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« Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors? »

Bachelor Thesis presented by

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In the purpose of obtaining a UAS - WS Bachelor's degree in
Natural Resources Management

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Declaration

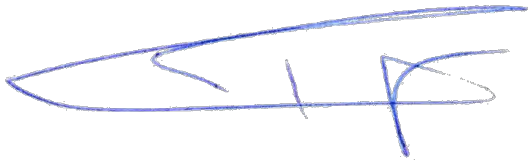
This Bachelor's degree is realized as part of the final examination of the High School of Landscape, Engineering and Architecture of Geneva, in order to obtain the degree of Bachelor HES in Natural Resources Management.

The student assumes responsibility for the work and accepts, if necessary, the confidentiality clause. On the other hand, its conclusions and recommendations, without prejudging their value, do not engage the responsibilities of the author, the hepia representative, the scientific advisor, the experts or hepia.

"I certify that I have done this work alone, without having used other sources than those mentioned in the bibliography. "

Done in Geneva, 24th August 2018

Fabrice BUFFARD



Picture on front page: *Giraffa camelopardalis tippelskirchi*, Katavi National Park.
Author: Arnaud Perotti, 2018.

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Résumé

Cette étude a eu pour objectif d'identifier et pondérer les corrélations entre les facteurs anthropiques et environnementaux avec les indicateurs de la biodiversité que sont la richesse spécifique, l'abondance relative et la distribution des moyens et grands mammifères, ceci dans un écosystème de forêts sèches. L'étude s'est déployée en Tanzanie, dans la région de Katavi, dans la réserve forestière qui abrite la zone apicole de Mlele, gérée par l'Association Apicole d'Inyonga (IBA) et l'ADAP.

Un réplica de suivi de la faune au moyen de pièges photographiques a été conduit entre les mois de juin et août 2018 sur 4 quadrats, couvrant la quasi-totalité des 850km^2 de la zone étudiée. Pour ce faire, deux équipes ont travaillé en parallèle et ont posé des pièges photos tous les 2 km, ceci selon une grille renouvelée peu avant le début de l'étude afin de pouvoir couvrir l'ensemble de la zone.

Bien que de nombreux biais et contraintes aient interféré avec la bonne conduite de cette étude, il a tout de même été possible de collecter un nombre suffisant de données. Les facteurs explicatifs choisis sont anthropiques ou environnementaux. Des analyses en composantes principales ont premièrement été réalisées avec le logiciel R sur les facteurs réponse tels que l'abondance relative et la distribution, puis une régression log-linéaire (Poisson) a été conduite sur la richesse spécifique.

Les résultats ont établi que les facteurs Explicatifs prépondérants qui régissaient les réponses des communautés de mammifères sont l'altitude, la distance aux routes et l'abatage d'arbres. Cette étude a permis également de démontrer que, bien que certains de ces facteurs explicatifs soient naturels, ils étaient toutefois fortement influencés par des facteurs humains – tels que le braconnage, la pêche et l'écorçage des arbres – qui trouvaient place dans des milieux accessibles, en plaine, et loin des routes.

En outre, ces analyses ont permis d'effectuer des recommandations précises pour que les patrouilles soient déployées dans les secteurs à forte biodiversité, ou proche des zones dans lesquelles les activités illégales sont le plus susceptible d'être conduites.

Enfin, une analyse de la viabilité financière de l'association apicole d'Inyonga et de son plan de gestion a été réalisée, ce qui a permis de mettre en lumière les forces et les faiblesses dans son mode de gestion actuel. Un tableau a donc été établi afin de proposer des mesures d'amélioration afin de garantir la pérennité des actions de conservation conduites par de cette association.

Mots clés : Mammals, Camera Trap, Survey, Distribution, RAI, Specific richness, Trophic guild

List of acronyms and abbreviations

ADAP	Association for the Development of Protected areas
AIC	Akaike Information Criterion
ArcGIS	Geographical Information System
MBKZ	Beekeeping Zone
CBNRM	Community-based Natural Resource Management
CCA	Canonical Correspondence Analysis
CF	Capture frequency
CT	Camera Trap
CT days	Camera Trap days
DMCO	Documentation and Monitoring Capitalisation Officer
FR	Forest reserve
GCA	Game controlled area
GLM	Generalised Linear Model
GPS	Global Positioning System
GR	Game Reserve
IBA	Inyonga Beekeeping Association
ILLE	Intelligence-Led Law Enforcement
ILP	Intelligence-Led Policing
MNRT-FBD	Ministry of Natural Resources and Tourism – Forestry and Beekeeping Division
NT	National Park
PA	Protected areas
PCA	Principal Component Analysis
RAI	Relative Abundance Index
TFS	Tanzanian Forest Services
VGS	Village Game Scout

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1 Introduction

1.1 Context

Protected areas remain the cornerstone of biodiversity conservation worldwide. Their impressive development in terms of coverage, extent and numbers is considered to be a success, making them one of the main global categories of land management (Deguignet *et al.*, 2017). But despite their continuous extension, biodiversity globally continues to decline (Pimm *et al.*, 2014).

Monitoring of wildlife populations is therefore key to ensure adaptive and tailored to the need management. Data on wildlife populations, distribution and abundance is essential to ensure a proper understanding of the impact of management on species. Nevertheless, even when data are rigorously collected and available, one question remains: what explains observed varying patterns of densities and distribution of species at a landscape scale?

Environmental and anthropogenic factors are explaining part of these varying patterns; however, the relative importance of every parameter remains difficult to weigh. Anthropogenic factors can either influence these elements both negatively (legal and illegal hunting, habitat degradation, infrastructures development leading to fragmentation, disturbance) or positively (management factors such as law enforcement levels and engineering) but it becomes more difficult when it comes to disentangling the determinant factors.

1.2 Study area

In such a context, the University of Applied Science of Western Switzerland (HES-SO GENEVA), in partnership with the Inyonga Beekeeping Association (IBA) and the Association for the Development of Protected Areas (ADAP), is conducting a regular monitoring of medium and large mammals in the Mlele Beekeeping Zone (MBKZ) (cf. figure 1 & Appendix 1), a community managed protected area located in Mlele District, Katavi Region, Western Tanzania.

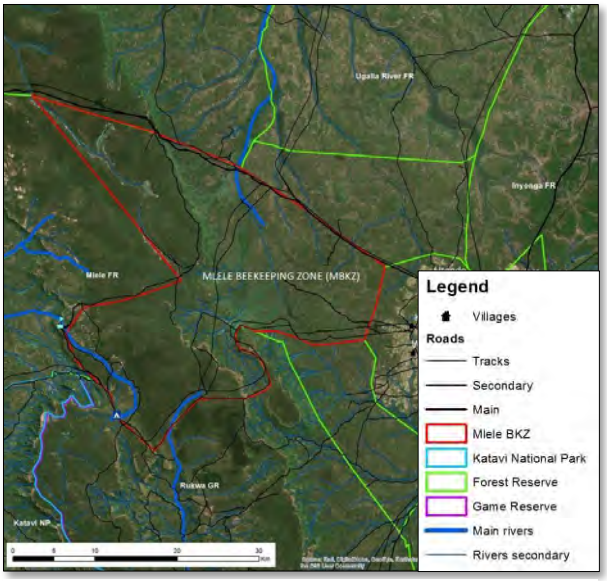


Figure 1: The study area, the Mlele Beekeeping Zone (MBKZ).
Source: Present survey.

The area reaches around 850 km^2 and is located within the Mlele Forest Reserve. To the South, it is bordered by Rukwa Game Reserve and by part of Mlele Forest Reserve. It is outlined to the West by Katavi National Park (NP) and Mlele Forest Reserve (FR) and by Mpanda North-East Forest Reserve to its north boundaries (Hausser 2016).

In 2010, Tanzanian Forest Services (TFS) took over the management responsibilities of the Ministry of Natural Resources and Tourism – Forestry and Beekeeping Division (MNRT-FBD). The Memorandum of Understanding signed by IBA and FBD was initially given IBA a 10-year management right into the MBKZ, also stipulating a mutual desire to develop and reinforce their cooperation for a sustainable use of forest products (such as bee products).

This area is also classified as a Game controlled area (GCA), which means that hunting blocks are allocated for five years to hunting's companies such as The Tanzania Big Game Safari company. It possesses exclusive rights on 14 game concession, upon which the Mlele Game Controlled Area, which overlaps the MBKZ (serial n°28, cf. Appendix 9).

The previous surveys conducted in the MBKZ have first revealed and then confirmed the significant species richness within the Reserve and its importance for medium and large mammals' conservation, which have been counted more than fifty species (Hausser *et al.* 2017).

Nevertheless, the data collected so far has not yet been correlated to the environmental and anthropogenic factors that can explain the varying patterns of distribution and abundance. This is exactly what the proposed research intends to do.

1.3 Statement of the problem and justification

In the above-mentioned context of global decline of wildlife populations in African and Tanzanian PAs, community-based conservation approaches have frequently been proposed as an alternative to the observed failure of state management. One of the weaknesses of this approach is that it frequently fails to consider the evolution of the ecosystem and biodiversity of interest under community management. This is not the case in the Mlele Beekeeping Zone, where a regular monitoring is implemented since 2013 with camera traps.

From a manager's point of view, monitoring of wildlife population is constrained by a trade-off between objectives and cost effectiveness. Large scale monitoring requires means in terms of trained staff, vehicles, fuel, material and time. In addition, available

methods are mostly far too expensive and require a fair amount of technical skills and assistance to be conducted, as it is the case in aerial surveys for example.

When considering the constraints from a community managers' point of view, it seems self-evident that aerial surveys or large-scale foot transects both require far too many financial and human resources.

Camera trapping represents a low-cost alternative, requiring little human resources, and is suitable to ensure regular monitoring of medium and large mammals (Schuette *et al*, 2017). It does not only provide the method piece of information about the diversity of species living in an ecosystem, but also the repetition of the same standardized sampling throughout years can yield interesting information through the analysis of specific quantitative indicators per species such as the number and location of each independent capture-event, the relative abundance and – if enough data is available – the occupancy of species. If the argument developed regarding the interest of having time series data are relevant at a general level, they indeed don't apply to the present work that focused only on one-year data set.

Qualitative analysis of the pictures can as well bring interesting data such as average group sizes, sex-ratio, young / adult ratios, or other behavioural observations.

Since 2013, data collection has been standardised over grids of 100 km^2 and repeated over years. These grids have been reviewed and modified in year 2018 (Mermod, 2018, unpublished) in order to extend the assessed area. This new configuration is now covering 100% of the Mlele BKZ, with a constant number of cameras compared to previous configuration (cf. Appendix 2 for new configuration and Appendix 3 for previous configuration).

This work takes place in this context and aims to correlate the results in terms of occurrence and distribution with both environmental and anthropogenic factors or assumed proxies of these factors.

1.4 Research project

1.4.1 Aims

The aim of this study is to investigate the key determinants of the species richness, distribution and abundance of medium and large mammals in a dry forest ecosystem, such as the existing landscape coverage taking place in the Mlele BKZ.

1.4.2 Significance

Current practices of quota allocations doesn't take into account such data. Adaptive management is needed to ensure performance of conservation whereas currently management is solely evidence-based. As an example, law enforcement activities (e.g. anti-poaching) is not based on scientific data about distribution and abundance of species and therefore might miss the target of conservation species.

