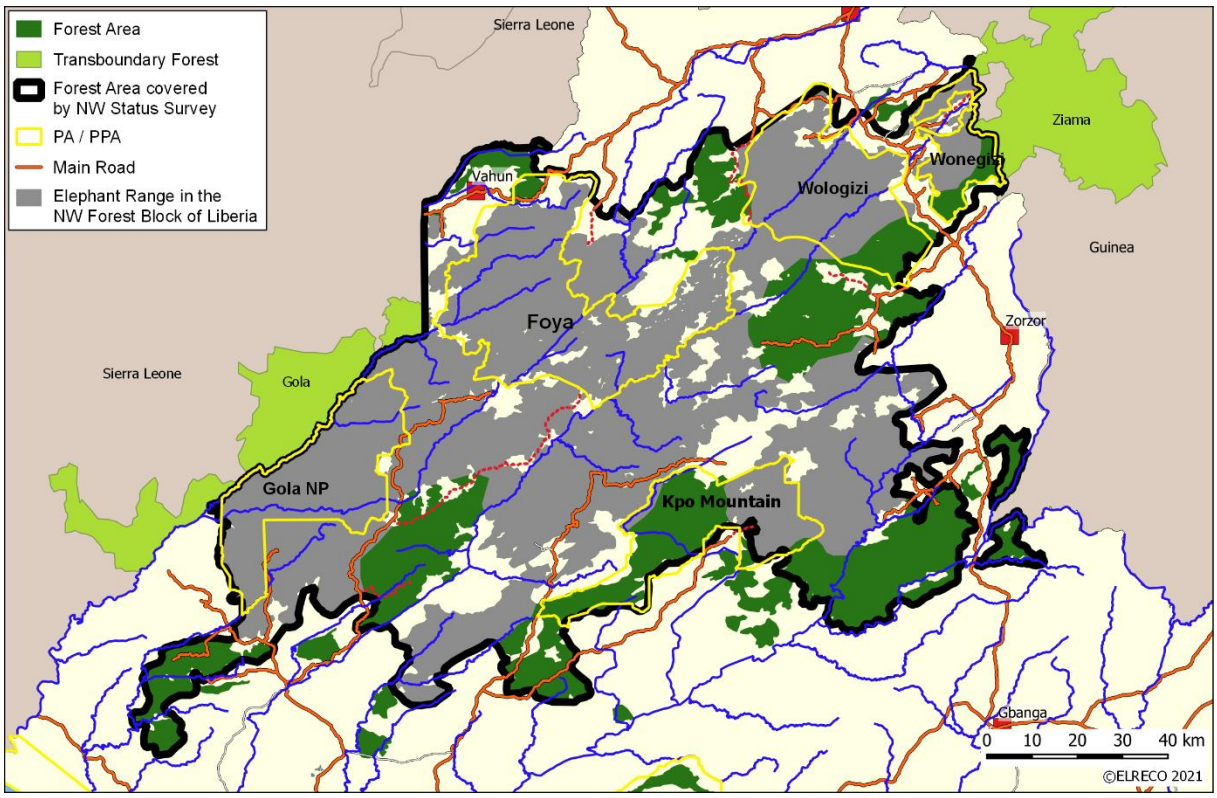


Figure 7. Forest Elephants Range in the Northwestern Forest Block.

3.2 Relative Abundance

Figure 8 and Table 3 show the relative abundance of elephants in the 24 surveyed Rapid Field Assessments Sites (RAS), expressed as dung-pile frequency (the four sites R16, R22, R24 and R26, where due to reported elephant absence no field surveys inside the forest were carried out, are not included). The pink spots in the map indicate the size of the surveyed area per RAS, which has been calculated as explained in Section 2.4.

In total 1308 dung-piles were recorded. The highest number, i.e. 385, was found in R09 in the southwestern part of Foya, resulting in an encounter rate of 12,42 dung-piles per km². Second-ranking in terms of dung density was R21 with 6,91 piles/km², followed by 3,29 dung-piles/km² both in R05 and R28. Comparably high numbers further were found in R07 (2,00 piles/km²), R20 (1,77 piles/km²), R14 (1,54 piles/km²) and R19 (1,14 piles/km²). All other sites contained less than 1 dung-pile/ km². Lowest-ranking with 0,05 piles/km² was R15, and no elephant signs at all were found in R04 in southern Wologizi. As outlined in the previous Section (3.1 and Figure 4), there are elephants in Wologizi PPA, but more common in the central and northern parts, while in southern Wologizi, according to the interviews and supported by the Rapid Assessment in R04, in the past elephants only sporadically passed through at certain times of the year on their way to the north, and today they seem to be totally absent.

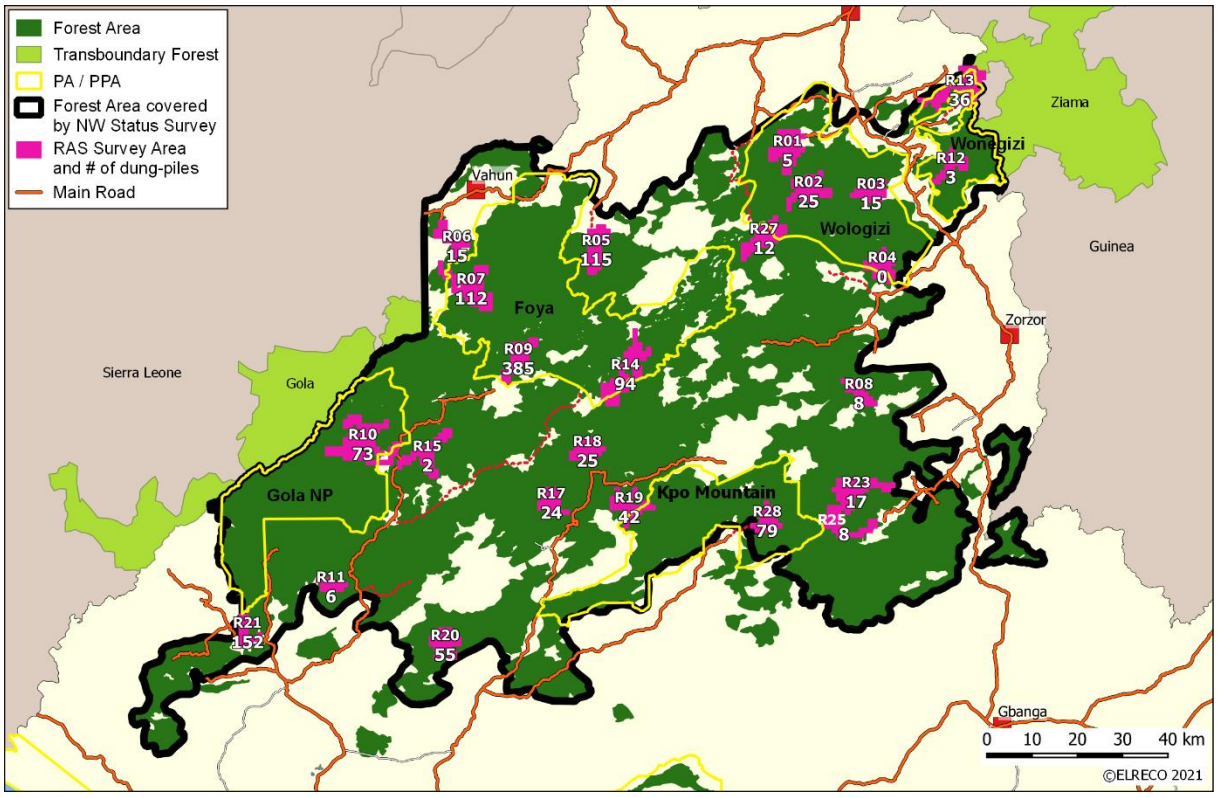


Figure 8. Number of dung-piles recorded by the Fecal Concentration Study in the 28 Rapid Assessment Sites (R01 etc.) in the Northwestern Forest Block.

Compared to the other sites the high encounter rate in R09 was outstanding and resulted from the fact that the survey area contained a major elephant migration route (Figure 9) that, according to local people, is used by elephants regularly every year between January and

March. On their way the animals obviously left a lot of feces on that route, which was still visible at the time of the survey in April and explains the high concentration of dung-piles in a relatively small area. R21, the second-ranking area, was the only site that was surveyed in the rainy season, when elephants in general spread farther out, and also come closer to communities than in the dry season (see Section 3.4), leading to a higher encounter probability of elephant signs in a given area. In fact, elephants were around in this area at the time of the survey. Other prominent fecal concentration spots among others were found in R07 where the field teams encountered several natural clearings, i.e. open areas, which are frequented by elephants at certain times of the year for feeding (Figure 10).

Table 3. Number of dung-piles (n) and dung-pile density (n/km²) per Rapid Assessment Site (RAS)

Rank	RAS	Survey Date	Surveyed Area (km²)	n	n/km²
1	R09	Apr 19	31	385	12,42
2	R21	Jun 20	22	152	6,91
3	R05	Mar 19	35	115	3,29
3	R28	Jan 21	24	79	3,29
4	R07	Mar 19	56	112	2,00
5	R20	Apr 20	31	55	1,77
6	R14	Feb 20	61	94	1,54
7	R19	Apr 20	37	42	1,14
8	R10	Apr 19	81	73	0,90
9	R17	Apr 20	27	24	0,89
10	R18	Apr 20	32	25	0,78
11	R13	Dec 19	55	36	0,65
12	R02	Dec 18	41	25	0,61
13	R06	Mar 19	26	15	0,58
14	R03	Jan 19	27	15	0,56
15	R11	Apr 19	14	6	0,43
16	R08	Mar 19	21	8	0,38
17	R23	Nov 20	47	17	0,36
18	R27	Dec 20	41	12	0,29
19	R25	Nov 20	33	8	0,24
20	R12	Dec 19	22	3	0,14
21	R01	Dec 18	45	5	0,11
22	R15	Feb 20	40	2	0,05
23	R04	Jan 19	32	0	0,00
Total:			**881**	**1308**	**1,48**

Figure 9. Elephant migration route in R09.

Figure 10a.Elephant dung on a clearing in R07.

Figure 10b and c. Clearings in R07, which are seasonally visited by elephants for feeding.

174 (13,30 %) of the 1308 dung-piles were fresh (less than 48 hours old, n = 62) or reasonably fresh (less than two weeks old, n = 112). Regarding the decay stages, a classification was possible for 1297 dung-piles; the majority, i.e. 884 (68,16%) fell into category S4, 242 dung-piles (18,66%) were allocated to S3, 147 piles (11,33%) to S2, and 24 dung-piles (1,85%) to S1. These figures shows that most of the dung found in the study was relatively old, which has implications on the selection of an appropriate methodology for the more detailed population size surveys planned in the next project phase, as discussed in Chapter 4.

3.3 Population Structure and Size

Population Structure

A major challenge in elephant surveys and population estimates is the species' ability to move over large distances in comparably short times (see also Section 3.4), which makes it difficult to assess the number of groups or individuals in a given area. Figure 11 shows the areas where fresh, defined as less than one week old, elephant signs were found at the time of the Rapid Field Assessment, which was the case in 20 of the 24 Rapid Assessment Sites. Elephant symbols with the same colour reflect surveys that were carried out in the same month and year, i.e. almost simultaneously, which allows inference on the population structure. In that view, especially the surveys of March 2019, April 2019 and April 2020 are interesting, indicating that the elephants found in Foya PPA must be different from that at the eastern edge of the Forest Block (green symbols), and those found in the central area between Foya and Kpo Mountain PPA different from the elephants in the southern forest fragment (red symbols). Further, the data (pink) suggest that the elephants from Foya are different from those south of Gola NP, and probably also from that in/around the northern Gola NP area.

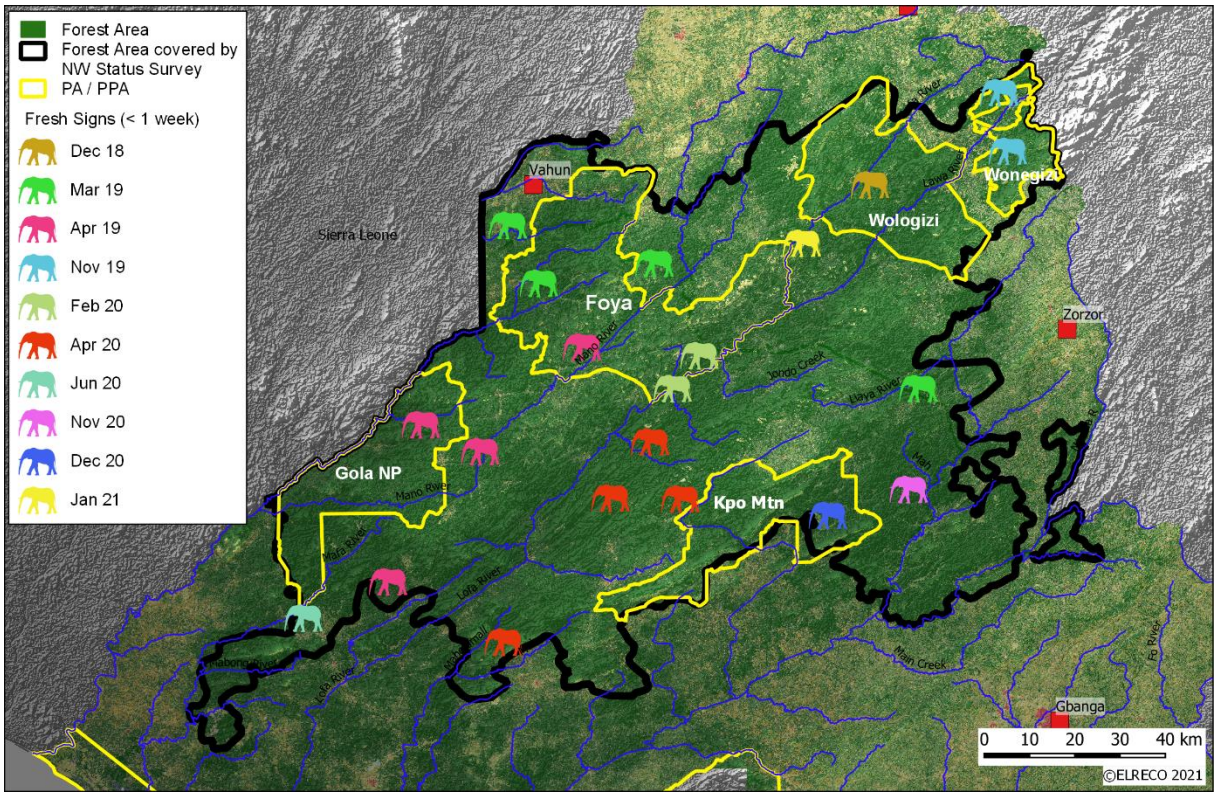


Figure 11. Location of fresh elephant signs found at the time of the Rapid Field Assessment.