The proposed research and its set of new data will allow management to be adapted in the light of the results. This would support an enhancement of management effectiveness of the study area. In addition, time series data will allow to assess the efficiency of the current management as well as to suggest pathways for its improvement.

1.4.3 Hypotheses

The current management process focuses on specific zones within the study area that are easy to access and considered by managers to be of high value for a cohort of herbivore species (floodplains, riverine areas).

1. Anthropological factors are the key determinant of the distribution and abundance, regardless of habitat quality and resource availability (that can be subsequently influenced by the management).
2. The presence of regular research activities is positively influencing distribution and abundance of species in the study area (Piel *et al.* 2015).

2 Material and methods

2.1 Data gathering and analysis methods

2.1.1 Methodology

Camera trapping has been used to collect information on animal's population and trends amongst the whole Mlele BKZ.

The proposed study design was developed by Dr. Fischer and is described in detail in Fischer et al. (2013) and Hausser et al. (2017). In this research we aimed to focus on replicating a cam-trap survey on 4 grids, already sampled between 2013 and 2016. Therefore, a new session of systematic sampling with camera traps was intending to be conducted on those four grids between May and August 2018.

However, due to seasonal constraints, such as an especially late rain season and flooded ground, which lead to high grasses and flooded ground (Mbuga) only one grid (M1) could have been sampled during May and June instead of two as initially planned, leaving M2 unassessed. As the aim of this work is to cover the widest range of habitats in the Mlele BKZ, and according to the previously explained constraints it has been decided, in accordance with the hepia scientific respondent (Hausser, pers.comm., 2018), to use the M2 results from a survey conducted during the rain season between December 2016 and January 2017, this along with the set of data assessed in this work.

The target of two grids sampled at the same time has been reached during the second round of sampling, thus M3 and M5 have been assessed. M4 grid was already dismissed due to its proximity to the size-increasing Inyonga city and the positively correlated thieves or depredations on cameras that occurred in the past years.

Previous grid configuration (10km x 10km to constitute 5 squares of 100km2) (Fischer et *al*, 2013) that was used for previous studies, has been changed in 2018 (Mermod 2018, unpublished) in order to cover the whole Mlele BKZ, maintaining the same number of cameras than before. A grid of 2km x 2km has been applied to the whole region, one camera being set up at each intersection (CT points) for a theoretical duration of 3 weeks (21 days), uninterruptedly 24hrs/day, replicating there the previous survey methodology conducted in the MBKZ. The total number of CT engaged was 144.

As positions of cameras have been theoretically set-up on ArcGIS using the grid previously described, this might have led to changes once the target point reached in the field. As an example, point M5-01 was in the middle of high grasses (Mbuga), without any tree in the surroundings to fix the camera on. Therefore, and following the

methodology (Fischer et *al*, 2013), a margin of +/- 100m around theoretical points has then be been used to optimise the capture's opportunities (cf. Appendix 4 for effective CT positions). Thus, and as far as possible, cameras have been placed near tracks, dawns, footprints or any other sign of mammal inhabiting the surrounding. It is to notice that the large knowledge of the VGS enable them to recognise quickly which sign belongs to which animal, as well as indicating how recent it was (to one-day accuracy).

2.1.2 Material

Camera traps are automatically triggered cameras based on motion or infrared sensors. Research applications include studies of niche ecology, detection of rare species, estimation of population size, species richness, as well as research on habitat use and occupation within human-built structures (Rovero & Zimmermann 2016, O'Connell et al. 2011). Camera traps applications are numerous, and the same dataset can be treated in many ways.

Therefore, applications directly depend on the objectives of the survey. As the regular survey conducted in Mlele is targeting the whole community of medium and large mammals, the sampling design aims to capture the maximum number of species. The 2x2 km grid cell is a compromise in order to capture large free ranging species moving over large landscape such as the elephant or the eland, as well as small territorial species like the cohort of small carnivores.

The model of camera used in this survey is Bushnell Trophy Cam HD No-Glow 14MP, Brown Trail (cf. figure 2). 72 cameras have been committed to this survey (2x36), so that 2 grids could be sampled at the same time. Using a sole and unique type of camera has guaranteed that grids' assessments can be compared as catching probability remains stable among species, whereas mixing types of cameras would have led to several bias in interpretations.

Figure 2 : Buschnell Trophy Cam HD Agressor No-Glow, Brown Trail. 72 cameras have been simultaneously used for this survey.
Source : Cameraland Sandton

Pictures were saved on 2GB SD cards, allowing an average of more than 6'500 pictures to be stored before the cards are full and the camera-trap to becomes inefficient. This storing space was largely sufficient considering the previous studies, were a maximum of around 4'500 pictures could be taken within the 21 days assessment's period. However, such high number of pictures indicates, amongst photo processing, that something went wrong during the

field's camera set-up, such as high grasses moving with the wind and leading to erroneous events, or the camera fixed on a too thin tree, moving also as the wind is blowing.

This risk was therefore reduced by choosing trees big enough not to move with the wind, but tight enough to allow the 2 meters rope to encircle it. Likewise, high grasses were weather burned before the placement of the camera or in case they were too green to catch fire they were cut with a machete.

Cameras have been positioned to avoid as much as possible the shade produced by the sun moving along the day to lead to useless pictures, or wrong events.

Finally, cameras have be secured with the help of a steel chain and a lock to prevent them from being stolen by poachers, beekeepers or illegal tree cutters, as has unfortunately been regularly encountered in previous studies.

GPS have been used to reach the theoretical cross points. The camera trap' coordinates were entered into GPS each day in the morning and short before departure, using North and East coordinates. These coordinates were extracted previously to the field work from the above-mentioned ArcGIS layer (Mermod 2018, unpublished), this through its respective attribute table, and converted into .csv Excel database to be printed and brought to field.

There were two models of GPS used during this survey: Garmin *e*Trex 10 and Garmin GPSMAP 64s (cf. figures 3 and 4).

Figure 3 : GPS Garmin *e*Trex 10 was used by one team. Source: buy.garmin.com

Figure 4 : GPS Garmin GPSMAP 64s has been used by the second team. Source: buy.garmin.com

2.1.3 Qualified team of VGS

The team was composed by 6 VGS, specially formed and trained on Camera Trapping technics. One of the VGS also served as a cook. This pattern allowed the constitution of two teams of three people each, working simultaneously on the same grid, which reduced significantly the time allotted to the CT set-up and recover. One driver has been committed as well to this field's work to ensure people and equipment transports. Thus, 6 days were necessary to set 72 camera traps on M3 and M5 grids, the same timeframe was necessary to recover them.

2.1.4 Data gathering

Through the methodology, team and material described above, pictures of animals crossing the sensor detection field of the cameras have been taken by camera-traps, each time with a set of three pictures, this to maximise the chances of a correct identification while assessing them once data collected.

Indicators gathered in this work (i.e. explanatory factors), such as listed by Hocking *et al*. (2006) and defined in accordance with Yves Hausser (pers.comm., 2018), can be either quantitative or qualitative data.

In addition to these, additional piece of information pertaining to these explanatory factors have been systematically collected through the field's work, assessing, amongst other drivers, illegals anthropogenic strains and pressures on the woodland cover of the Mlele BKZ. Unfortunately, no hunting quotas could have been collected, despite several attempts made by mail to the Tanzanian Big Game Safari.

2.2 Quantitative data

2.2.1 Distances from CT sites to explanatory factors

At first, the layer containing the CT sites had to be converted into UTM (Universal Transverse Mercator) to match other layers' geographical projections. This has been done by: right-click on the CT sites layer, click data, choose Export data, save the new set into UTM.

Then, distances to explanatory factors (see chapter 2.4.4 for the complete list) to CT sites have been extracted one by one from this new UTM ArcGIS layer through ArcToolbox, using the (Analyst) Proximate function.

Inlet entities is the new UTM layer of the CT sites, whereas explanatory factors were used as proximate entities.

After having created additional layers on ArcGIS to transpose data gathered during the fields' work (anthropogenic strains such as poaching activities, tree cutting, tree debarking, or even new Beekeepers camps' discovery), the same procedure was applied as above.

Results have been consequently added to the ArcGIS attributary table of the CT sites layer and have been exported to .csv Excel file.

2.2.2 Altitude of CT sites

The MBKZ is ranging in height from 1'000m to 1'400m, offering various ecological niche to mammals.

The altitude of each CT site has been extracted using the ArcGIS ArcToolbox, Spatial Analyst Tools, Values extraction to points. This created a new layer (automatically in UTM projection), that has been exported to a .csv Excel file.

2.2.3 Landscape cover

In order to extract the landscape cover surrounding each CT site, right-click on the new UTM CT sites layer, then click on Juncture and relations, Join. This allows to join data points to a layer based on a mutual spatial location.

Then, choose Join_Output as a new layer, select Point-Point as a classification of entities, and set the result to be stored in a new set of layers.

Again, this new set of data has been exported to a .csv Excel file.

2.2.4 Exporting data from ArcGIS to .csv Excel file.

This has been done by using the ArcGIS ArcToolbox, Conversion tools, by selecting Table to Excel function.

The results had to be ordered into rows and columns so that they could be suitable for further R analysis (cf. chapter 3.3 for R analysis).

2.2.5 Research effort

The research effort is calculated by adding the sum of CT operations' hours, divided by 24 hours. The result shows a number of days during which the CT effectively worked, expressed in Camera Trap Days (hereafter, the CT days).

This indicator can also inform manager on the completeness of the fauna sampling (sampling effort) as it is directly correlated to the number of individuals sampled (Gotelli and Colwell, 2001).

It could also have been described with an accumulation curve, which represents the number of species captured by camera traps, in accordance with the sampling effort. The accumulation curve will rise quickly at the beginning to reach an asymptote as increasingly rare taxa are added to the community assessed.

This SAC is naturally partially depending on site-specific features as well as detection rate for each species. However, when the asymptote is reached, the sampling is considered as exhaustive (Rovero *et al*., 2016). This SAC has not been produced in this work.

2.2.6 Lepus software

It is a software, developed in collaboration with hepia school, which aims to facilitate the seizure of raw data pertaining to a camera trap survey. It allows individuals events to be sorted amongst any human analysis.

Results can be extracted and used for several purposes, such as creating GIS layers for distribution, RAI or species richness. It allows also the extractions of statistics pertaining to the set of data seized, such as research effort or graphs representing the number of individual events, this in a simple and user-friendly manner.

This software has been used in this survey for the extraction of statistics and for maps production.

2.2.7 Independent capture event

It may happen for individuals or groups to stay in front of a CT for a few minutes. Thus, in order not to overestimate the detection rate of these, and in case animals cannot be identified at an individual level (through patterns, scars, horns, etc…), sets of pictures of a group or an individual of a species will be counted as one independent capture event, if pictures are not separated by 30 minutes (O'Brien *et al*., 2003; Bowkett *et al,* 2008).

This avoids that multiple images of the same animal posing in front of CT to be scored as multiple events.

2.2.8 Detection probability

It is the probability for an individual to be captured at least once during K capture's occasion of a survey campaign. It varies across time, space and species (Rovero et Zimmermann, 2016).