A better understanding of the Forest Elephant population of NW Liberia is further facilitated by known movement patterns within the Forest Block, which are illustrated in Figure 12, showing the species' wander behaviour within its distribution range, as identified by the status survey, through interviews, field surveys, corridor assessments and supplementary local information. Supported by additional knowledge such as topographic features and geographic

spacing, all status survey data strongly indicate that there are seven main clusters or subpopulations of Forest Elephants in the NW Forest Block (Figure 13):

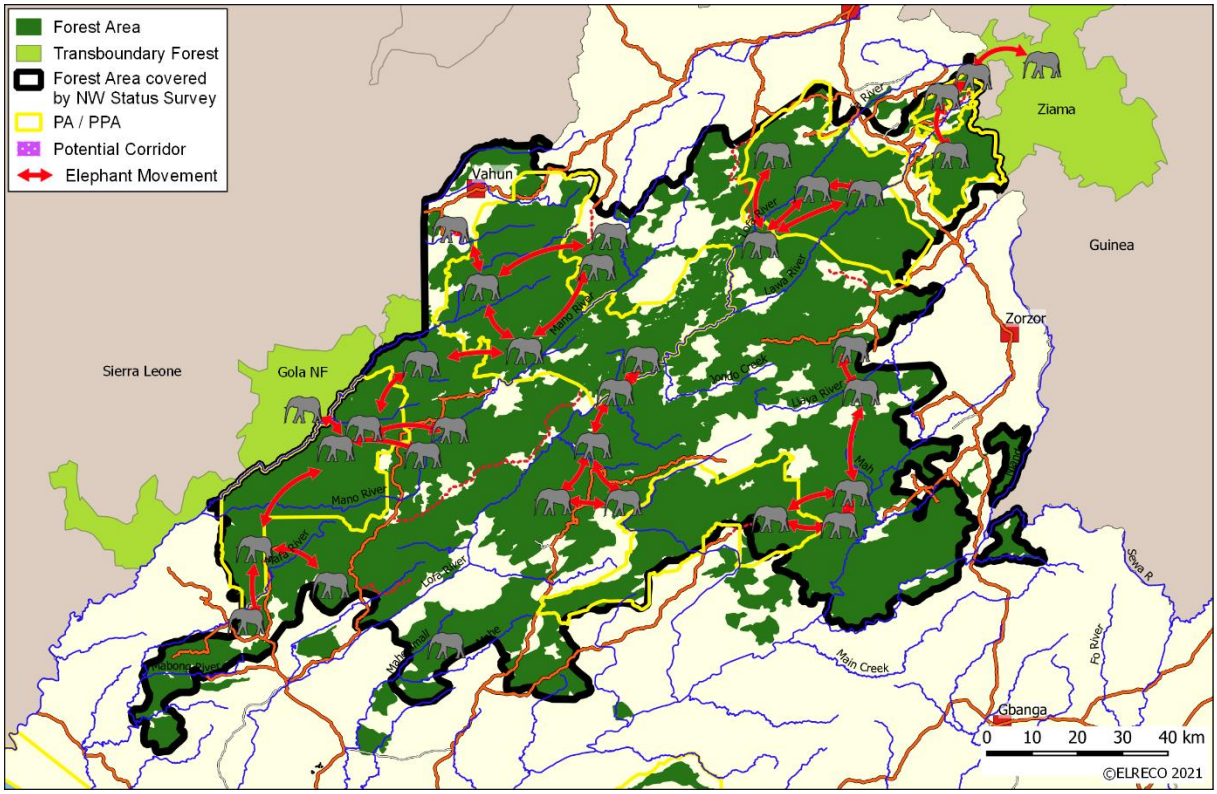


Figure 12. Forest Elephant movement patterns within its distribution range.

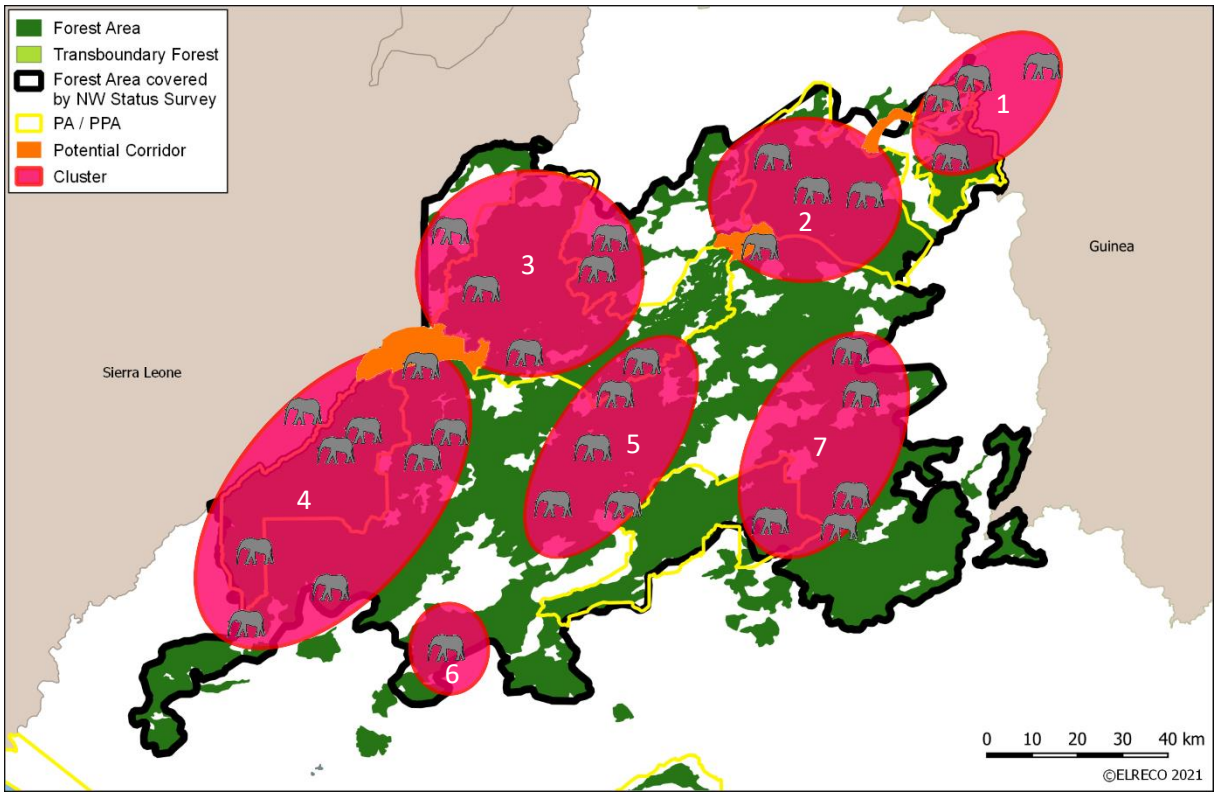


Figure 13. Proposed subpopulations (1-7) of Forest Elephants in the Northwestern Forest Block and potential corridors for (re-) connection of the different clusters.

(1) The Wonegizi-Ziama Cluster

(2) The Wologizi PPA Cluster

(3) The Foya PPA Cluster

(4) One Cluster in the wider Gola NP landscape (hereinafter referred to as the Gola Cluster)

(5) One Cluster in the central area between Foya and Kpo Mountain PPA (hereinafter referred to as the Central Cluster)

(6) An isolated Cluster in the southern forest fragment (hereinafter referred to as the South Cluster)

(7) The Cluster east / northeast of Kpo Mountain PPA (hereinafter referred to as the Kpo East Cluster)

"Cluster" or "Subpopulation" in this report means a form of self-contained unit, without being necessarily isolated from other clusters (except the South Cluster, see below), but with a cluster's individual elephants being more interconnected with each other than with those of other clusters. Regarding the Wonegizi-Ziama and Wologizi Cluster, for example, the status survey showed that the Forest Elephants of Wonegizi mainly roam in and around Wonegizi PPA and into the adjacent Ziama Biosphere Reserve in Guinea, but almost not any longer into Wologizi PPA. In the past there were several locations where elephants used to cross the main car road between the two PPAs, but today only one spot is left where this still happens, with only a few individuals occasionally crossing the road (see also below and Section 3.4). Similar results were found by the corridor assessment of the Wologizi-Foya connection that contains an old elephant migration road, which today obviously is not used anymore. The Central Cluster is largely isolated from the northern subpopulations by the elongated Mountain Range between Mano and Lofa River (Figures 5 and 11), although at this stage it is not known to what extent that Mountain Range represents an insurmountable physical barrier for elephants or if there are certain areas where elephants can easily pass and interact with the other cluster. The same applies to the Foya and Gola Cluster, which might represent one large subpopulation rather than two clusters, or two intersecting clusters that are well connected via the forest corridor between the two (P)PAs. According to the desk study, elephants are present in that corridor area (see also Section 3.1, Figure 4), but more data are required through the genetic analysis and detailed follow-up surveys to evaluate the extent of interaction and exchange between the two proposed clusters. On the other hand, the isolation of the South Cluster at this stage can be considered as good as confirmed, not only because the potential connection route to the Central subpopulation is heavily fragmented, but also because due to extensive gold mining activities especially northeast of the South Cluster's location, elephants are reported to avoid that area and more concentrated in the southwestern part of that remaining forest fragment. The Kpo East Cluster might still be connected to the western subpopulations through the central, though largely fragmented forest area, but the survey did not find any indication for any movements towards north, into Wologizi. Extensive parts of the forest between the Kpo East and Wologizi Cluster are currently under operation of a logging company, so it seems plausible that elephants avoid this area.

Based on the survey data, and under consideration of topography and human settlements, three potential corridors have been identified that could possibly (re-)connect the majority of the proposed clusters (Figure 13), from West to East:

(1) Gola NP – Foya PPA

This area offers good conditions, as the forest connection is still largely intact and it is part of the Gola-Ma Project, managed by RSPB/SCNL, that aims at sustainable use and protection of natural resources, and among others has established two Community Forests in that area. According to their monitoring data, elephants occur in the corridor region, but, as mentioned above, at this stage the interaction and movements of the Gola-Foya Cluster, including transboundary migrations into Sierra Leone, are not well understood yet and would need follow-up studies, including the identification of main elephant migration routes within that corridor to come up with proper corridor management solutions. The area further contains the transboundary Morro River, which might offer favourable conditions for elephant movements as well. In general, big rivers and adjacent river banks in uninhabited areas appear to be quite suitable corridors for elephants, not only because of the species' dependence on water and ability to move along, swim and cross rivers, as well as to cope with the often impenetrable low bush vegetation of the bank slopes, but also because due to logistic challenges, big rivers might be of less economic interest for future investments and infrastructure projects.

(2) Foya PPA – Wologizi PPA

This area contains the Lofa River and an old, inactive elephant migration route. The corridor survey found fresh elephant signs south of Lofa River, closer to Wologizi than Foya, and all signs indicated movements within / towards the Wologizi area but not further southwest in direction to Foya PPA. The (middle aged) chief hunter of that area said that he knows from his parents that elephants used this route in the past, but he himself cannot remember any incidents, i.e. it can be assumed that elephant migration in this area stopped decades ago. Possible reasons remain unclear. The forest itself is still in a very good condition today.

(3) Wologizi PPA – Wonegizi (P)PA

The proposed corridor area includes the Lofa River, where elephants used to move along in the past (latest known case was in 2014), as well as the only spot where elephants still cross the car road today. The forest connection between Wonegizi and Wologizi is already completely interrupted by the main car road, human settlements and related anthropogenic activities; however, given that elephants do not necessarily require contiguous forest cover, but rather follow traditional routes, regardless of vegetation type, there would be no need for a reforestation of the proposed corridor, but to focus on the identification and proper management of the main path that elephants use in that area, in order to sustain and probably revive Forest Elephant movements and exchange between the two (P)PAs.

Population Size

More insights in the composition and size of the different clusters were drawn from four different resources, i.e. (1) interviews and additional local information, (2) the Fecal Concentration Study (see results in Section 3.2), (3) contemporary occurrence of fresh signs in different areas (Figure 11) and (4) based on the Rapid Assessment Sites data, the relative density of all elephant signs found within a Cluster (Table 4).

Table 4.Number of relative dung-pile density (n/km²) and all elephant sign density (n/km²) per Cluster.

No.	Elephant Cluster	Dung-piles/km²	All Signs/km²
1	Wonegizi-Ziama	0,51	1,61
2	Wologizi	0,37	0,88
3	Foya	4,24	5,01
4	Gola	1,48	2,11
5	Central	1,18	2,50
6	South	1,77	2,84
7	Kpo East	0,90	1,69

In most communities local people understandably could not provide specific information on the number of elephants or groups in their area, but gave more general statements such as many, medium or low. Caution was advised when people said there are “plenty” elephants in their forest and signs “all over”, as sometimes subsequent field surveys showed that although there were indeed a lot of footprints and feeding marks in certain area, they might as well have been caused by one group of elephants that roamed for a few days or weeks in a specific area for feeding, leaving an admittedly confusing amount of signs, which could easily lead to misinterpretation. More detailed information, however, is available for Wonegizi, where according to local people, and supported by the field survey results, elephants mostly concentrate in the northern parts, and are thought to consist of two or three groups of 7-8 individuals/group, plus a few single bulls, i.e. in total ca. 20-25 individuals. This appears realistic, also in view of survey data from 2017 from the adjacent transboundary Reserve in Guinea, which showed that the population in Ziama, which seems to be linked to the Wonegizi elephants, has reduced drastically since 2004 from around 200 individuals to a mere 15 recorded in 2017 (SLOANE 2017).

In Wologizi there are two main areas where elephants mostly are found, i.e. in the northern parts between Lofa River and the Mt. Wologizi Mountain Ridge, and in the central parts between Lofa and Lawa River (Figure 4). Compared to Wonegizi, the first impression during the field surveys was that Wologizi contains more elephants than Wonegizi, however, both the relative dung-pile density and that of all elephant signs were lower in Wologizi (Table 4). This comparison, again however, does not take into account that the Wonegizi Cluster also includes distribution areas in Ziama, the size of which is not known and recognized in the calculation. Further, most field surveys were conducted in the dry season, when in Wologizi elephants mostly concentrate along the Lofa and the Lawa River, while in the rainy season

they spread out wider and then are also found in the northern parts (RAS No. 01, Figure 3), while in northern Wonegizi elephants were reported to occur year-round (see Section 3.4). If considering the data from central Wologizi only, i.e. from RAS No. 02 and 03, both dung-pile density and all signs density were similar to that in Wonegizi, i.e. 0,59 dung-piles/km² and 1,43 signs/km², respectively. Based on these indications, as a conservative estimate it is assumed that the Wologizi Cluster will also contain at least 20 individuals, but very likely more.

In the Foya Cluster area, according to Figure 11, there must be at least four different groups only in the surveyed RAS, and it was also the area with the highest density records of all sites (Table 4). Given its comparatively large size, which moreover has not yet been exhaustively surveyed in this first rapid status assessment, especially the more difficult to access core areas (see also Figure 3), the number of elephants in that Cluster must be much higher than for example in Wonegizi. A look at the total sizes of the two respective Cluster areas (i.e. Foya and Wonegizi) and the ratio of their elephant record densities suggests at least a multiplication factor of 5 for Foya, i.e. it probably contains 100 – 150 individuals.

Similar considerations apply to the Gola Cluster that stretches over the largest area of all Clusters, for which prior to the status survey already comparatively many elephant data were available from partners, and therefore in favour of other, hitherto unstudied areas in the NW Block those were not included again in the rapid field assessments (see also Figure 3). However, the data available from partners are mainly presence data only, but do not provide sign density records, and therefore don't allow a quantitative comparison with the survey sites of this study. More details about the Gola Cluster are available from RAS 21 at its southernmost edge (Figure 3). In Varguaye, one of the hotspots of Human-Elephant-Conflicts with regular crop-raiding issues (see Section 3.8), people said that the elephants usually come from the north, i.e. the southern part of Gola National Park. At the time of the Rapid Field Assessment (June 2020), they assumed that there were 3-4 elephant groups in their area plus at least one single male. For two groups people had more details, i.e. one group comprising three individuals and the other group at least ten elephants. This means that at the time of the survey there were ca. 20-30 elephants in the closer vicinity of Varguaye, which was further supported by the dung-pile density found in RAS 21, which was the second highest of all sites (Table 3). Given that usually not all elephants that have access to farms become crop-raiders (CHIYO et al. 2011a), it is likely that there are additional groups in the southern Gola National Park area, so this region might hold probably 50 elephants, and the whole Park maybe up to 100 individuals. Taking all these considerations into account, the wider Gola landscape, i.e. the entire proposed Gola Cluster area, including the transboundary Reserve in Sierra Leone, might contain similar numbers as the Foya Cluster, i.e. ca. 100-150 elephants.

Within the Central Cluster, especially the Foya area plays an important role for elephants, and also showed a higher density record than the survey sites in the southern parts of the Cluster. Further, the "Foya elephants" of that Cluster seem to be different elephants than those found in the south. In the latter area, according to local information there obviously roam ca. five groups, with one group of two, one with four and one group consisting of ten elephants. So the Central Cluster could hold 40-50 elephants.

The isolated South Cluster, based on local information that there is “one big group” in the southwestern part of the forest fragment, confirmed by the field survey which also resulted in the second highest elephant record density of all Cluster sites (Table 4), might contain ca. 10-20 individuals.

The most important elephant area in the Kpo East Cluster is the southwest (RAS 28), i.e. the one inside Kpo Mountain PPA, which was also supported by dung-pile density records that were ca. 10 times higher in RAS 28 than in the other Cluster survey sites (RAS 08, 23, 25, see Table 3). The elephants in the north are under pressure from nearby logging company operations in the forest towards Wologizi, and in the southeast of the Cluster extensive mining activities take place, and there is still an active elephant hunter in the area (RAS 23) who in 2019 allegedly killed six elephants (see Section 3.7). Therefore the number of elephants in that Cluster is assumed to be low. Interview communities in the southeast think that there are one or two small “family” groups and two or three old bulls in the area. According to the interview and field survey in the southwest, i.e. RAS 28 inside Kpo Mountain PPA, in the dry season there are usually four or five single bulls around, while in the rainy more elephants, including groups, come into the area. The rapid assessment in R28, which took place in the dry season (January 2021), found both fresh and old signs that confirmed this statement. Size records of fresh footprints and dung boli pointed towards the presence of three or four big bulls, but as also smaller footprints were found, there was at least one family group in the area at that time. At this stage it is not clear yet, but appears likely that the southeast elephants are the same as or among those found in the southwest, i.e. escaping from the increasing pressure by mining and hunting activities and finding a safer refuge within the Kpo Mountain PPA. The entire Kpo East Cluster area hence might not contain more than 20-30 elephants.

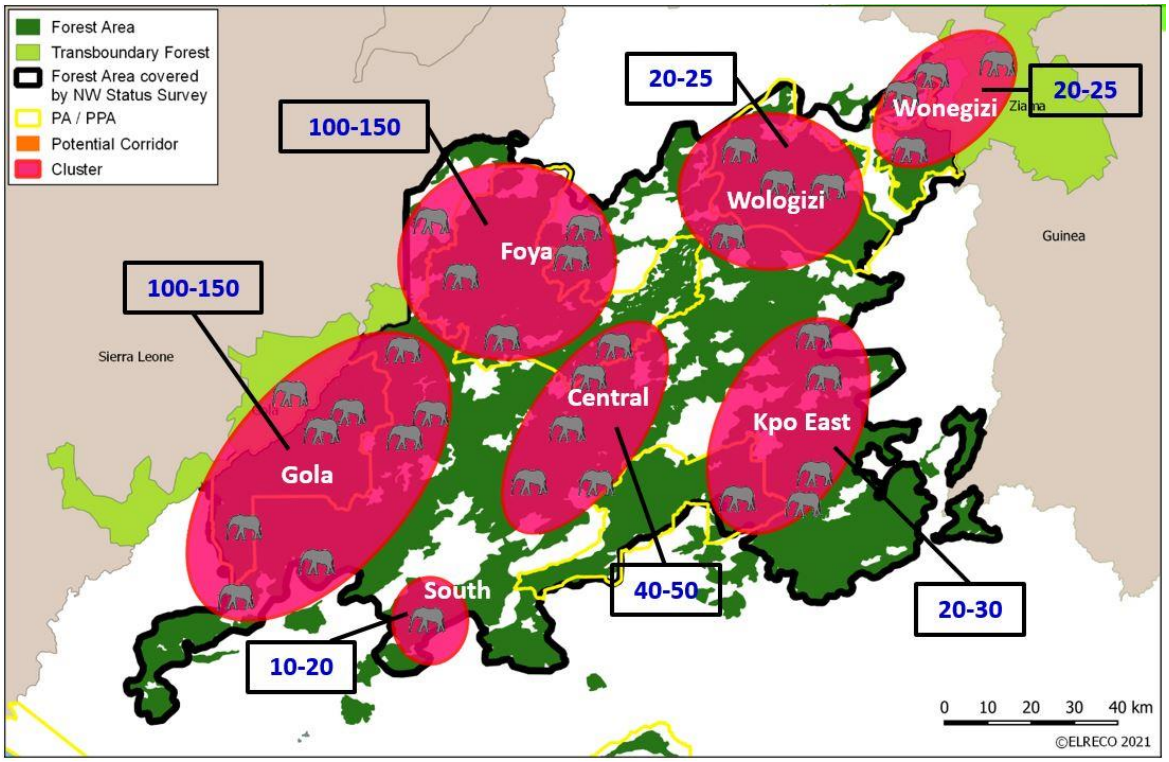


Figure 14. Proposed population estimate of Forest Elephants within the different clusters.

In total, there might be 350-450 elephants in the Northwestern Forest Block. This is to be treated as a preliminary, conservative estimate, mainly based on Wonegizi as a reference, i.e. only one site that might not be representative for the whole region, and these preliminary data still need to be amended and consolidated by results of the genetic analysis (Section 3.5) and detailed follow-up surveys in selected Cluster areas, which are planned in ELRECO's next project phases.

Age and size structure of the NW Forest Elephant population

Age and size classes were derived from footprint length and dung boli circumference (Figure 15) as outlined in Section 2.4. Throughout the status survey, in total 1321 dung-piles were recorded in the NW, 1308 inside the Rapid Assessment Sites (see Section 3.2), and 13 during additional field activities outside of the RAS, for example during a farm inspection in a Human-Elephant-Conflict case. 182 (13,78%) of the 1321 dung-piles had one or more intact boli, and measurements were taken from 154 dung-piles. If the dung-pile contained more than one intact bolus, the largest three boli were gauged to calculate the dung-pile's mean bolus circumference (MBC, in cm). In total 311 boli were measured, ranging from a minimum circumference of 20 cm to the maximum of 63 cm. The sample size of footprints was 339 measurements, with a minimum length of 13 cm up to the maximum of 52 cm, corresponding to an approximate shoulder height of 72 cm and 2,94 m, respectively.

Figure 15. Measurement of footprints (left) and dung boli size (right).

The distribution of records across age/size classes is presented in Tables 5 and 6 and Figure 16. First of all, the data show that all age/size classes are represented in the Forest Elephant population of the NW Forest Block. They comprise very young/small individuals, youngsters, adolescents, as well as adults of different age, including some tall, i.e. obviously old bulls above 2,40 m shoulder height. The percentage of age/size classes further reflects the expectable population structure of a long-living and slow-reproducing species, i.e. a greater number of subadults/adults and medium-large sized individuals than young and/or small animals, respectively.

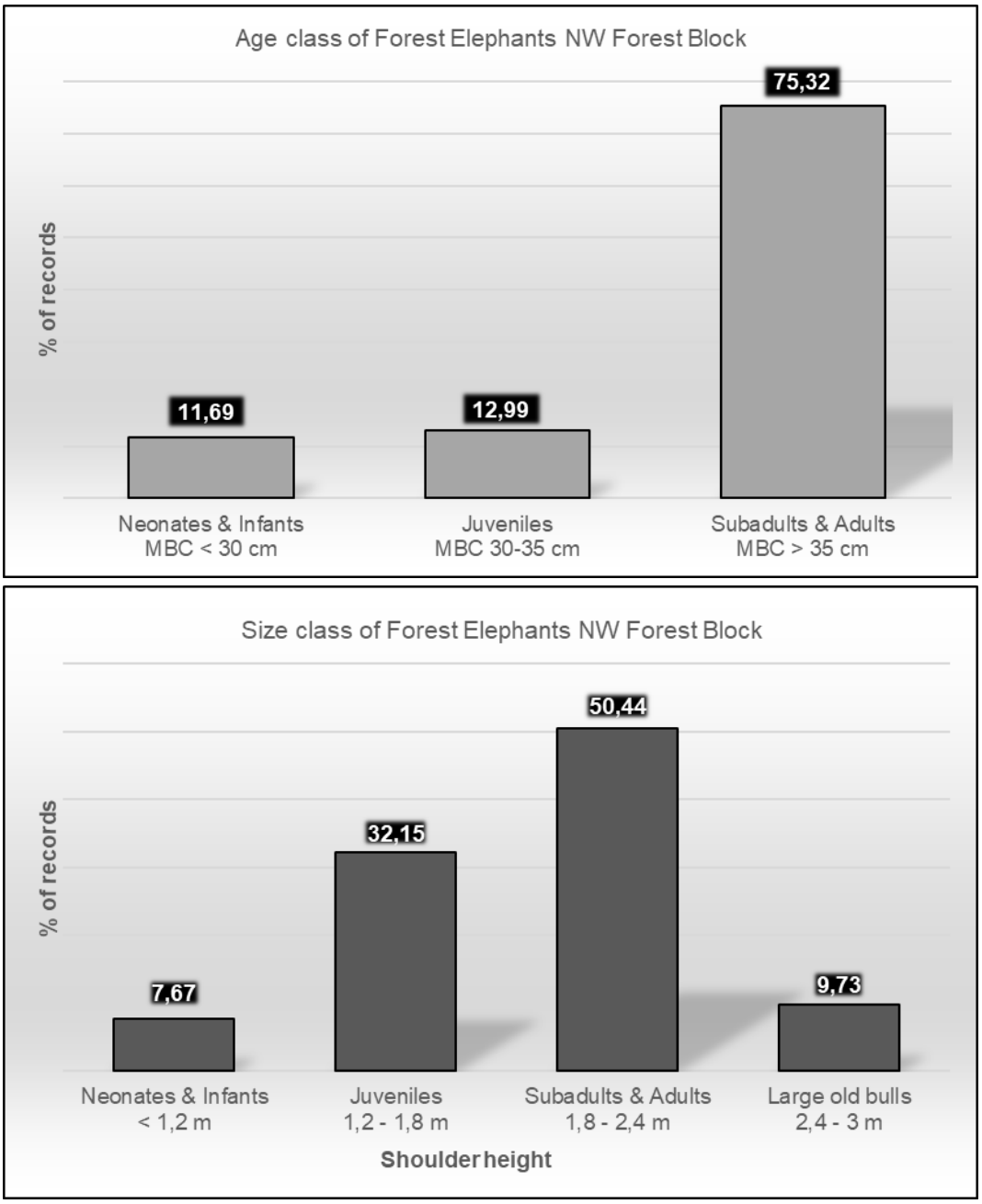


Figure 16. Age (top) and age/size (bottom) class frequencies of the Forest Elephant population in the Northwestern Forest Block.