The difference in the detection probability between each of the species can be influenced by the size of the home range: the larger, the more the species will be pictured by a large number of CT, whereas a species with a small home range will activate less cameras, but with a higher number of independent events per CT (Harmsen *et al*. 2010). It can also be influenced by the travel speed, the body size or the behaviour proper to each species, or by the detection angle of the camera used (Harmsen *et al*. 2010).

Due to time constraints and for processing purposes, the detection probability has been considered for this study as uniform between assessed mammals.

2.2.9 Species richness

Species richness refers to the number of species in an area and/or a biological community. Systematic samplings over the same area and over time enable the assessment of this value.

The detection probabilities, which directly influence the results, are directly correlated to the grid size, which should be neither too small nor too big, in order to cross habitats' patterns of the largest number of species (Fischer *et al*., 2013).

This component is considered to address at least one of the environmental or anthropogenic factors listed in chapter 2.3. This response has been assessed using R software.

2.2.10 Distribution

The independent capture events have been used as an indicator of the presence/absence of mammals' taxa and allowed the production of a distribution map through ArcGIS for each species assessed.

Lepus software offers the possibility to produce Distribution maps automatically once the data were entered in the database. Once exported to ArcGIS, the map's key had to be created, and its scale added.

This component is considered to respond to at least one of the environmental or anthropogenic factors above listed. This response has been assessed thanks to R.

2.2.11 Naïve occupancy

One of the basic descriptor of the species' presence is the naïve occupancy. It represents the proportion of CT sites that pictured one species, this relative to the total number of CTs that have been deployed. It then indicated the species' presence throughout the area sampled. The result is expressed in percentage.

However, such naïve descriptors might understate the real occupancy of a species as a non-capture doesn't necessarily mean a real absence but might arise from a non-detection (MacKenzie *et al.* 2012, MacKenzie *et al.* 2009, MacKenzie *et al.* 2006). As a matter of fact, magnitude of ecological niche, body size, habitat use and behaviour would influence the detectability as well (Rovero *et al*. 2016, Harmsen *et al*. 2010). These biases have not been taken into account in this survey and therefore results comparison over time and space might lead to erroneous conclusions (Sollmann *et al*. 2013).

2.2.12 Relative Abundance Index (RAI)

The Relative Abundance Index shows how common a species is relative to the other species (evenness) within a delineated area and/or biological community. It also reflects the capture success rate. However, as for the naïve occupancy, it may underestimate their real abundancy as this descriptor doesn't consider the specific detection rate of each species (Sollmann *et al.* 2013). The RAI used here is the camera trapping rate (O'Brien 2011), which informed on the population abundancy.

This has been calculated by dividing number of independent pictures by the research (sampling) effort, and by multiplying the result by 100 (i.e. events per 100 days of camera trapping) (Jenks *et al*. 2011**,** Rovero *et al*. 2014**,** Cusack *et al*. 2015). Results were extracted from Lepus software.

Once more, Lepus software was able to create ArcGIS compatible Maps at a species level, accordingly to their index of relative abundance.

This component is likely to respond to at least one of the environmental or anthropogenic factors previously listed. This response has been characterised using R software.

2.3 Qualitative data

Complementary information on environmental and anthropogenic factors have been collected, either through direct observations or through the study of available grey literature (ADAP and IBA project reports, previous Bachelor and Master thesis conducted in the region, records from the judiciary).

2.3.1 Management factors

Conservation of Mlele Beekeeping Zone is highly dependent on actions that will be taken in the coming months to achieve IBA's financial sustainability. A Management Plan (MP) has been established in 2016 (Hausser 2016) and provides ADAP and IBA with critical points to achieve this objective. Therefore, it sounded worthfully to assess the management team on the completeness of the various points that compose this MP, the difficulties encountered in reaching them and their proposal to do so.

This was also a way to highlight the strengths and weaknesses of the actual ADAP and IBA Management.

Therefore, semi directed interviews with the DMCO of IBA, Mr Twinzi (Documentation and Monitoring Capitalisation Officer), the Manager of IBA (Mr. Kanumba), the Project supervisor of ADAP (Mr. Halfani) and the Head of the VGS (Mr. Malenbeka) – all located in Inyonga, Mlele district – have been conducted to assess firstly their knowledge regarding main objectives and duty listed in the MP. Then, to appraise how they consider their implementation feasible, how they can be implemented, and at which timescale. Finally, to gather and compare their ideas and opinion on struggling issues that are facing – or soon to be faced – both ADAP and IBA institutions, focusing on IBA sustainability.

A focus was also made on villagers' awareness of what is actually doing IBA in the MBKZ, their acceptance of it, and any potential economic spinoffs that could prevent illegal misuse of the forest's products, this to confirm or invalidate hypotheses 2.

Interview template was developed by the current MP and addressed subjects it takes over. Furthermore, some specific questions for each interviewee were added at the end of the interview, allowing the interviewee to express a general appreciation or opinion on subjects directly correlated to their position and role within IBA or ADAP.

2.3.2 Anthropogenic factors

Pression factors such as illegal logging, poaching activities, illegal fishing or illegal tree debarking have been systematically assessed during the field work. Furthermore, since 2017, patrols are monitored by means of GPS, and therefore have been assessed as well, this to investigate any response of the animals' communities (cf. Appendix 10).

Furthermore, correlation between explanatory factors only have been assessed (cf. chapter 3.3.1).

2.3.3 Environmental factors

Land cover for the whole Mlele BKZ is available through ArcGIS layers (Mermod 2018, unpublished). Four major landcovers have been retained for the use of this analyse: Closed woodland, Open woodland, Wooded Grassland and Open Grassland.

Response of the mammal's community to the landcover and the altitude has been assessed through their distribution and abundancy, using R software.

2.4 Data mining

2.4.1 Camera trapping data

At sampling completion (i.e. 21 days), SD cards were collected and recovered. Data has been uploaded to a laptop, and taxa identified to the species level, this based on existing field guides, such as the Kingdon Field Guide to African Mammals second edition (Kingdon 2015), or such as A Field Guide to the Larger Mammals of Tanzania (Princeton Field Guides) (Foley *et al.*, 2014). Also, a list of predictive mammals in the area has been established in order to facilitate their identification (cf. Appendix 13). Observations were entered in Lepus database along with the traditional excel sheet method.

The use of a specific software for pictures treatment developed in collaboration with hepia named Lepus has been done as a test, assessing the time saved compared to traditional method using an excel sheet to report information. Both methods were used during this survey.

In addition, direct field's observations, which have been systematically reported on a field book during the fieldwork, were added to the results belonging to the closest CT point.

2.4.2 Maps production trough ArcGIS

From that database, data has been imported in ArcGIS 10.5 to generate distribution's maps per species, using independent capture events, as explained previously.

Lepus software has been used to do so, as this function as been implemented throughout July 2018.

Similarly to distribution's maps, the RAI for each species was extracted from Lepus and imported into ArcGIS 10.5 to produce maps (cf. Appendices 7 & 8).

2.4.3 Characterisation of the Cameras traps through "R"

At first, each Camera trap has been independently characterised, using the "R" packages listed in the next chapter. This process provided the study with a clear assessment of

the homogeneity of the sampling process in terms of “explanatory factors”, which are detailed in the next chapter.

2.4.4 Correlations between explanatory factors and Response factors through “R”

“Explanatory factors” have been defined using the existing literature (Hockings *et al.* 2006) in collaboration with the hepia scientific respondent (Hausser, pers.comm., 2018). The complete list of assessed factors is the following:

- distance to main roads
- distance to Beekeeper’s camps
- distance to Inyonga village
- distance to permanent water (temporary water stations have been ignored, such as water holes, dried up river arms, etc…)
- distance to ADAP camp
- distance to illegal activities such as (all accordingly to this survey’s field’s observations, along with VGS reports, but when GPS points were stated):
    - timbering
    - tree debarking (to produce traditional beekeeping’s hive)
    - poaching activities
    - fishing activities
- altitude
- landscape coverage
- number of patrols

“Response factors”, which are the core of this study, are listed below:

- species richness
- distribution
- abundancy

Then, correlations between these explanatory and response factors have been proceeded, weighted, in order to disentangle the predominant one(s). However, when facing a multivariate analysis (which is the case in this study), one of the major problem is to get a comprehensive visualisation of the correlations when it exceeds three dimensions.

In such data sets that are containing many variables, it is common for some variables to be correlated (overlapping). The explanation comes from the fact that more than one variable can assess the same driving principle governing the behaviour of the system. Consequently, correlation might also inform about redundancy in the set of data.

Principal component analysis (PCA) is a rigorous statistical method that replaces a group of correlated variables with a single new one. This new set of variables is called principal component. The aim of a PCA analysis is to summarize the set of data contained in a continuous (i.e. quantitative) multivariate data by reducing their dimensionality, this without any loss of important information (Kassambara 2018)

An R package is an extension of R software containing data sets and specific R functions to solve specific questions. Dedicated “Factoextra” (Kassambara & Mundt, 2017) and “FactoMineR” packages (Le *et al*., 2008) have enabled proceeding to this PCA analysis. “FactoMineR” package was used strictly for data analysis, whereas “Factoextra”, based on “ggplot2” package (Wickham 2016), has allowed visualisation of the results into charts and graphs.

After having run a PCA analysis, the most important row/column elements have been highlighted using:

- Their cos2 values corresponding to their quality of representation on the factor map
- Their contributions to the definition of the principal dimensions.
    - Eigenvalues have been used to determine the number of principal components to retain after PCA (Kaiser 1961). This is commonly used as a cut-off point for which PCs are retained. This holds true only when the data are standardized. Eigenvalues can also help limiting the number of components to that number that accounts for a certain fraction of the total variance.
- The Scree Plot, which is the plot of eigenvalues ordered from the largest to the smallest. The number of components is determined at the point, beyond which the remaining eigenvalues are all relatively small and of comparable size (Jollife 2002, Peres-Neto, Jackson, and Somers 2005).

Then, “Vegan” package (Oksanen *et al*. 2012) was used to perform a Constrained Correspondence Analysis (CCA) (a.k.a. Canonical Correspondence Analysis) and a Redundancy Analysis.

Finally, using the above-mentioned R packages, the correlations between the "explanatory factors" and the "response factors" – by taking them one by one – have been processed through R software. The functions used for this data mining will be explained along in the chapter 3.3, as they are used.

2.5 Constraints

2.5.1 Seasonality

Field constrains such as an especially late rain season and partially flooded ground in the open flood plains have complicated the detection of indices of mammal's activities around the area sampled.

For the same reasons M2 grid couldn't be assessed, although initially planned, as hardly -to not- accessible by car as the ground was flooded. Considering also the fact that there the grass was still green and very high (more than 2 meters), it couldn't be burned. This situation would have led to poor quality sets of pictures, making no identification possible except maybe for large animals, which again would have led to misinterpretation of the species' richness and of the local biodiversity.

2.5.2 SD cards

For the first round of M1 grid survey, many of SD cards had not been correctly emptied before being engaged on the field. Thus, as recovering the SD cards and the data they contained, it has been noticed that pictures from the previous surveys of October 2017 were numerous. This resulted in a reduction in the storage-capacity of new pictures and led some cameras to stop working before the 21 days initially scheduled as their SD card were full.