Table 5. Age class frequency of the NW Forest Elephant population derived from mean bolus circumference (MBC) per dung-pile (n = 154).

Age Class	Approximate Age	MBC	% of records
Neonates and Infants	0 – 5 years	< 30 cm	11,69
Juveniles	5 – 12 years	30 – 35 cm	12,99
Subadults and Adults	> 12 years	> 35 cm	75,32

Table 6. Age and size class frequency of the NW Forest Elephant population derived from footprint size (n = 339).

Age Class	Approximate Age	Shoulder height	% of records
Neonates and Infants	0 – 5 years	< 1,20 m	7,67
Juveniles	5 – 12 years	1,20 – 1,80 m	32,15
Subadults and Adults	> 12 years	1,80 – 2,40 m	50,44
Large old bulls	> 45 years	> 2,40 m	9,73

In general it is assumed that the records based on footprint size are a bit more reliable than those derived from dung bolus size, not only because of the larger sample size of footprint measurements, but further because compactness, shape and hence the size of dung boli, apart from the elephant's age, also depend on the actual dietary composition and degree of dehydration at the time of measurement, and measurable, i.e. intact, dung boli usually are also fresh or not too old yet, and thus represent particularly the age composition of the elephants that were present in the study area at the time of the survey, i.e. mostly that of the dry season. The size of footprints, on the other hand, does not depend on so many different factors, i.e. besides age to some extent on the nature of the underground (swamp, sand, wet or dry soil etc.), and thus can be more robustly related to age class. Moreover, footprints are much longer durable and therefore better represent the typical elephant population in a specific area over time. In comparison to the dung boli size data set, the footprint based results mainly suggest a higher proportion of Juveniles (32% versus 13%) and less Subadults/Adults (i.e. inclusive the large bulls 60% versus 75%).

The presented data refer to the elephant population across the entire NW Forest Block. Regarding the proposed subpopulations, for most areas except the Wologizi and South Cluster the sample size was large enough to allow a representative analysis of the population composition per area (Table 7, Figure 17). Given the special case of the isolated South Cluster, results are presented despite the comparably small sample size of 15 measurements, as in this case they seem representative for the entire subpopulation, which might contain just a few individuals.

The Wonegizi, Central and Kpo East Cluster show a similar age/size class distribution pattern as found for the entire NW region, with a bit higher proportion of the larger and older classes though, i.e. subadults, adults and old bulls totaling in ca. 70-75%, "at cost" of Neonates and Infants in Wonegizi, and of Juveniles in the Central Cluster, and of both in the Kpo Cluster. In Wonegizi this reflects the assumed low total number of individuals, i.e. if the whole population might only be 20 elephants, it is plausible that those will be mostly in the middle age/size classes, and only very few individuals in the smallest and largest category. A small population was also suggested for Kpo East, which however contains a disproportionate high amount of large bulls above 2,40 m, i.e. almost 25%, the highest proportion of this size class of all sites.

Table 7. Age and size class frequency of the proposed subpopulations in the NW Forest Block, derived from footprint size (Wonegizi n = 51; Foya n = 65; Gola n = 54; Central: n = 107; Kpo East n = 42; South n = 15).

Age Class Shoulder Height	% of records					
	Wonegizi	Foya	Gola	Central	Kpo East	South
Neonates & Infants < 1,2 m	1,96	12,31	14,81	7,48	2,38	0,00
Juveniles 1,2 - 1,8 m	27,45	53,85	46,30	21,50	23,81	13,33
Subadults & Adults 1,8 - 2,4 m	64,71	33,85	35,19	56,07	50,00	73,33
Large old bulls 2,4 - 3 m	5,88	0,00	3,70	14,95	23,81	13,33

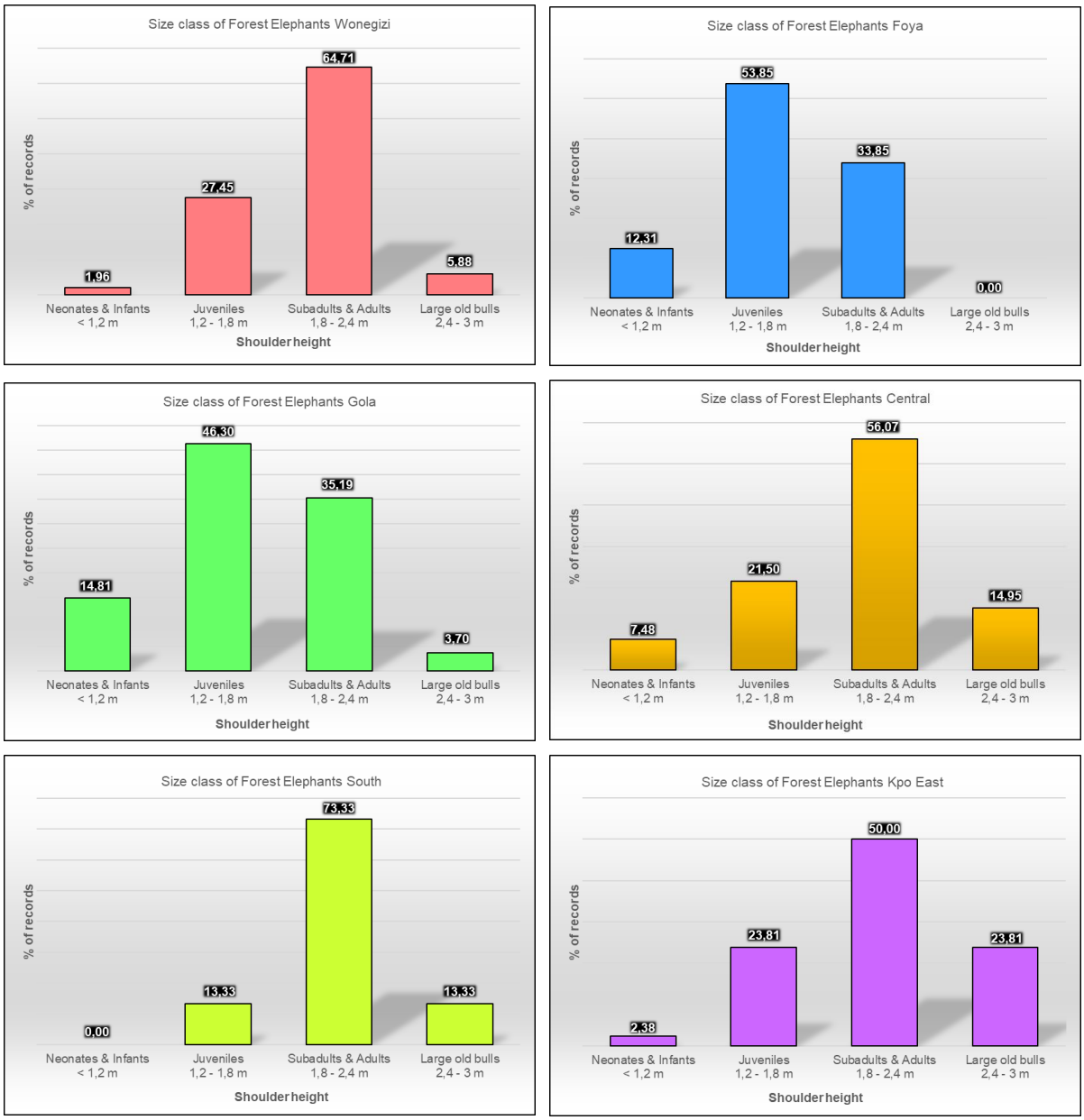


Figure 17. Size class frequencies of the Forest Elephant subpopulations in the NW Forest Block.

This might be related to the huge anthropogenic impact in that area, causing especially females with their offspring to avoid those places. On the other hand, however, the fact that there is a high poaching pressure, obviously for ivory, which is assumed to target at large old bulls, seems a bit contradictive to their relative high percentage. Not necessarily though, if the number of old bulls was even higher before and now is already in decline, but since nothing is known about the Kpo Cluster's population trend over the past years, this remains speculative. A relative high proportion of ca. 15% old bulls was further found in the Central Cluster. The Foya and Gola Cluster appear "younger" than the other sites, with higher proportions of young and smaller individuals, i.e. neonates, infants and juveniles, making up 66% and 61% of the respective subpopulation. In general all subpopulations seem intact in terms of that they are reproducing, without considering a probably limited population number and genetic variance. The latter might be especially problematic for the isolated South Cluster, and be better understood by the results of the genetic analysis.

3.4 Seasonal Distribution and Migration

Regarding the elephants' movement patterns, they in general tend to spread out more in the rainy season (May-October), while in the drier months they are more confined to certain areas deeper inside the forest, close to large water bodies. 14 interview communities said that elephants generally come closer to their farms and settlements in the rainy season, which coincides with the main harvesting time of certain crops, and this is also the time when most of Human-Elephant-Conflicts happen (see 3.8).

In Wonegizi, Forest Elephants occur in the central and northern parts, but not in the south. The northern area was identified as Wonegizi's key elephant habitat, where elephants are present year-round, while in central Wonegizi they seem to occur more temporarily, i.e. mostly during the rainy season. As pointed out in previous sections, the Wonegizi elephants roam within and around Wonegizi and into Ziama, but there are no indications for regular movements into Wologizi PPA. In the past there were several locations where Forest Elephants used to cross the main road between Wonegizi and Wologizi, but today only one crossing point in the northern area between the two PPAs is left (see proposed corridor in Figure 13). No major elephant migrations are taking place between the two PPAs today, but more only a few individuals, likely single bulls, occasionally still cross the main road, especially around crop harvesting time in the second half of the rainy season, when elephants in general are reported to come closer to farms and human settlements.

In Wologizi, elephants concentrate around the Lofa River and Lawa River, especially in the southwestern part of the PPA, in the dry season, while in the rainy season they tend to spread out, and among others can be found in the mountainous forest on the Mount Wologizi Mountain Ridge in the northwestern part of the PPA.

Similar observations exist from central and western Foya, where elephants in the dry season allegedly assemble closer around major rivers, i.e. mainly Mano and Morro River deeper inside the PPA. In addition, the Rapid Field Assessment found strong indications for elephants

traveling from the southwestern edge of Foya towards Northeast/East in the late dry season 2019 (February/March).

Regarding the elephant population in/around northern Gola NP, the interview groups described a regular West-East-West movement, with elephants in the rainy season, especially in June, July and August, coming from west closer towards the eastern border and in part traveling further eastwards into the forests outside of the National Park, and in the dry season retreating back westwards. However, the field teams also found fresh elephant signs in different eastern areas in and around northern Gola NP in the dry season (April 2019 and February 2020), meaning that there are also exceptions from general tendencies as perceived by the local people. One of the local field assistants in Gola said that elephants do not follow a fixed (seasonal) pattern, but they are mainly looking for food and at the same time trying to avoid humans. The latter (according to him) would explain why they spread out more in the rainy season, when there is less human activity and disturbance in the forest, and retreat to remoter areas in the dry season. However, in other areas people said that *because* elephants are more widespread and scattered over the forest in the rainy season, humans avoid or reduce activities inside the forest during that time of the year, to prevent encounters and risky situations. Further, the fact that elephants retreat to remoter places in the dry season might be more related to water scarcity confining elephants closer to the big rivers during the peak of the dry season. Moreover, it must be noted that seasonal distribution and overall migration patterns further depend on the social unit, i.e. differ between family groups (females with their offspring) and individuals (bulls). So the main driving factors for elephant movements depend on various ecological, social and respective local conditions, and hence may differ between different areas. This will be discussed in Chapter 4.

Interesting insights in the migration behaviour of Forest Elephants additionally were gathered from two migrating elephants from Guinea who in September 2020 left their original home in the Ziama Biosphere and went on a 4-month journey Southeast. The two males (Figure 18), who are known from a long-term monitoring program in Guinea, crossed over from Guinea to northeastern Liberia and stayed in the region, with occasional short visits of Côte d'Ivoire. It is assumed that they are brothers and since their mother had been killed by Guinean poachers in August 2016, they stayed close to human settlements and thus are habituated to people, which not only makes them very vulnerable to poaching, but also implicates potential risks for local people. Given this special situation, an Elephant Emergency Committee (EEC), represented by FDA and NGO conservation partners, including ELRECO, was set up to coordinate most urgently required actions such as safeguarding the elephants, creating awareness and taking risk prevention measures to protect local people and their farms. Among others, a permanent Ranger Escort was set up who constantly followed and tracked the elephants (Figure 19). On the 17th of December 2020 the two elephants returned to Guinea, where on the 25th of December they finally reached their original home again. In this almost 4-month journey they covered a distance of approximately 780 km. At the time of this report the two elephants are still in Ziama, but obviously they split, with the older elephant

moving around alone now, and the younger joined a group of three elephants. However, this still has to be confirmed by follow-up data from Guinean partners.

Figure 18. The two male elephants from Guinea, visiting Liberia in late 2020.

Figure 19. Movements of the two visiting elephants from Guinea (left) and their protecting ranger escort (right) from October until 25th December when they finally returned to their origin in Ziama Biosphere Reserve in Guinea.

The motivation of the two elephants for the migration and if they had a fixed destination "in mind" is not known, but they had undertaken a journey before, in May/June 2019, within Guinea from Ziama to N'Zerekore, which lies on the same route they took in September 2020. The case among others gives important information about the distances elephants are able to travel and will help to better understand movement patterns of other, wild elephant groups and how the so far identified key populations in NW Liberia might be interconnected, especially when considered together with the results of the genetic analyses in the ongoing project phases. The possibility of close observation of the two elephants further provided a fantastic opportunity to learn more about elephant behaviour, which given the special case that these two particular elephants are habituated to human presence might not necessarily apply to wild elephants, but still can be considered as valuable knowledge. It moreover created a unique experience for people to see these iconic animals from a close range and thus helped to increase awareness and better understanding of Forest Elephant conservation in general.

3.5 Dung Sampling and Genetic Analysis

187 (14,13 %) of all dung-piles were fresh (less than 48 hours old, n = 72) or reasonably fresh (less than two weeks old, n = 115). 105 dung samples were collected, i.e. 103 from 15 Rapid Assessment Sites (Table 8), and two from the migrating Elephants from Guinea. Among the first, 6 samples were from the Wonegizi Cluster, 15 from the Foya Cluster, 29 from the Gola Cluster, 33 from the Central Cluster, 6 from the South Cluster and 14 from the Kpo East Cluster.

Table 8. Number of collected Elephant Dung Samples from the Rapid Field Assessment Sites (RAS).

Month/Year	RAS	Cluster	Samples
March 2019	R05	Foya	15
March 2019	R08	Kpo East	4
April 2019	R10	Gola	7
April 2019	R11	Gola	2
November 2019	R12	Wonegizi	1
December 2019	R13	Wonegizi	5
February 2020	R14	Central	16
April 2020	R17	Central	6
April 2020	R18	Central	6
April 2020	R19	Central	5
April 2020	R20	South	6
May/June 2020	R21	Gola	20
November 2020	R23	Kpo East	1
November 2020	R25	Kpo East	1
January 2021	R28	Kpo East	8
		Total:	**103**

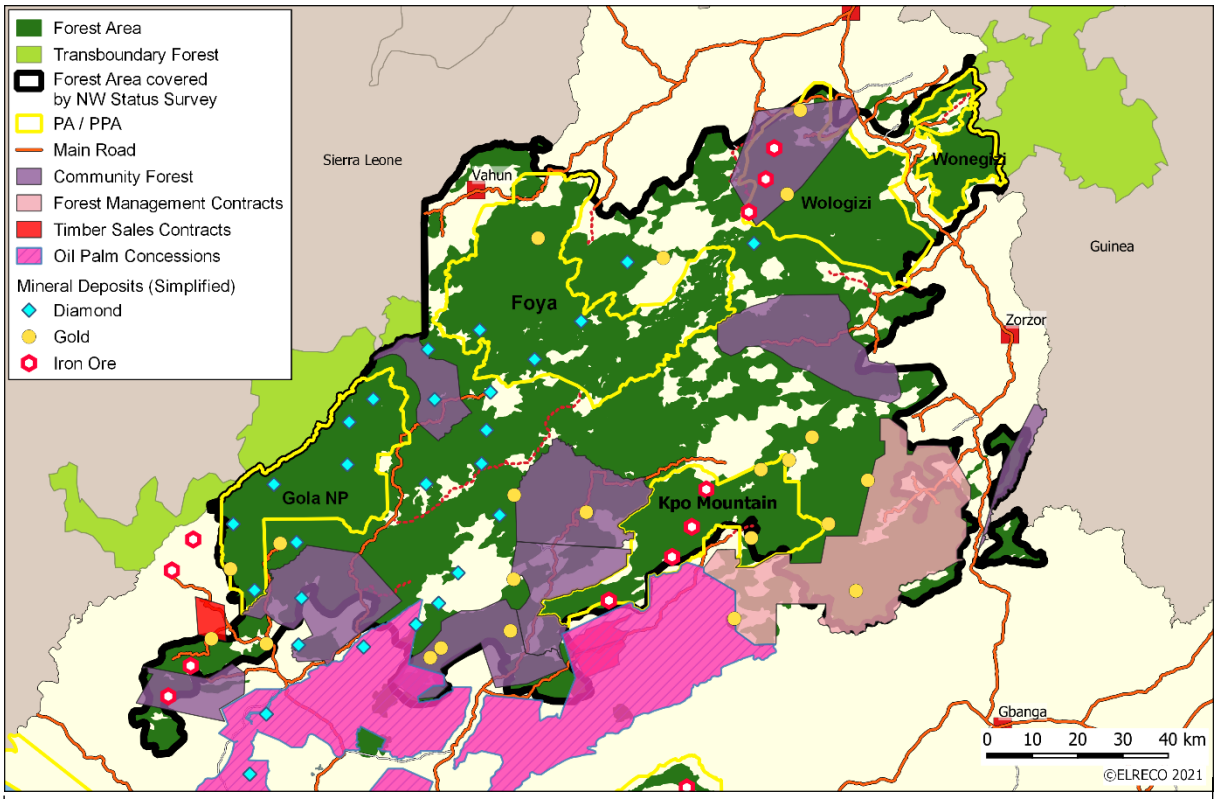
At this stage, 93 dung samples have been exported to Germany and are stored at the Institute for Zoo and Wildlife Research in Berlin for genetic analysis. First randomized tests of DNA presence were positive. The starter kit for genetic analysis, i.e. SNP markers and chips have been designed and are available, however due to restrictions and delays under the COVID 19 pandemic, the analysis has not started yet.

3.6 Key areas for Forest Elephant long-term conservation

Figure 20 shows key areas of economic resources / interests that were considered relevant for the Factor Analysis, in terms of overlapping with potential elephant habitats and the possibility of becoming a threat or in conflict with Forest Elephant conservation in the NW Forest Block. These include main deposits of diamonds, gold and iron ore, as well as zones set aside for the use of forest resources. Among the latter, the Community Forests, if properly managed and monitored, are considered most promising in support of conservation efforts outside of PAs/PPAs. However, Community Forests also have the authority to make management decisions, which means that a Community Forest currently practicing conservation management can easily change the plan and focus on logging. This is the case for example in the Community Forest area south of Wologizi, and in part west of Kpo Mountain PPA. It is difficult and beyond the scope of the Forest Elephant Conservation Project to assess how effective, with regard to sustainable conservation practices, the Community Forestry concept is practically implemented at the different sites in Liberia.

At present Liberia holds five Protected Areas and eleven Proposed Protected Areas, whereof the NW Forest Block holds one PA – Gola National Park –, the gazettement of a second PA, Wonegizi Multiple Use Reserve, is underway, and Wologizi, Foya and Kpo Mountain still have PPA status, meaning that they were set aside for conservation but are not legally managed and protected yet. Given that valuable commodities are found a.o. in these areas, which at the same time contain important elephant habitats, conservation efforts must focus on the preservation and proper management of the PAs, PPAs and the proposed connecting corridors. In that view, besides Gola National Park, especially Foya PPA plays a significant role for long-term elephant conservation, and has been identified as a priority area for the following reasons:

- Foya presently is still neglected in terms of conservation measures (e.g. Gola NP and Wonegizi are managed by FDA with support of conservation partners, Wologizi is part of a wider Ziama-Wonegizi-Wologizi landscape project)
- The results of the status survey showed that Foya contains considerably high numbers of elephants (Figure 14)
- Its geographic location in the center of the NW forest belt, surrounded by already managed conservation areas is advantageous, and would also facilitate the monitoring of not only the Foya elephant population but also of neighbouring elephant groups
- It contains some clearings that would be ideal for establishing a field station and behavioural-ecological Forest Elephant studies



Forest Management Contracts: Long-term forest resource licenses issued by the Government that allows a person to manage a tract of forest land and harvest or use forest products.

Timber Sales Contracts: Short-term forest resource licenses issued by the Government that allows a person to harvest timber from a specified track of forest land.

Community Forest: Areas set aside for the sustainable use of forest products by local communities on a non-commercial basis (no prospecting, mining, settlement, farming or commercial timber extraction). "Community"; in the sense of community forestry means a group of local residents who share a common interest in the use and management of forest resources, with traditional or formal rights to the land and the forests on it.

Source: FDA & World Resources Institute (2018); GUNN et al. (2018)

Figure 20. Areas of (potential) economic interests in the Northwestern Forest Block.

Together with Gola NP, the "Foya – Gola belt", including connecting corridors, is considered of highest priority for sustainable Forest Elephant Conservation in the NW Forest Block, including a permanent field station (Figure 21). For the latter, Figure 21 shows two possible locations, one close to Gola NP and another at the southern border of Foya PPA, which currently due to road conditions however is still difficult to reach, i.e. only accessible for motorbikes but not for cars, and therefore logistically challenging. The proposed locations would serve as a temporary, initial logistic base from where to conduct more detailed exploratory field surveys about the surrounding elephant population, and then decide on a suitable focus population (e.g. ideally one that is in close vicinity year-round and contains different sex-age-classes and social units) and the final location of a permanent station.

Focusing on the Foya-Gola belt however does not mean that other areas should be neglected, but ideally aim at sustaining the entire northern forest belt connection, i.e. stretching from

the Ziama-Wonegizi-complex across Wologizi and Foya into the southwestern Gola end. Currently there seems to be no exchange anymore between the Wonegizi-Ziama and the Wologizi elephants, which in view of the assumed small population size in both areas however would be favorable, a.o. with regard to sustaining genetic diversity, and therefore the conservation of connecting corridors (re-)linking Ziama-Wonegizi with Wologizi, and Wologizi with the Foya-Gola belt must also be taken into account in future conservation management decisions. Further, the special situation of the South Cluster, which very likely represents an isolated self-contained unit, would offer excellent conditions for behavioural, ecological and demographic studies, and should be properly protected and managed, with support of the local communities.

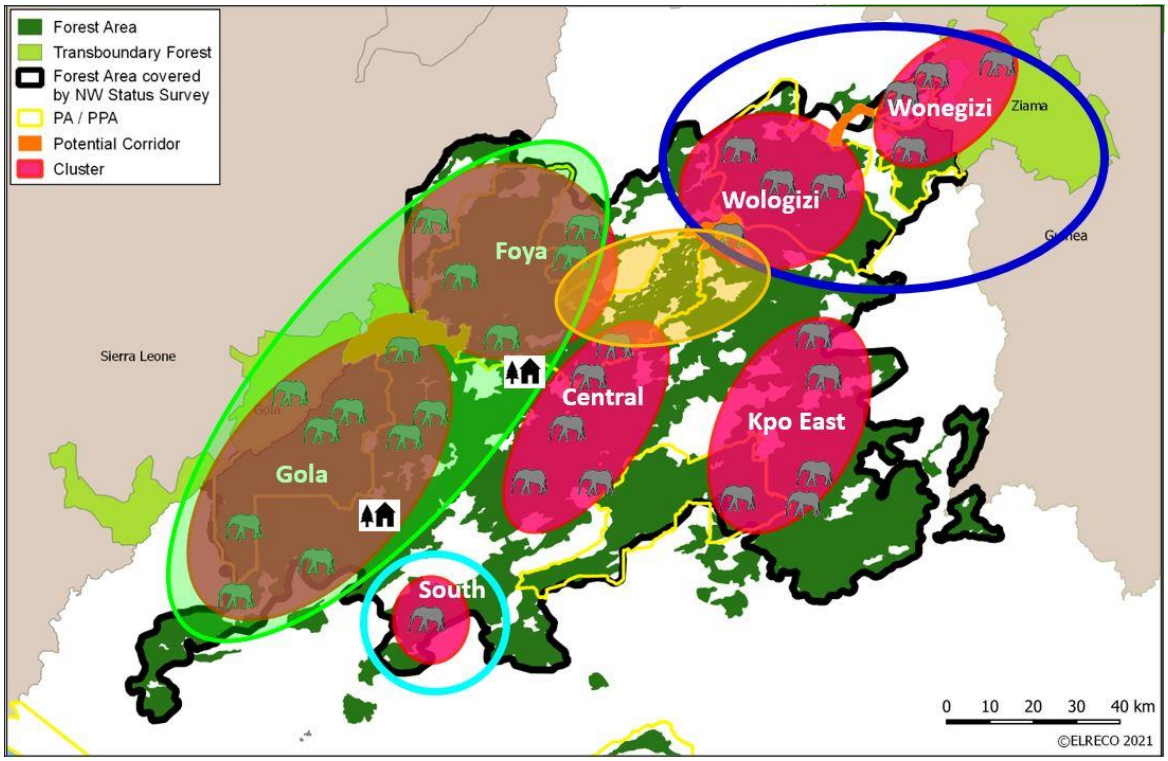


Figure 21. Key areas for long-term elephant conservation efforts in the NW Forest Block. Green: Foya-Gola belt, blue: Wologizi-Wonegizi-Ziama landscape, turquoise: South Cluster, orange: connecting corridors. Proposed initial location of Field Station.