Moreover, some SD cards were having the same number, whereas each must have a single ID, this to avoid confusion while assessing their data. Pushing the investigation further and checking all the SD cards available, until quadruplets in numbers have been found. This explains the difficulties encountered when reconciling the Protocol with the effective data contained in each SD card. A clearance has then been operated and each SD card has been reattributed a new and single and unique number to avoid further complications for this specific survey and for the future ones.

2.5.3 Batteries

While preparing the batteries for the second round of camera trapping on M3 and M5, it has been noticed that most of them couldn't be recharged properly, and that their number differed from the list of assets by more than a hundred, out of 800. Again, this led to a

reduced -to no- pictures collected in some sites. The age of the batteries can explain partially their weaknesses, however, it has been noticed that their storage was made in bags instead of having been properly stocked in the dedicated wooden box, mixing the batteries and allowing false-contact between them, reducing considerably their capacity, or provocating short circuit.

In addition, it has been brought to light that the way of removing batteries from the Bushnell cameras was usually done using a knife, considerably affecting their sealing and tightness at first, but also increasing the risk of further misfunction.

Finally, chargers used to recharge the batteries are from two models and seemed to indicate a full-charge point at different levels, which has led to use partially or uncharged batteries while engaging the cameras. No battery tester was available to avoid such disappointments.

Therefore, a few CT stopped working (i.e. 29 cameras) before the 21 days cycle, and some did not work and gathered no data at all (i.e. 12 cameras). 41 out of 144, it is around 29% of the overall cameras that didn't worked properly. On its own, this point has reduced the global operational time, impacting the research effort and returning false low diversity indices.

2.5.4 Camera set-up

Sensitivity of the cameras' captors for M3 and M5 grids has been set-up to high, accordingly to instructions given by Dr Fischer to VGS' head in 2017. Furthermore, camera set-up has been rushed for M5 and especially for M3 grid, placing the camera too high and pointing straight or up, instead of pointing the ground.

Combined with points 2.5.1 and 2.5.3, this has significantly reduced the overall operational time of some cameras, impacting again the research effort, returning also false low diversity indices, and involved a huge pictures' processing time.

Thus, loads of pictures were useless, as a high number of pictures were taken activated by the sun, the leaves or grass movements (cf. table 4). This issue was however highly predictable as already encountered in other studies as well (Cusack *et al*. 2013).

2.5.5 Lepus software

Lepus software (© Laurent Hubert - Version 4.0.1 build 19062018 beta, followed by releases v.4.1, v.4.2), which has been specially developed to simplify pictures' processing and counting, and which is still under development, is a web-based software.

Although it is suitable for a use with a responsive internet connection, this study took place in Inyonga's village were the use of internet can only be considered through a mobile phone tethering 3G connection (4G is not available in Inyonga). This can be costly and/or time consuming considering the huge amount of data gathered upstream.

For instance, the process of uploading the 9.8GB for the grid M1 took 3 days, on a nine hour per day basis.

2.5.6 Bugs in the permit delivery process

Last but not least, although the Tanzanian Commission for Science and Technology (COSTECH) was contacted in due time (i.e. 3 months before departure, April 2018) to get the permit of penetrating the Mlele Forest Reserve were this study took place, and despite numerous mails remained unanswered, and after having faced various and still unexplained delays, the permit was finally delivered on the 24th of July.

That is more than 30 days after the planned calendar and led to serious delays in the field's part's implementation of this survey. By chance, a solution could be found thanks to an allotted delay for the result's remittance of this study, which was granted by Head of Natural Resources Management branch, M. Patrice Prunier.

3 Results

3.1 Quantitative data

3.1.1 Research effort

The table below expresses the research effort, expressed in Camera Trap days (CT days), for the four assessed grids, i.e. M1, M2, M3 and M5 (cf. table 1).

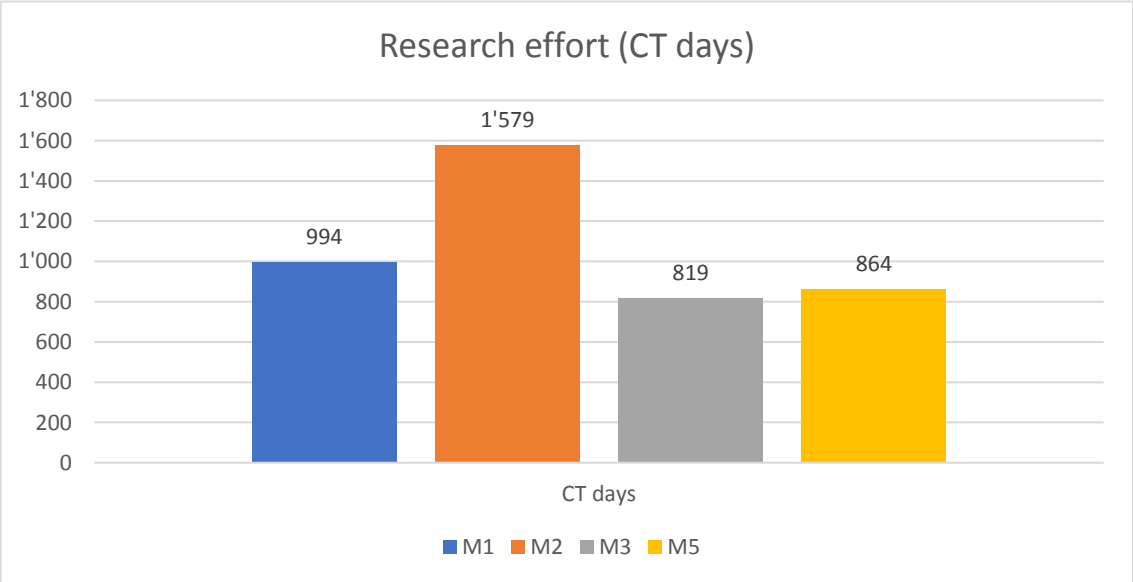
For **M1** Grid (session 2018), 33 cameras have been working and accounting 18'596 pictures, of which 1'017 independent events, summing 30 taxa, for a duration of **994 Camera-days effort** (CT days).

For **M2** Grid (session Winter 2016-2017), 31 cameras have been working and accounting 5'433 pictures, of which 993 independent events, summing 38 taxa, for a duration of **1'579 Camera-days effort** (CT days).

For **M3** Grid (session 2018), 34 cameras have been working and accounting 45'455 pictures, of which 885 independent events, summing 31 taxa, for a duration of **819 Camera-days effort** (CT days).

For **M5** Grid (session 2018), 36 cameras have been working and accounting 58'031 pictures, of which 1373 independent events, summing 32 taxa, for a duration of **864 Camera-days effort** (CT days).

Table 1: Graph showing the Research effort per Grid in terms of CT days.
Source: Present survey (data for M2 Grid are extracted from a previous survey conducted in 2016-2017 during the rain season)

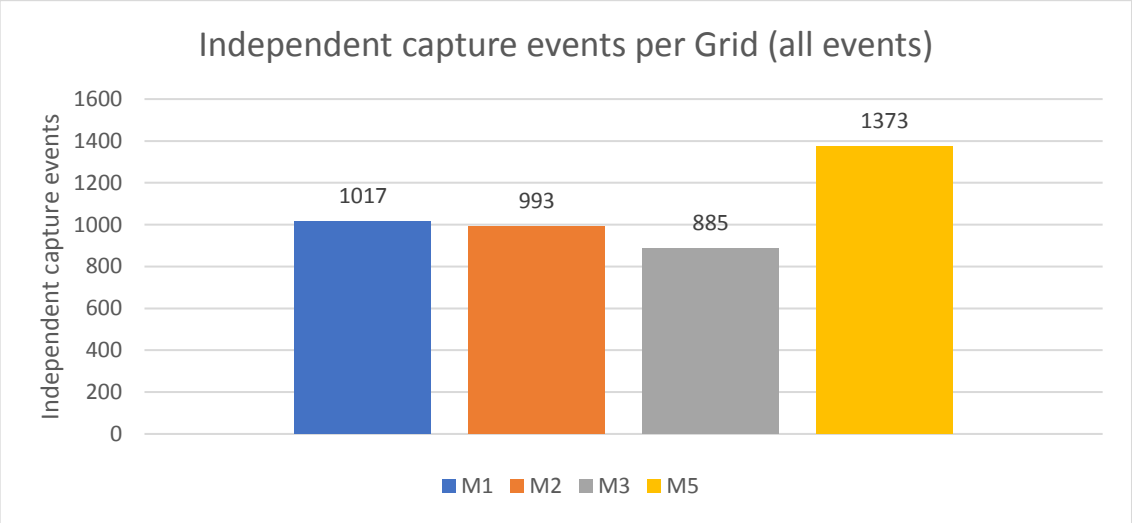


3.1.2 Independent capture events

Below are shown the results for the Independent capture events per species and per assessed grid (i.e. M1, M2, M3 and M5). This graph (cf. table 2) shows all the independent events, even ones that pictured none animals, i.e. accounting for wrong events.

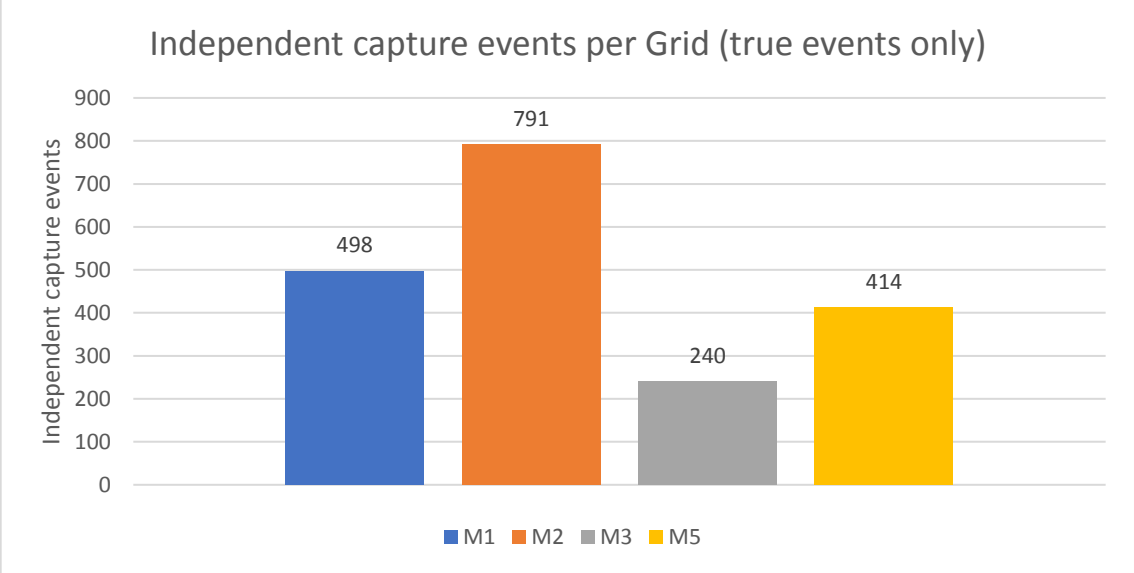
However, birds (such as *Bucorvus leadbeateri or Numida Meleagris*) and Reptiles (such as *Varanus albigularis*) have been removed from these results as they don't belong to Mammals Class and therefore are outside the scope of this study.