3.7 Threats

The NEAP lists the following major direct threats to the Forest Elephants of Liberia:

- Illegal Killing
- Ivory Trade
- Human-Elephant-Conflict (HEC)
- Habitat loss and degradation
- Fragmentation

Regarding the situation in Northwest Liberia, the status survey identified three main issues that are most critical for the Forest Elephants in that Forest Block, i.e. (1) human

encroachment and disturbance of elephant habitats, (2) resulting Human-Elephant-Conflicts and (3) poaching for ivory. Human encroachment and disturbance are mostly caused by:

- Slash-and burn shifting cultivation (Figure 22)
- Red Wood harvesting, especially in the area south of Kailahun (Figure 23) and in the northern part of Wologizi
- Logging companies operating in the forest south/southwest of Wologizi, and west of Kpo Mountain PPA
- Chain-sawing operations around Varguaye
- Mining, especially in/around Gola National Park (Figure 24), in Gola Konneh District around Varguaye (Figure 25), as well as in large areas west and east of Kpo Mountains. In the latter there are at least eight large gold mining camps.
- Commercial bushmeat hunting (Figures 26, 27), particularly in the forest south of Kailahun and in the central forests between Mbarma, Belle Fassama and Zolowo

An overview of those hotspot areas of human impact is illustrated in Figure 28.

Figure 22. Slash-and-burn cultivation.

Figure 23. Red Wood logs.

Figure 24. Mining village in Gola National Park.

Figure 25. Gold Mining Field in Gola Konneh.

Figure 26, 27. Bushmeat and Hunting Camp in the NW Forest Block.

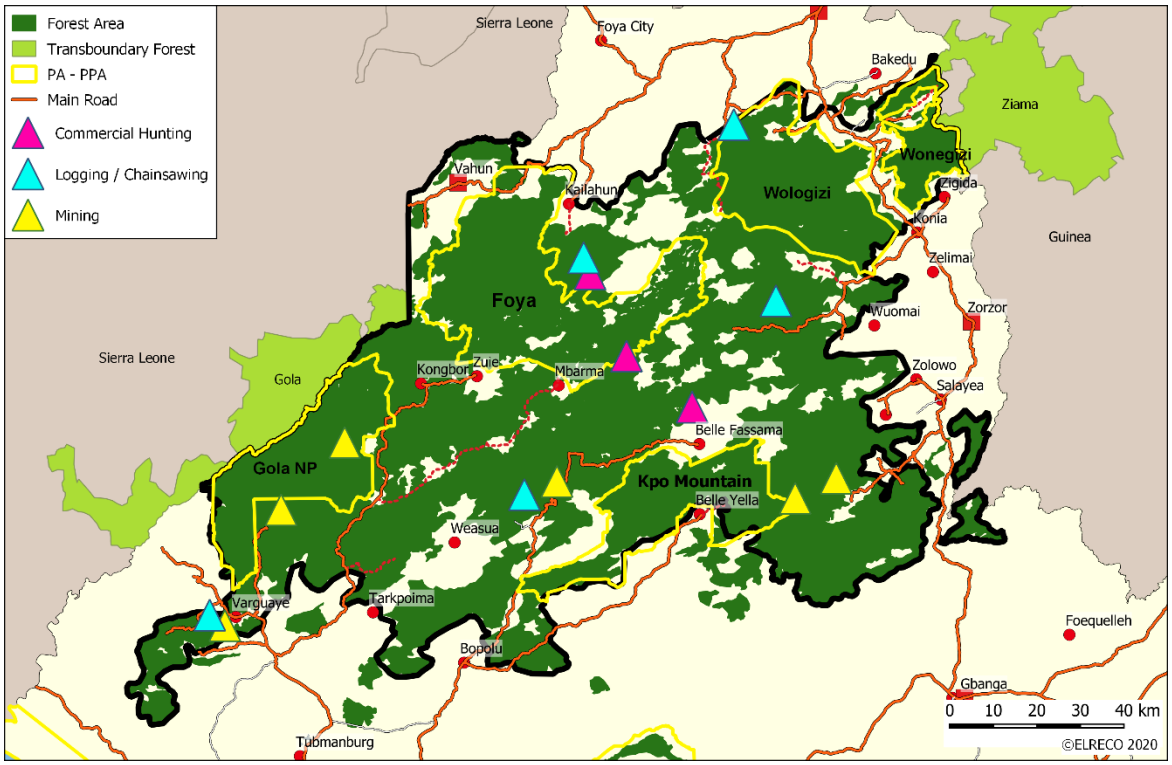


Figure 28. Some areas of major human impacts in the NW Forest Block.

Especially the impacts inside the forest and resulting disturbance of elephant habitats become an increasing problem, as elephants seem to avoid those areas and get increasingly displaced and marginalized, leading sooner or later to Human-Elephant-Conflicts in the surrounding communities. Further, large scale exploitation of forest resources usually entails additional negative impacts such as increasing human population within forest habitats including the establishment of settlements, as well as commercialized hunting businesses.

Although bushmeat hunting usually is not targeted on elephants, killing of elephants still happens in Liberia. At least 18 elephants were killed since late 2018, ten in the NW and eight in the SE Forest Block (Table 9). During the status survey the field team became aware of an active elephant hunter in Kpo East who allegedly killed six elephants for ivory in 2019, and just shortly before the field survey in November 2020 wounded an elephant in the attempt to kill it. In addition to the cases listed in Table 9, two more incidents from the NW in April 2020 seeped through but remain unclear, i.e. in one case information spread that an elephant had

been killed around Kailahun (northeastern border of Foya PPA), but a reliable informant of ELRECO residing in that community had not heard anything about it, so either it was a false message or happened in another area (as many villages in that region have similar names). The second case was reported from Gainkpai west of Kpo Mountain PPA, where an elephant allegedly was shot and wounded, but later people said it was a Forest Buffalo.

Table 9. Known Forest Elephant Killing cases Oct 2018 – April 2021. MOJ/MIA: Ministry of Justice/Internal Affairs; LIS: Liberia Immigration Service; TCU: Transnational Crime Unit

No.	Date	Location	County / Forest Block	Info	Action taken by FDA	Result
1	Oct 2018	Belle Forest	Gbarpolu/NW	1 elephant killed	FDA sent a team including Police to Salayea District	A lady arrested in possesion of smoked elephant meat
2	Mar 2019	Sapo NP	Sinoe/SE	4 elephants killed	FDA sent a team including INTERPOL, MOJ, Police to crime scene	Suspect arrested, tried but acquitted by court
3	Mar 2019	Gelahun	Gbarpolu/NW	1 elephant killed	Unreported case, not in FDA files	
4	Apr 2019	Gola Konneh	Grand Cape Mount/NW	1 elephant killed	FDA sent a team from regional office in Tubmanburg	Two pieces of ivory confiscated and turned over to FDA
5	Sep 2019	Belleh Forest	Gbarpolu/NW	1 elephant killed	FDA sent a team comprising TCU and LIS	Ivory confiscated, suspect arrested and convicted
6	2019	Kpo East	Gbarpolu/Lofa NW	6 elephants killed by one elephant hunter	*ELRECO only became aware of these cases in late 2020, and it was impossible to trace back further reliable details, except a vague indication that the hunter obviously was arrested and went to jail, but was (illegitimately) soon released again*	
7	Feb 2020	Krahn Bassa PPA Mile 48, Pellokon	Sinoe/SE	1 elephant killed	FDA sent a team including TCU, INTERPOL, MIA and Police to Pellokon	Suspects absconded with ivory but 3 arrested for obstructing legal process
8	Aug 2020	Krahn Bassa PPA Smajillah	Sinoe/SE	1 elephant killed	FDA delegation sent for investigation	Obviously the son of the clan chief was involved, i.e. killed the elephant, and the FDA delegation was threatened by the clan people with traditional power and chased away
9	Aug 2020	Krahn Bassa PPA Smajillah	Sinoe/SE	1 elephant killed	FDA delegation sent for investigation	FDA delegation threatened and chased away by local people
10	Apr 2021	Krahn Bassa PPA Shaw David Town	Sinoe/SE	1 elephant killed	*at the time of this Report under investigation*	

Given that elephant killing is a very sensitive topic about which local communities usually do not like to talk openly, and that due to the remoteness where these crimes take place there is often a delay between the incident and the investigation, allowing for evidence and culprits to disappear, it is quite challenging to get clear, detailed and reliable information about the respective circumstances of those cases. Triggering factors seem to be both ivory poaching and HEC. Preventing and addressing wildlife crimes in Liberia is further hampered by a weak law enforcement system, i.e. law enforcement activities still are mostly restricted to patrols and awareness, probably occasional arrests, but cases are hardly seen through to the finish. However, measures for improvement and strengthening the system are already underway by the recent establishment and mobilization of a Wildlife Crime Taskforce and a Wildlife Confiscation Unit under the patronage of the Liberia Law Enforcement Sub-Committee.

3.8 Human-Elephant Coexistence

a) Perception of elephants among local people

An essential factor for making elephant conservation in Liberia successful is the buy-in from local people, especially of those living in the elephant range communities. There is a need for real understanding, acceptance and pride of elephants being a unique part of Liberia's outstanding biodiversity, as well as recognizing the importance of elephant conservation. In that view it first of all required baseline information on people's current knowledge and general perception of Forest Elephants. This information was obtained by two ways, (i) by directly asking people in the interviews and during field trips how they feel about elephants ("Do you like elephants?" "Why?"), and (ii) by the upcoming questions from the audience during awareness campaigns.

Figure 29 shows the answers to the direct questions. 53% had a positive attitude towards elephants and 37% perceived elephants as negative. The remaining 10% had to be classified as "Other", i.e. answers like "Yes, we like elephants because of their meat", which is not rated as a positive perception from a conservation perspective, or like "We don't have a problem [figuratively] with elephants, as long as they don't come to our villages and farms and destroy our crops".

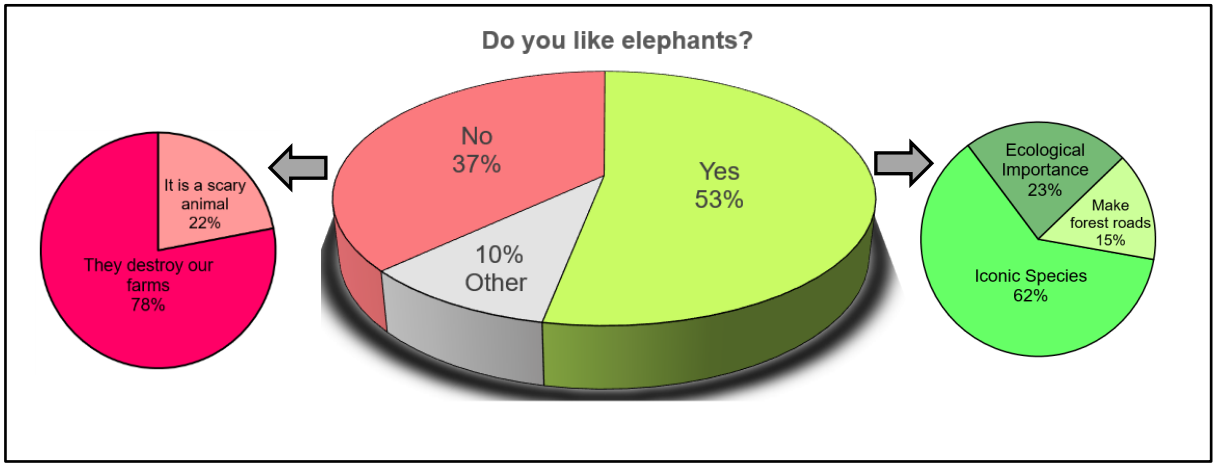


Figure 29. Perception of elephants by local people in elephant range communities.

This issue was also the reason for 78% of the "No" answers, while the other 22% don't like elephants "…because it is a scary animal". The latter reflects mainly the problem of mental stress that people experience during direct encounters with elephants, for example when they go fishing along the rivers or stay in the forest for hunting, while crop-raiding includes both mental stress and economic loss. The reasons for a positive attitude were allocated to three main categories: (1) People perceive elephants as an iconic species and admire their size, power and strength (62%), (2) People are aware of the ecological importance of elephants, such as seed dispersers, forest gardeners etc. (23%), and (3) People appreciate elephants because they open up roads in the forest (i.e. make it easy for humans to walk in the forest, 15%).

It needs to be taken into account that the responses to the direct questions certainly might be biased, e.g. interviewees wanting to be complaisant to the project and demonstrate a positive perception, or communities facing problems with elephants thinking more negatively about elephants than those in undisturbed areas. In fact, not surprisingly almost 100% of the "No" answers came from communities who face regular and serious elephant crop-raiding issues. On the opposite, 85% of "Yes" answering communities so far never had any, and 15% only minor HEC cases (e.g. only one or two cases within the past years, see below). Still the information was useful to get a first grasp of prevailing sentiments.

Questions and comments during awareness campaigns referred to the following three main topics, ranked by significance[1]

(1) Human-Elephant-Conflict
E.g. elephants coming close to the villages, issues of crop-raiding, what can people do to protect themselves and their farms, who they should inform etc.

(2) Benefit for local people from elephant conservation
There were two drivers behind the questions in this category, i.e. on the one hand people asked for their direct economic benefit or monetary gain from protecting elephants, and on the other hand there was the concern that elephant conservation could mean a cutback or loss of existing livelihoods, e.g. through the establishment of Protected Areas. For example, a diamond-miner in Camp Alpha said that they don't want elephants but continue mining.

(3) Other
Miscellaneous questions, mostly related to elephant biology, e.g. how researchers know how old elephants get; difference between Savanna and Forest Elephants; why ivory is so valuable; etc.

Issues related to general policies and law enforcement were addressed by FDA staff, while ELRECO answered the more technical and scientific questions. It would go beyond the scope of this report to list all the single questions and answers. Human-Elephant Conflict will be the topic of the next section. Regarding the questions about the benefit for local communities from elephant conservation the field team mainly highlighted the ecological significance of elephants for the maintenance of forest habitats, short-, medium- and long-term opportunities for communities through involvement in Forest Elephant Conservation activities such as jobs, capacity building and Human-Elephant-Conflict mitigation measures, as well as the potential for eco-tourism development in elephant range communities in the future.

[1] Attendance of awareness programmes and the number of questions varied between sites and in part was very large. During the Q&A sections usually 5 questions were collected first and subsequently answered. To ensure that all important topics the community was interested in could be addressed, repeated questions referring to the same issue were put on hold after a while (i.e. after 3-5 repetitions, depending on the situation) in favor of other subjects that needed attention, and later the questions and topics were weighed by significance (i.e. order and repetition of questions per topic; e.g. what was the very first question that was asked, how often did it come up before any other question was asked etc.)

b) Human-Elephant-Conflicts (HEC)

Throughout the status survey, twelve HEC hotspots were identified in the Northwest (Figure 30), all related to crop-raiding. A hotspot is defined as an area where Human-Elephants-Conflicts happen and usually affect several communities within that area. The identified hotspot areas are:

(1) Varguaye (south of Gola NP)
(2) Bomiwood (south of Gola NP)
(3) Zuie (southwestern Foya)
(4) Mbarma (southern Foya)
(5) Gelahun (within western Foya)
(6) Nyeyema (northwest of Foya)
(7) Kailahun (north of Foya)
(8) Lutisu/Kotee (northern Wonegizi/Wologizi)
(9) Goyala (northern Wonegizi)
(10) Worlowumo (eastern Forest Block)
(11) Fassala (eastern Forest Block)
(12) Sarkpodeh (eastern Kpo Mountain)

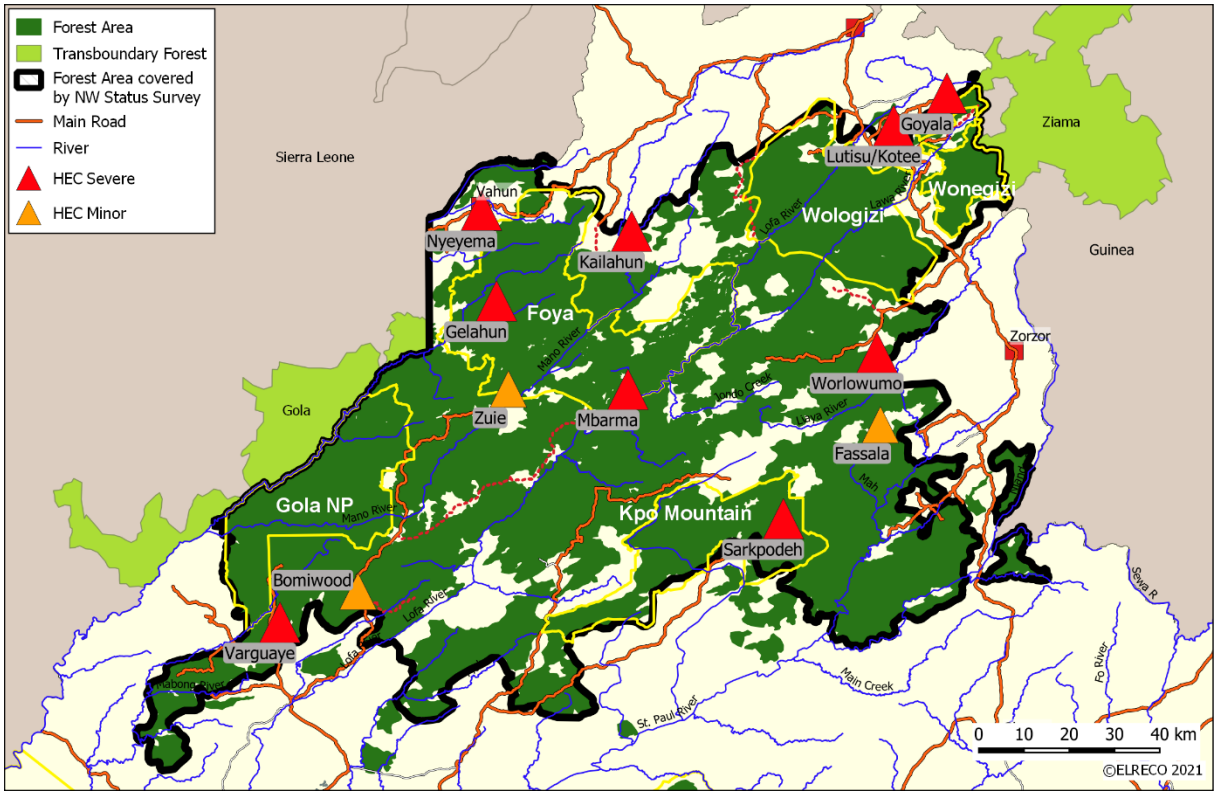


Figure 30. Hotspots of Human-Elephant-Conflicts in the Northwestern Forest Block.

It was neither within the scope nor the aim of the HEC evaluation under the status survey to conduct an elaborate quantitative assessment of the respective damages caused by crop-raiding elephants – which would not only require time- and cost-consuming procedures but would also need to be carried out instantly when damages happen -, but by interviewing

farmers and undertaking short field inspections to collect reliable on-site information about reported cases, and better understand the driving factors behind, in order to come up with suitable solutions.

In three areas, i.e. Zuie, Fassala and Bomiwood, conflicts seem to be just a minor issue, in terms of frequency and extent of destruction. At the time of the survey in Zuie in April 2019 for example, people only reported of a case in 2017, when one elephant stayed in the closer area for ca. six months and disturbed several farms. The people of Fassala reported that crop-raiding by elephants happens every year, but it turned out that this only applies to a "forest garden", i.e. an old and nowadays abandoned plantation in the forest which still produces crops like bananas, plantains, bitter balls (sort of eggplants) etc.. Nobody is living there permanently anymore (i.e. the area is unguarded), but the owner just visits the place occasionally for harvesting. Elephants do not disturb the people's main farms around their town though. In Bomiwood, people said that elephants usually come every year to the southwestern farming area. The latest case happened only three days before the interview took place, when an elephant allegedly destroyed "everything of an old farm". The field team inspected the place, which, as in the case of Fassala, turned out it to be a small abandoned forest garden. There were fresh signs indicating that an elephant had passed through just a few days ago, so this information was correct, but the only sign of destruction that was found was a bent banana tree (Figure 31). I.e. instead of "destroying a whole farm" it looked like the passing elephant had merely taken a snack. The forest garden owner's main and permanently inhabited farm was located just 1,3 km away from the elephant's transit area, and inspection showed that there was no damage nor any indications of an elephant's recent presence anywhere nearby.

Figure 31. Banana tree destroyed by a passing elephant in a forest garden southwest of Bomiwood.

In all the other hotspots, conflicts are more severe, i.e. occur regularly and at a larger extent, affect main farms and thus besides mental stress can lead to considerable annual harvest losses. In general, elephants seem to prefer the very nutritious, “high-energy” crops such as sweet potato, corn, pumpkin, bananas etc., but actually eat almost all types. Conflicts mostly happen every year in the late rain season / at the beginning of the dry season, i.e. the second half of the year (July-December), the main harvesting time. In some communities the situation is very serious, e.g. in Kailahun, Varguaye and Nyeyema people reported that elephants sometimes even enter the villages, especially if ripe fruits such as fruiting banana and mango trees are present, and in Varguaye recurring and – allegedly – intense farm raids discouraged some people to such an extent that they gave up farming.

Human-Elephant-Conflicts typically happen in areas with progressive encroachment and destruction of elephant habitats, for example through the extension of a community’s farming area at cost of forest areas. Affected farms usually are always those farthest away from the village, and/or those close to forest edges. Secondly, another, probably even more significant main driver that was identified in the status survey is the disturbance of elephant habitats by increasing human activities inside the forest. Several hotspot communities reported that they actually never had problems with elephants in the past, but only since a few years, and interestingly those times coincided with other major changes in the area. In Kailahun, interviewees said that HEC started in 2015, and linked this recent development to the simultaneous onset of large scale harvesting of Red Wood in the forest south of Kailahun. In addition to the direct negative impacts of the timber extraction such as habitat destruction and noise, it caused the development of a commercial hunting business in that area. In Varguaye and surrounding communities, the problems began a few years ago with a drastic increase of human activities in the area, mainly artisanal mining as well as chain-sawing. Farmers of Sarkpodeh are affected by elephant crop-raiding since 2008, coinciding with an extensive growth of gold mining activities. In some areas, however, people also believed that the reason for (increasing) problems with elephants is that, compared to the past, today elephants are not hunted anymore, as it is illegal, dangerous or because there are no professional elephant hunters in their area anymore.

Affected communities were further asked what they usually do in HEC cases. Typically, farms are not guarded in Liberia, i.e. are left unprotected in the night, also in elephant range areas with known and repeated elephant crop-raiding incidents, and in general farmers do not have much knowledge about appropriate HEC mitigation measures, except probably making noise and fire, but usually stay passive and understandably develop a very negative attitude towards elephants, often resulting in threats to kill them.

HEC therefore not only pose a serious threat to humans, but also to elephants and urgently need to be addressed. This also in view that the twelve listed hotspots by far are not all HEC affected places in the Northwest, but additional areas that were not directly covered by the status survey are known, e.g. from local reports to FDA. Hence, a timely intervention is required to mitigate those conflicts and thus approach a peaceful coexistence between humans and elephants (see Chapter 4 and 5).

4. Discussion and Conclusions

The results of the Forest Elephant status survey stress the importance of the Northwestern Forest Block for elephant conservation in Liberia. Forest Elephants are widely distributed across the entire landscape. Particularly the large contiguous forest areas apparently are key habitats for the species. Fortunately, major parts of those crucial sites have already been set aside by the GoL for biodiversity conservation, although up to date only one area – Gola National Park – has full Protected Area status. Therefore an important conservation measure will be to push on a speedy gazettement of the Proposed Protected Areas – since this process is already underway for Wonegizi, it applies especially to Foya and Wologizi PPA. At the same time, it has to be ensured that the designated Protected Areas are effectively managed; - cases like the four killed elephants in Sapo NP in 2019 or the presence of active mining camps inside Gola National Park show that the PA status alone does not automatically mean that the biodiversity within a PA is safe. Hence, Protected Area gazettement and management will be one of the challenges for the species' long-term conservation in Liberia.

Elephants do also occur outside of (P)PAs, i.e. the future management of these areas will be equally important. However, given expectable future economic interests as well as already existing economic use plans and operations, it will not be possible to save all those areas, and increasing anthropogenic pressure in certain parts of the present elephant range will progressively force the species to retreat to less disturbed places. In that view, and also accounting for the species' migratory behavior in general, the identified elephant key habitats outside of (P)PAs, particularly the central forest block between Gola NP, Foya and Kpo Mountain, the forest east of Kpo Mountain, as well as the proposed connecting corridors must be properly managed in terms of sustainable resource use practices in alignment with species conservation too. Although at this stage it is not fully understood yet how far elephants roam and how the identified subpopulations are interconnected and related with each other, the existing database of the status survey already points out the importance of maintaining the forest connectivity across the northwestern landscape for the sustainable conservation of the Forest Elephant in that region.

Insights into the migration patterns of the Forest Elephants in the Northwestern Forest Block show that they spread out more and come closer to settlements in the rainy season, while in the dry season they stay deeper inside the forests. More detailed studies are required to better understand these movements, but they are most likely driven by the spatial and seasonal availability of food and water resources, as well as by the attempt to avoid humans. This is also supported by studies of Forest Elephant movements in Gabon and the Congo Basin, which showed that both ecological factors such as food, water and habitat, and anthropogenic pressure (poaching, roads, disturbance) strongly influence movement patterns, depending on the level of protection in a given area (BLAKE et al. 2001; BLAKE et al. 2008; KOLOWSKI et al. 2010; SCHUTTLER et al. 2012; MILLS et al. 2018). Daily and seasonal habitat preferences further are driven by climatic parameters, i.e. during daytime and in the dry season elephants spend more

time in the forest where the dense canopy cover protects them from sunlight and high temperatures (BLAKE et al. 2001; MILLS et al. 2018).

The assumption that, besides ecological factors, avoidance of humans plays a role for movement patterns of the Forest Elephants in NW Liberia may sound contradictive to the fact that elephants obviously come closer to human settlements in the rainy season. In that case, however, ecological drivers such as seasonal shortage of natural forage or the availability of mature crops might prevail. More information is necessary about those elephants approaching human areas, i.e. about their age, sex and numbers. Understandably, people in the affected communities are scared of elephants and try to avoid encounters, so they usually cannot provide much information on that. There are indications of some cases, however, that the "visiting" elephants were single bulls or bachelor groups. It is very likely that female family groups, especially with young calves, avoid humans more than single males do, who probably cope better with the implied risks (CHIYO et al. 2012; HOARE 2012). This is further supported by our observations that elephants in "poor" or exposed habitats, such as for example marginalized forest edges, were single individuals, i.e. most probably bulls. Male elephants generally are known to be more bold and taking more risks than cows. They are responsible for 70-100% of elephant crop damage incidents both in African elephants (BHIMA 1998; HOARE 1999; JACKSON et al. 2008; AHLERING et al. 2011) and Asian elephants (SUKUMAR & GADGIL 1988; EKANAYAKA et al. 2011), which is explained by a male "high-risk high-gain" foraging strategy (CHIYO et al. 2011a, 2011b, 2012). The extent of how much an elephant is scared of humans hence will depend on a number of factors such as sex, age, experience, sexual reproduction status, poaching level, as well as environmental parameters. At this stage it can be said that the tendency to avoid humans definitely has an influence on the Forest Elephants' behavior in the NW Forest Block, as for example indicated by the cases of crop-raiding of abandoned forest gardens in Fassala and Bomiwood instead of nearby, well-guarded farms. Similar observations were reported by miners in Gola and Kpo East, respectively, who live in "camps" (small settlements) with attached vegetable gardens inside the forest, and said that elephants do only enter gardens to feed when the camps are abandoned for a while. Last but not least, observations of the field team during the rapid assessments showed that it is nearly impossible to directly encounter elephants. Several times the teams were very close to the animals, could hear and smell them, but when they tried to follow or approach them, the elephants "suddenly" were gone. This obvious natural tendency to avoid humans is of importance especially with regard to Human-Elephant-Conflict mitigation, which will be discussed further below.