Table 2: Independent capture events per Grid assessed (all events, even ones without animals pictured).
Source: Present survey



Results with Independent capture events, of which have been removed the wrong events and kept only events that pictured animals, are expressed in the chart below (cf. table3).

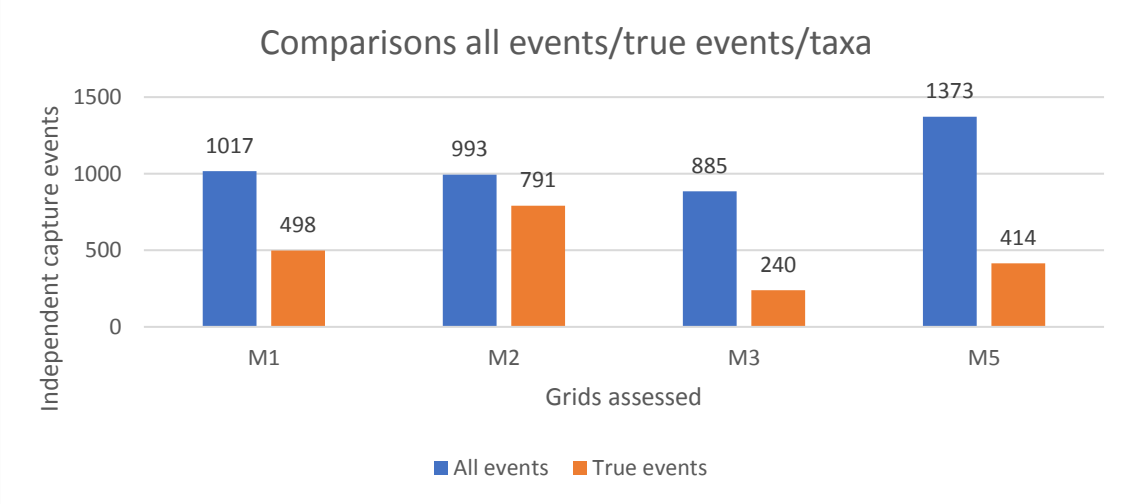
Table 3: Independent capture events per Grid assessed (true events only).
Source: Present survey



At an area level (i.e. whole Mlele BKZ, with results discarding M4 Grids), the number of independent capture events has been 4'268 (accounting for wrong events), of which **1'947 were true events** (CT pictured animals).

At this stage, it can be worthwhile comparing those results with each other (cf. table 4), adding the number of taxa detected, this to highlight the utility of setting-up cameras correctly to avoid loads of wrong events (cf. chapter 2.5.3 and 2.5.4).

Table 4: Comparisons at a Grid level between all Independent capture events, true events (which pictured animals).



3.1.3 Species richness

The 4 graphics below (cf. tables 5 to 8) show the Species richness within each CT site assessed in 2018 (or during 2016-2017 for M2 Grid). Furthermore, a map showing the Species Richness over the MBKZ has been produced and can be seen in Appendix 12.

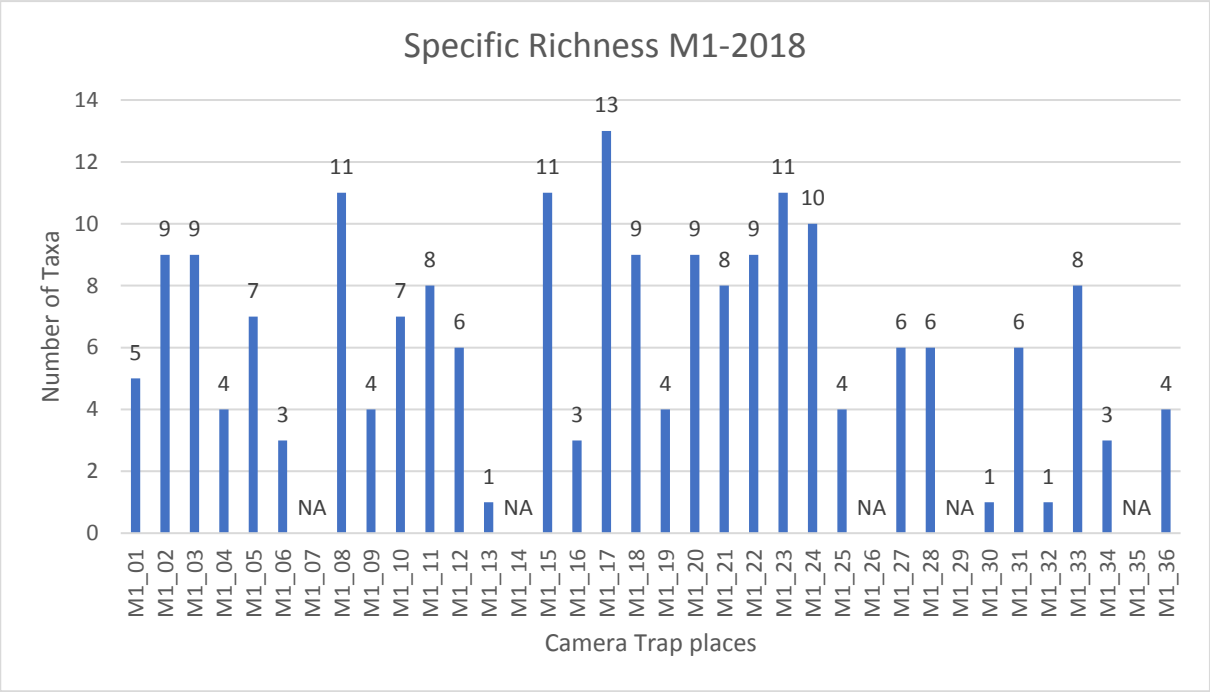
Again, birds (such as *Bucorvus leadbeateri or Numida Meleagris*) and Reptiles (such as *Varanus albigularis*) have been removed from these results as they don't belong to Mammals Class and are therefore outside the scope of this study.

Cameras that didn't work have therefore not recorded pictures, which is different from cameras that worked but did not pictured animals. In order not to confuse the former with the later, the symbol "NA" (for not available) has been used to express cameras that did not worked, whereas a "0" means the camera was considered fully functional but did not pictured any animal.

Cameras with "NA" are here represented but have not been considered for further statistical process so that their results do not interfere with a real "0".

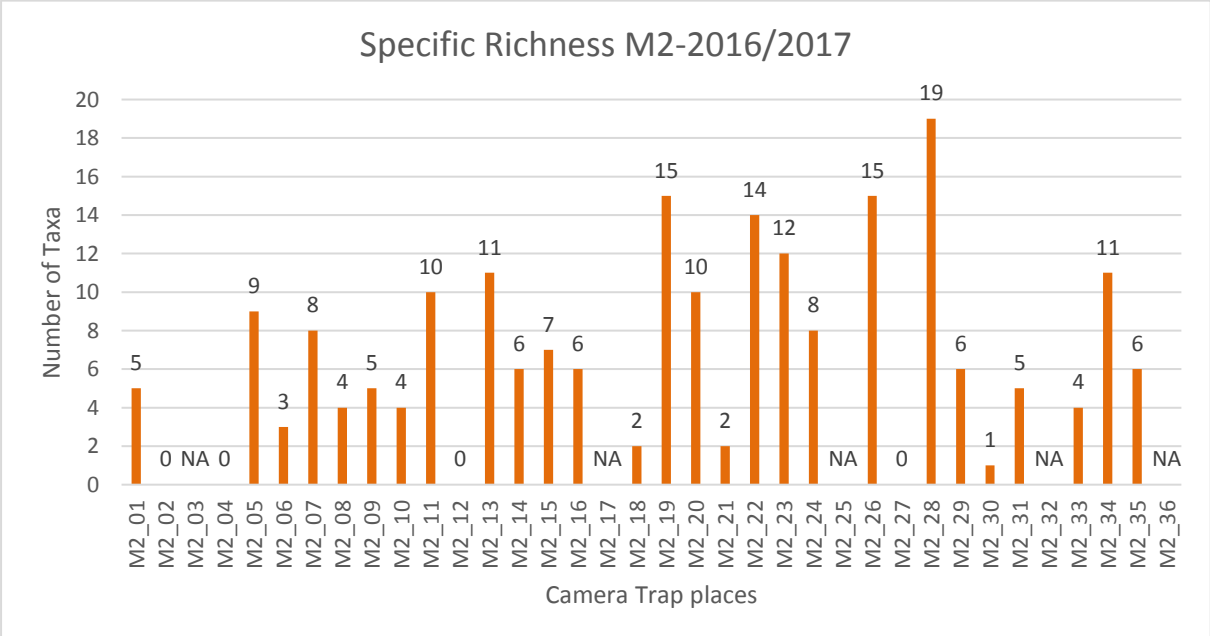
At **M1** grid level (cf. table 5), the specific richness shows **30 species**, amongst which the *Panthera pardus* (VU) and the *Giraffa camelopardalis* (VU).

Table 5: Specific Richness within each CT site belonging to M1 Grid, assessed during July 2018. Source: Present survey



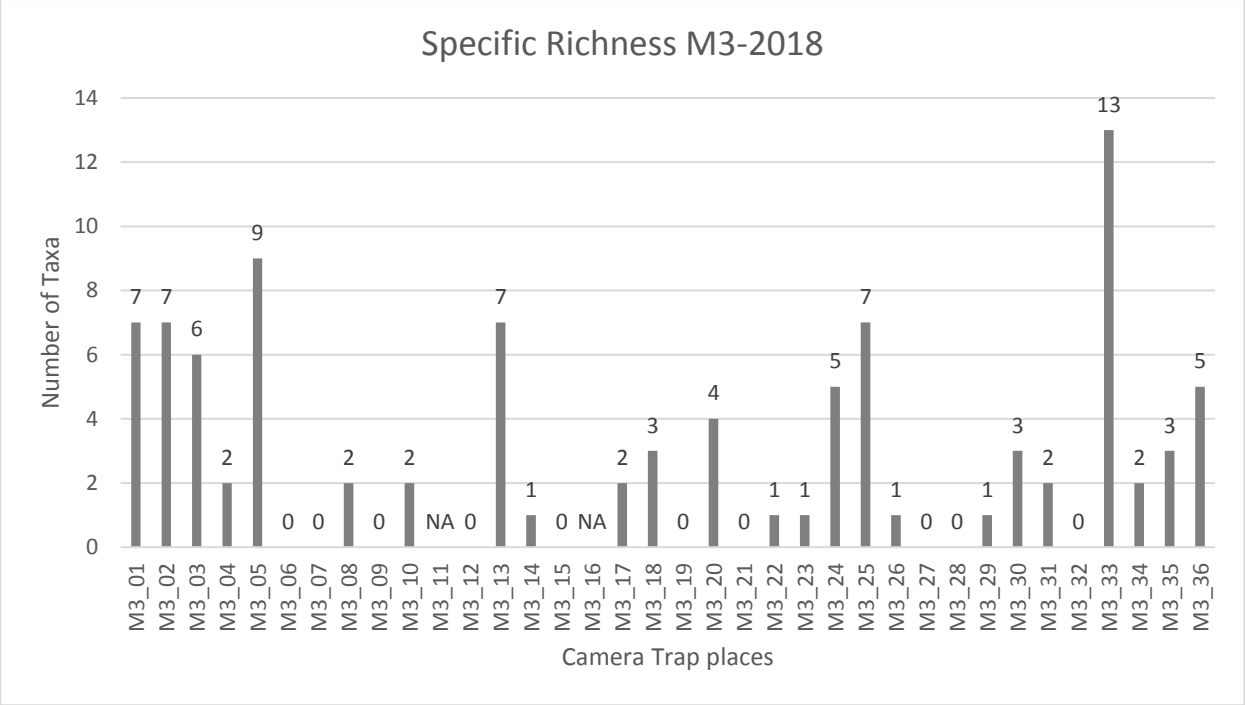
At **M2** grid level (cf. table 6), the specific richness reaches **37 species**, amongst which the *Panthera pardus* (VU), the *Giraffa camelopardalis* (VU) and *Smutsia* temminckii (VU)

Table 6: Specific Richness within each CT site belonging to M2 Grid, assessed during December 2016 and January 2017.
Source of data: Previous survey. Chart: Present survey



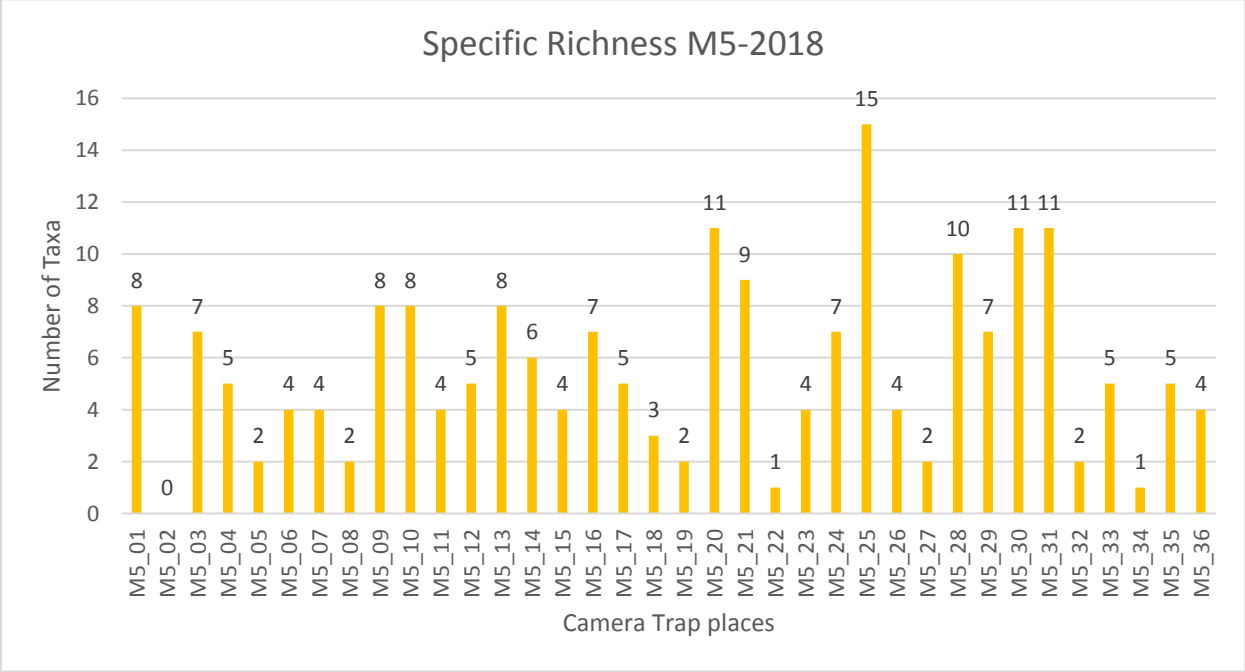
At **M3** grid level (cf. table 7), the specific richness shows **31 species**, amongst which the *Panthera pardus* (VU) and the *Giraffa camelopardalis* (VU).

Table 7: Specific Richness within each CT site belonging to M3 Grid, assessed during July 2018. Source: Present survey



At **M5** grid level (cf. table 8), the specific richness shows **32 species**, amongst which the *Panthera pardus* (VU) and the *Giraffa camelopardalis* (VU).

Table 8: Specific Richness within each CT site belonging to M5 Grid, assessed during July 2018. Source: Present survey



At an **area level** (i.e. MBKZ), the overall Specific richness sums **40 species** of mammals. The table below (cf. table 9) shows the name of the specific richness present in the assessed area, along with their UICN status (IUCN 2018).

Table 9: Specific Richness for the whole Mlele Beekeeping zone along with their UICN status. Source: Present survey.

	Taxa	M1	M2	M3	M5	UICN Status*
1	*Alcelaphus buselaphus lichtensteinii*	X	X	X	X	LC
2	*Bdeogale crassicauda*	X	X	X	X	LC
3	*Cercopithecus mitis moloneyi*	X				LC
4	*Chlorocebus pygerythrus*		X	X	X	LC
5	*Civettictis civetta*	X	X	X	X	LC
6	*Cricetomys gambianus*	X	X	X	X	LC
7	*Crocuta crocuta*	X	X	X	X	LC
8	*Damaliscus lunatus*		X	X		LC
9	*Equus quagga bohemi*	X	X	X	X	NT
10	*Galago senegalensis*	X		X	X	LC
11	*Galago sp.*	X				*n/a*
12	*Genetta angolensis*	X	X	X	X	LC
13	*Genetta maculata*	X	X	X	X	LC
14	*Genetta sp.*	X	X	X	X	*n/a*
15	*Giraffa camelopardalis tipelskirshi*	X	X	X	X	VU
16	*Hippotragus equinus*	X	X	X	X	LC
17	*Hippotragus niger*	X	X	X	X	LC
18	*Hystrix africaeaustralis*	X	X	X	X	LC
19	*Ichneumia albicauda*				X	LC
20	*Lepus sp.*	X	X	X	X	*n/a*
21	*Mellivora capensis*	X	X	X	X	LC
22	*Mongoose sp.*		X			*n/a*
23	*Mungos mungo*	X	X		X	LC
24	*Orycteropus afer*	X	X	X	X	LC
25	*Otolemur crassicaudatus*		X	X	X	LC
26	*Panthera pardus*	X	X	X	X	VU
27	*Papio cynocephalus*	X	X	X	X	LC
28	*Pedetes surdaster*	X	X	X	X	LC
29	*Petrodromus tetradactylus*	X	X	X	X	LC
30	*Phacochoerus africanus*	X	X	X	X	LC
31	*Philantomba monticola*		X			LC
32	*Potamochoerus larvatus*	X	X	X	X	LC
33	*Raphicerus sharpei*	X	X	X	X	LC
34	*Rhynchogale melleri*		X			LC
35	*Smutsia temminckii*		X			VU
36	*Sylvicapra grimmia*	X	X	X	X	LC
37	*Syncerus caffer*		X			LC
38	*Taurotragus oryx*			X	X	LC
39	*Tragelaphus scriptus*	X	X	X	X	LC
40	*Tragelaphus strepsiceros*	X	X	X	X	LC
X = Present in the assessed grid						
* The IUCN Red List of Threatened Species. Version 2018-1. <www.iucnredlist.org>. Downloaded on 12 August 2018.						

The survey managed to catch 40 species out of 50 recorded in previous research (Hausser *et al*. 2017). This is demonstrating a good performance of this survey.

3.1.4 Distribution

Distributions maps have been produced for all mammals present in the assessed area, using the Independent Capture Event index. Maps are available in Appendix 7.

3.1.5 Naïve Occupancy

Naïve occupancy has been appraised, at first at a Grid level (cf. tables 10 to 13)

Table 10: Naïve occupancy for the M1 Grid.
Source: Present survey

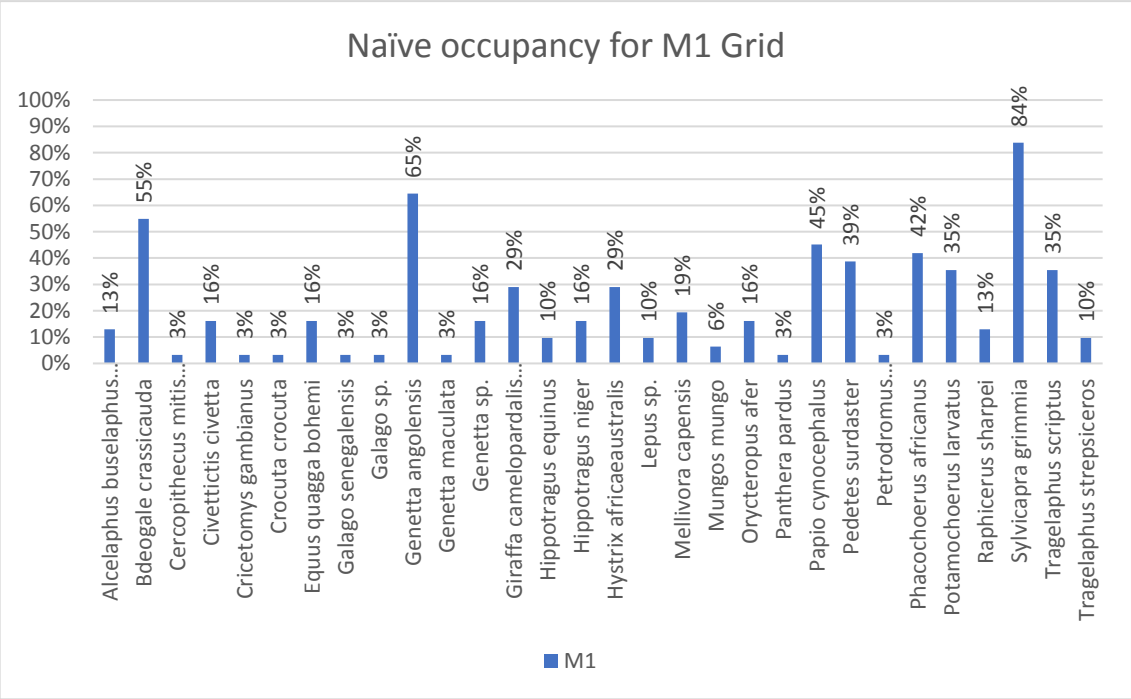


Table 11: Naïve occupancy for M2 Grid.
Source: Data from previous survey. Chart: Present survey