According to the demographic parameters that were collected in this study, the Forest Elephant population in the Northwestern Forest Block is reproducing and intact (without taking into account in this context that other factors such as low numbers, isolation and a probably limited genetic variability might weaken the species' robustness to survive, and hence the intactness is quite fragile and could quickly tip over). The age/size class distribution corresponds to the natural population structure one would expect from a long-living, late and slow-reproducing animal species such as the Forest Elephant. With an average primiparity age

(the mother's age at first birth) of 23 years and an average inter-birth-interval of 68 months (i.e. 5 years and 8 months), African Forest Elephants are one of the world's slowest reproducing mammals (TURKALO et al. 2017). This limits the number of offspring per female Forest Elephant to maximum 5 babies, assuming that she will survive until reaching the maximum reproduction age of on average ca. 50 years (TURKALO et al. 2018). In that view, the bit skewed age/size class distribution of the comparably "younger" Foya and Gola subpopulations appear unusual, if not impossible, which could be explained by the following reasons:

(1) Footprints measurements were collected at random and not following a systematic approach like for example used in the Fecal Concentration Study, which consequently recorded ***all*** dung-piles found in a given study area. A measurement of all footprints would have been extremely time-consuming if not impossible, and also questionable with regard to the expectable output, given that one among others would have measured the footprints of same individuals over and over again, for example when following an elephant road or inspecting a feeding area. It is possible that the random approach led to a bias in recording, for example an unintended preference of measuring smaller footprints than the more common middle-sized. But since the measurements were always taken by the same two persons throughout the entire status survey, a possible bias would have affected all survey sites, i.e. there should not be too much difference between the data sets of the single subpopulations.

(2) A high recent poaching pressure in Foya and Gola, leading to a drastic recent decimation of especially larger/older individuals.

(3) It has to be kept in mind that the allocation of footprint size to shoulder height and further to age class is a good indicator to relatively quickly get a first insight into the elephants' overall population structure, especially in areas for those such data are still completely lacking, but still it remains a proxy and is not carved in stone. Compared to Savanna Elephants African Forest Elephants are still poorly studied and demographic data scarce. Actually it is not known how big on average a 23-year-old female West African Forest Elephant is, and it is possible that the majority of the measurements in Gola and Foya fall into the "transition zone" between the postulated age categories, i.e. particularly in the adjacent categories "Juveniles" and "Subadults & Adults". I.e. large juveniles "in reality" would have to be classified already as subadults. Within the category "Juveniles", records in the upper range between 169 cm and 179 cm shoulder height accounted for 31% in the Foya Cluster and 40 % in the Gola Cluster.

Clearly, it would require more detailed studies that focus on specific demographic parameters to better understand the relation of age, size and growth rates in West African Forest Elephants.

The population size estimate of the Forest Elephant population in the Northwestern Forest Block of in total 350-450 individuals is based on a variety of data sets and strong indicators that were collected throughout the status survey, and considered as a robust proxy of its expectable magnitude. Further consolidation will be achieved by follow-up surveys. The challenge for reliable population size assessments is that it usually is not possible to count all individuals within a certain area (within a given time), especially not in a forest habitat, and

not of a migrating species such as the Forest Elephant that can cover large distances in comparatively short times. Therefore special methods are applied that do not require total counts but allow an extrapolation from a sample to the total population. The method of choice depends on a variety of factors, i.e. not all available population assessment methods are suitable for all species and study sites. The status survey data, especially those of the Fecal Concentration study, provide a valuable guideline for the selection of the appropriate method for population estimates of Forests Elephant in Liberia. It appears that line transect dung sampling surveys, a commonly used standard technique for population estimates, is not suitable, because it requires a sufficient number of fresh dung-piles for the dung decay study in a given area, as well as an adequate dung-pile encounter rate along transects (details see HEDGES & LAWSON 2006), which according to the findings of this study as well as based on ELRECO's experience from numerous previous large mammal surveys in Liberia is very unlikely to be achieved. Instead, it will be more feasible to apply the fecal DNA-based capture-recapture approach (HEDGES & LAWSON 2006). The required baseline data for those follow-up studies, such as dung-pile encounter rates and densities, favourable target areas etc., are now - through the status survey - already available for the NW Forest Block, and the necessary arrangements for the genetic analysis by an accredited laboratory in place.

End of March 2021 IUCN published their recent taxonomic review and reclassification of the African Elephant. Postulated by scientists since years, based on morphologic and genetic evidence (e.g. GRUBB et al. 2000; ROCA et al. 2001; ROHLAND et al. 2010), the African Forest Elephant is now finally recognized as separate species (*Loxodonta cyclotis*), and listed as Critically Endangered, the highest IUCN class for risk of extinction (GOBUSH et al. 2021). The 2016 African Status Report (THOULESS et al. 2016) provides the most recent reliable estimate of the West African population, i.e. 11.489 elephants plus probably an additional 2.886-3.377 from guesses, i.e. maximum around 15.000 elephants across 13 countries. However these numbers still include Savanna Elephants, that besides Forest Elephants in West Africa occur in Mali (Savanna Elephants only) and Nigeria. If the numbers of these two countries are discarded from the above total, ca. 14.000 Forest Elephants are left in 11 countries, with the majority of 9.900 individuals occurring in the transboundary area (WAP complex) between Burkina Faso and Benin. Hence the estimated maximum number of Forest Elephants in the remaining 9 West African countries, including Liberia, in 2016 was ca. 4.000 individuals. On a more regional level, i.e. regarding Liberia and its neighbouring countries, the 2016 Status Report lists 135-155 Forest Elephants left in Sierra Leone, 64-138 in Guinea, and 650-800 in Côte d'Ivoire. However, according to a recent statement by the Ivorian Water and Forestry Ministry, the actual number of Forest Elephants in Côte d'Ivoire today is fewer than 500, and in Guinea they today might be left only in the Ziama Biosphere Reserve, from where a drastic population collapse had been reported in 2017 (SLOANE 2017). For Liberia, the 2016 estimate was ca. 1.550 Forest Elephants, however largely based on guesses and only included one systematic survey from 2009 in Sapo National Park (BOAFO & SANI 2001; THOULESS et al. 2016). The topical results from the December 2018 – January 2021 status survey in this report estimate ca. 350-450 Forest Elephants in NW Forest Block, and, considering the bigger size of

remaining potential elephant habitats in the Southeast, probably a bit larger figure can be expected from the Southeastern Forest Block, so it is assumed that there are at least ca. 1.000 Forest Elephants left in Liberia today. This preliminary conservative estimate needs to be further consolidated, both by follow-up surveys in the NW and the continuation of the elephant status survey in the Southeast, but is already a very good indicator for the country's expectable total population size. In light of the above presented figures for West Africa and Liberia's neighbouring countries, it once again stresses the significance of Liberia as the focus and likely only hope for the survival of the last sustainable Forest Elephant populations in the region. However, although in comparison with most other West African countries Liberia still holds a high number of elephants (i.e. after Burkina Faso and Benin, and probably Ghana, the third- or fourth-highest population of the 12 West African countries that still have Forest Elephants), the number is still small and vulnerable. In addition to the main direct threats that were identified by the status survey, i.e. habitat encroachment and disturbance, HEC and poaching, Liberia's Forest Elephants are also indirectly threatened by the species' fragmentation and slow reproduction rate. Liberia's Forest Elephant population is divided into the two main clusters in the northwestern and southeastern Forest Block, and within these blocks in part split into fragmented and almost isolated small subpopulations. Further, due to their concerning slow population growth rate, African Forest Elephants are extremely vulnerable to any decimation. A study of Forest Elephants in the Central African Republic showed that the doubling time for a Forest Elephant population is almost 60 years, and 41 years excluding human impacts, which is three times higher than that reported for Savanna Elephants (TURKALO et al. 2017). In that view, the loss of only one single individual is a catastrophe, i.e. each single elephant counts. Therefore, the killing of elephants in Liberia must be stopped immediately. It is a serious national and international crime that cannot continue to go unpunished any longer, and any elephant hunter regardless of his social status must be prosecuted and trials seen through to the end. However, it would be delusive to think proper law enforcement only is *the* solution. Although it might be a very effective deterrent for other hunters and progressively reduce/stop hunting, proper law enforcement alone is not good enough, because the killed individual elephant is already dead and lost for the population forever, not only as valuable contribution to the total population size number but also as a reproducing individual ensuring the long-term preservation of the species beyond the individual elephant's own life span. Therefore the prevention of killings in the first place must be considered as of highest priority, and besides law enforcement additional measures for enhanced protection such as regular ranger patrols and awareness campaigns must be taken.

As the status survey showed, killing of elephant in Liberia is not only caused by poaching for ivory, but also happening or prone to happen in the context of Human-Elephant-Conflicts. In general, local people's perception of elephants and attitude towards elephant conservation is ambivalent and largely anthropocentric, meaning that not only the negative feelings reflect human interests (people are scared or loose crops by elephants), but also some of the stated positive feelings. For example, considering elephants useful because they open roads in the

forest, or because of their meat. The dominating topic about elephants however were Human-Elephant-Conflicts, which need to be taken very seriously, also with regard to a successful long-term elephant conservation strategy. They certainly should not be downplayed, but as the study showed it is important to collect consolidated information on the severity of conflicts and the drivers behind. In all cases human encroachment and/or disturbance of elephant habitats were the main reasons for the conflicts. In general it can be said that (i) the closer the settlement and/or farms to the forest and (ii) the higher the human impact inside the elephants' original habitat, the more likely conflicts with elephants will emerge. All HEC-identified communities, even the seriously affected, however also stated that the most damage to their crops is not caused by elephants but other animals such as cane rats, squirrels and monkeys. That elephants are never the most frequent crop raiding species is well-known from other HEC sites across Africa, and according to a number of well quantified studies the range of total crop losses attributable to elephants is quite low (between 0,3–21%, on average 5-10%; overview see HOARE 2000a, HOARE 2000b). Nevertheless, a direct encounter with elephants certainly is a very scary and possibly life-threatening experience, and combined with the feeling of being powerless causing a lot of stress, and thus crop-raiding by elephants very likely is perceived much more dramatic than by any other species (HOARE 2000b), probably with the exception of the buffalo.

The mitigation of those conflicts therefore will be key to gain the local people's support and commitment for elephant conservation. There are tested mechanisms in place (overview see e.g. PARKER et al. 2007; HOARE 2012), including both simple, quickly applicable, low-cost methods (e.g. guarding farms, alarm system, acoustic and olfactory deterrents) as well as more elaborate and costly techniques such as beehive fences. Usually a combination of measures needs to be applied and has to be tested for site-specific effectiveness and implementation feasibility. Especially an early warning system and communal guarding seem to be crucial and very efficient (SITATI & WALPOLE 2006), given also the tendency of elephants to avoid humans, but which seems to be nowhere seriously applied in Liberia yet. Therefore the local communities must also take more responsibility in handling, or better, preventing those conflicts.

In conclusion, the following approach for the mitigation of Human-Elephant-Conflicts in Liberia is recommended:

Step 1: Identification of HEC Hotspots and collection of baseline data on extent, severity, frequency and context of conflicts

Step 2: Introduction of Community-Based Conflict Mitigation (CBCM), i.e. site-specific packages of suitable, cheap, simple, effective short-term measures

Step 3: Implementation of long-term measures (e.g. Land Use Planning, Beehive Fences, Research and systematic HEC Monitoring, Eco-Tourism development)

Step 1 is part of the status survey and completed in the NW Forest Block. Step 2 has been started with a first training of nine HEC-affected communities from six of the identified hotspots and FDA Rangers in February 2021, and will be ongoing activity in ELRECO's immediate next project phase 2021/2022.

5. Recommendations

Based on the findings of the Forest Elephant Status survey in NW Liberia the following next actions are recommended:

1. Immediately address and mitigate Human-Elephant-Conflicts
   - Continue training of HEC affected communities and FDA staff in community-based mitigation measures
   - Establish a pilot site for testing and demonstration of HEC mitigation measures
   - Develop a HEC Rapid Response Strategy

2. Immediately address and stop killing of elephants
   - Strengthen proper end effective enforcement of the National Wildlife Law
   - Ensure regular and well-equipped law enforcement ranger patrols in/around PAs/PPAs
   - Nationwide “Stop killing elephants “ awareness campaign

3. Follow-up elephant population estimate surveys in selected key habitats in the NW

4. Address extensive human impact in elephant habitats
   - Stop all illegal activities such as commercial hunting, unauthorized mining or timber extraction etc. in identified areas
   - Enhance regulations and monitoring of resource use, e.g. by zoning and designation of certain areas for chain-sawing, farming etc. around communities, consultation of communities prior to issuance of resource use licenses by government agencies etc.

5. Speedy gazettement of Foya PPA and Wologizi PPA

6. Continue status survey in and transfer lessons learnt to the Southeastern Forest Block

The identified priority activities require the involvement, action and support of various institutions, including FDA and other government agencies, national and international NGOs, and donors. ELRECO’s immediate next project activities in 2021 will focus on Step 1 and Step 3, and under Step 2 on starting a “Stop killing elephants” campaign in the project’s respective operational areas. Beyond these direct actions, ELRECO is always available to provide expertise, technical and logistic input in order to support, facilitate and speed up other priority actions that are required for effective and sustainable long-term conservation of Liberia’s Forest Elephants.

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