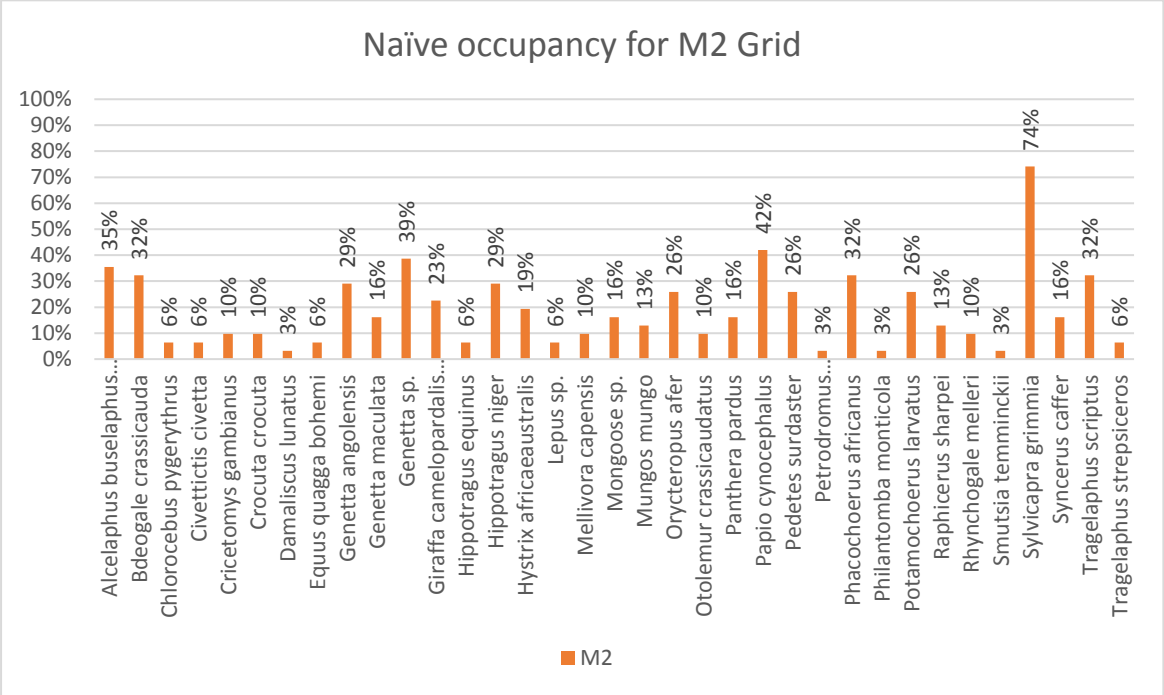


Table 12: Naïve occupancy for M3 Grid.
Source: Present survey

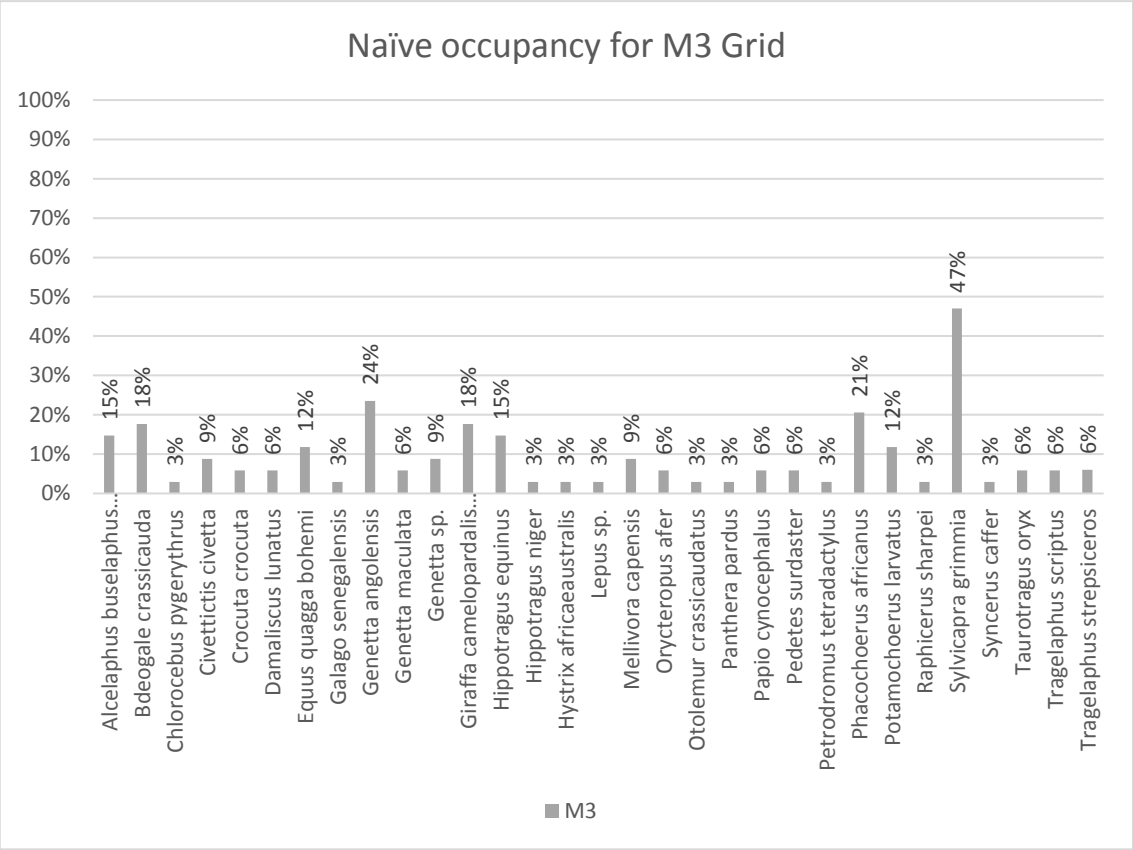
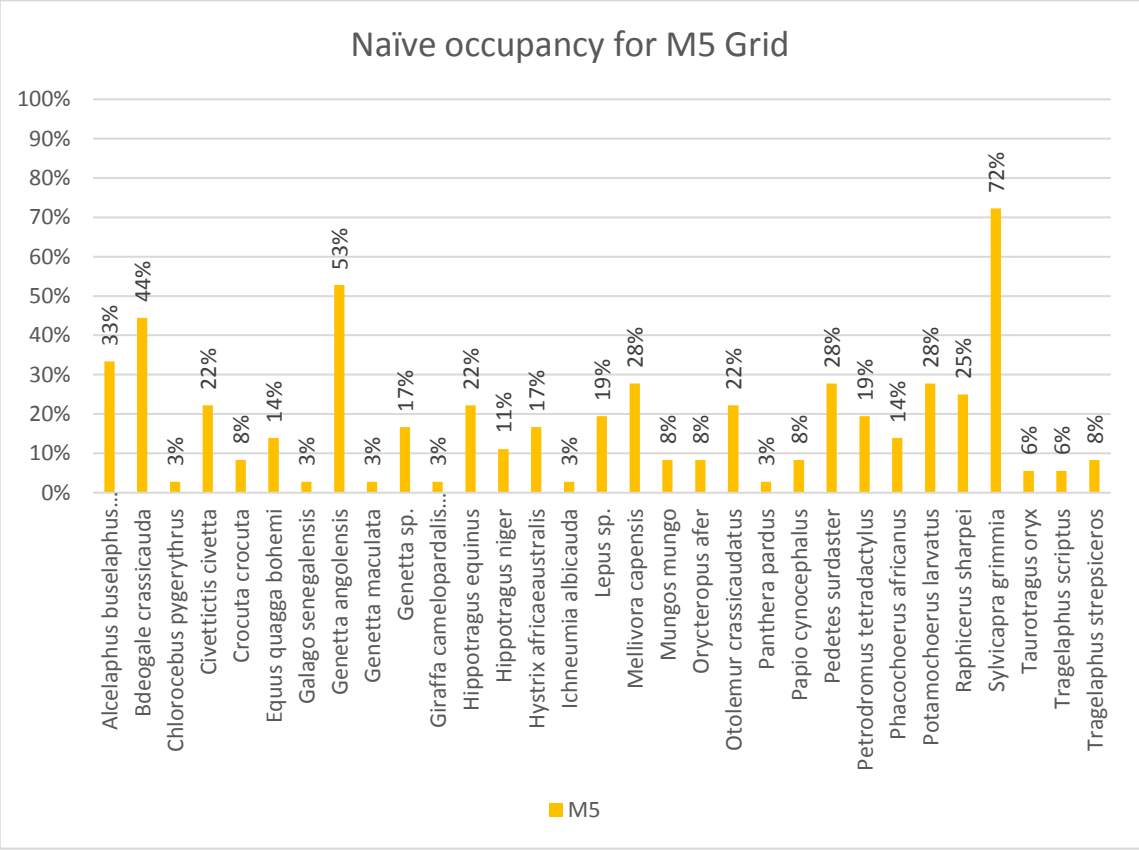
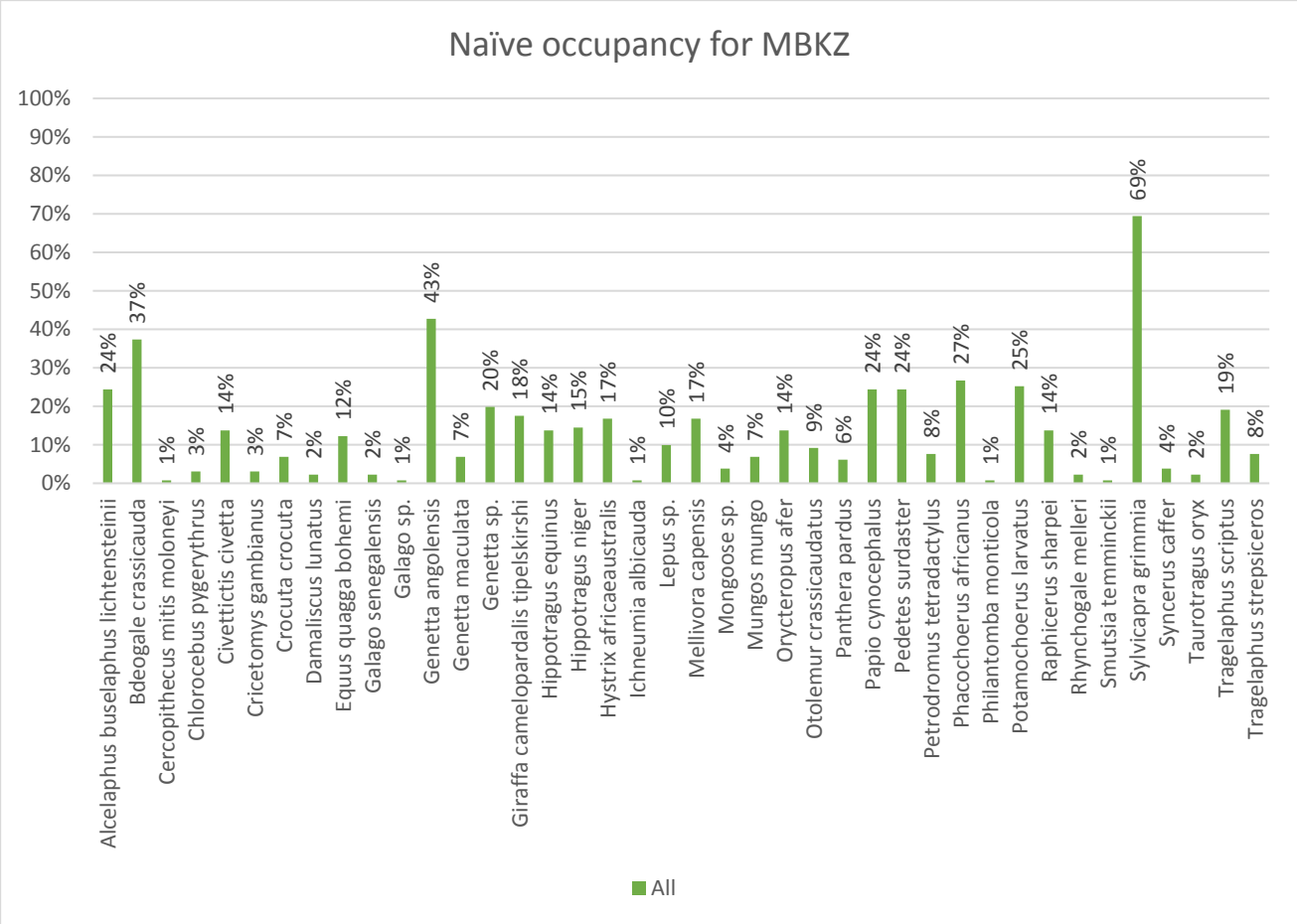


Table 13: Naïve occupancy for M5 Grid.
Source: Present survey



Then the overall naïve occupancy for the MBKZ has been also assessed (cf. table 14)

Table 14: Naïve occupancy at an area level.
Source: Present survey.



3.1.6 Relative Abundance Index (RAI)

The results for the RAI are presented in table 15 to 18, per grid. Birds (such as *Bucorvus leadbeateri or Numida Meleagris*) and Reptiles (such as *Varanus albigularis*) have been removed from these results as they don't belong to Mammals Class, therefore outside the scope of this study.

Maps of the RAI for each mammal have been produced and are available under Appendix 8.

Table 15: Relative Abundance Index for M1 Grid, assessed in July 2018.
Source: Present survey

Table 16: Relative Abundance Index for M2 Grid, assessed during the 2016-2017 campaign. Source: Present survey

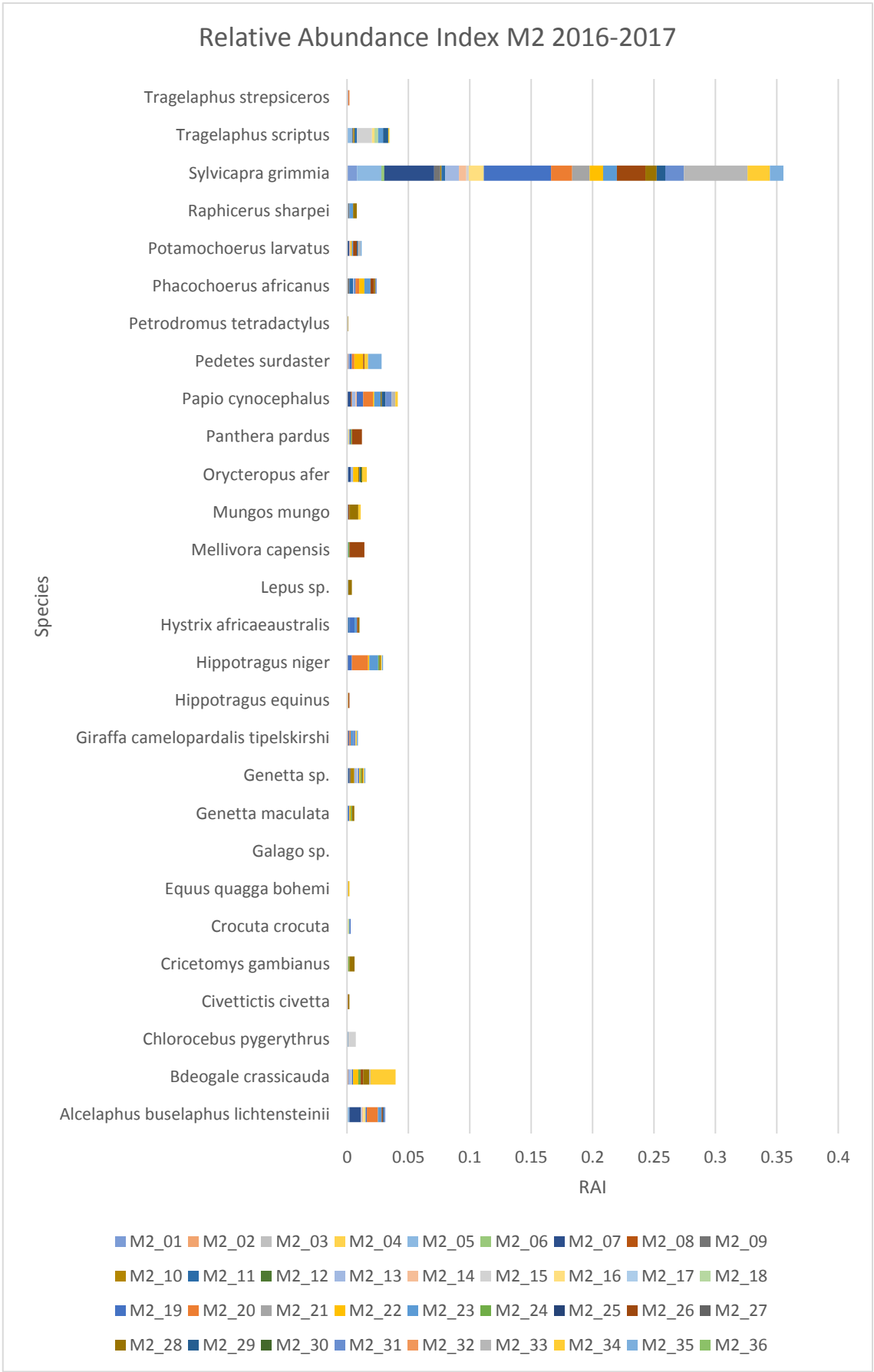


Table 17: Relative Abundance Index for M3 Grid, assessed in July 2018.
Source: Present survey.

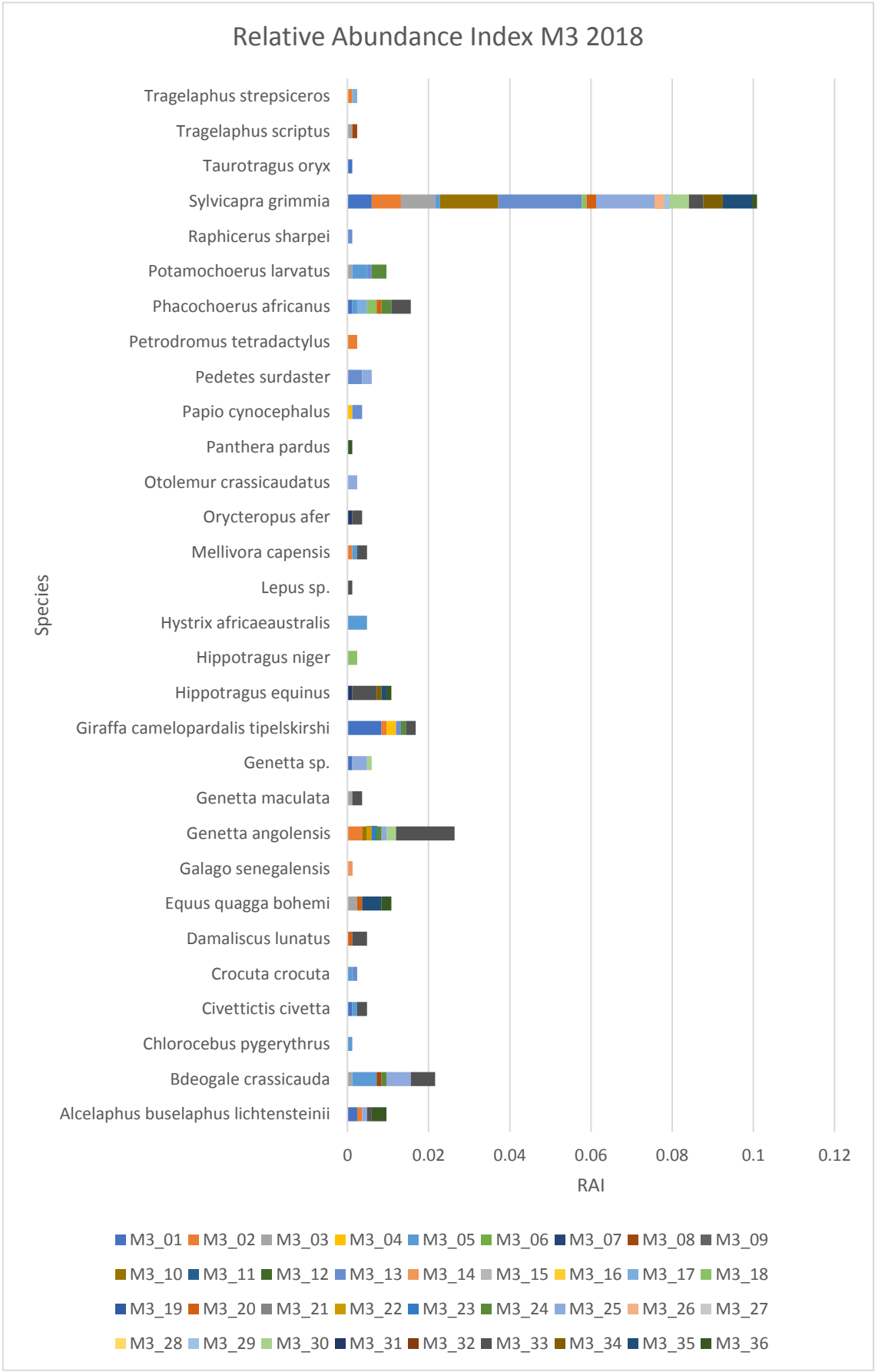


Table 18: Relative Abundance Index for M5 Grid, assessed in July 2018.

3.2 Qualitative Data

3.2.1 Anthropogenic factors

During the fieldwork of the survey, it hasn't been noticed any high number of **illegal logging**. This information has been confirmed by Dr. Urs Bloesch (pers.comm., 2018), who conducted a tree survey through transects in the Mlele BKZ during July 2018. All sites that presented such illegal anthropogenic strains were visually old. Some sites though displayed though ancient activities of woodworking as old wooden planks were still littering the ground.

Nevertheless, near the M3-03 CT point (coordinates WGS84 06.53826/031.73821), as we were walking to set-up cameras, sound of an axe hitting a tree has retained VGSs' attention. They decided to attend on the spot, as quietly as possible, in order to catch and penalise the offender. In situ, a big tree was found cut, an illegal logger with an axe in his hands, ready to harvest the little honey encase in the trunk.

VGSs did what they are empowered to, that is taking his equipment and its identity, then seriously warned him of being brought to court if he was cought a second time. The offender flew after this (cf. figures 5 and 6).

Figure 5: Illegal logger being caught by VGS, its data record.
Source: Present survey.

Figure 6: Big tree littering the ground after being cut by illegal logger.
Source: Present survey.

The picture is more mixed when it comes to consider the **tree debarking** (cf. figures 7 & 8). This activity is supporting the traditional beehives manufacturing as bark is used for their conception. Though it is illegal in a forest reserve, this activity takes place in various areas within the Mlele BKZ, as it could have been reported during the field's work.

Figure 7: A girdled bark of tree for making bark hive.
Source: Present survey

Figure 8: Aged traces of tree debarking, barks still strewing on the ground.
Source: Present survey.

Traditional beehive manufacture is to be considered of a high impact on the woodland cover of the Mlele District (FBD 2000). This practice is also expressly prohibited by the law since 2002 (United Republic of Tanzania 2002). Though IBA Manager (Kanumba, pers.comm. 2018) assesses the percentage of modern beehives at around 50% of the overall beehives stock, only few modern ones have been mapped during the field work. For the record, the figures are around 10% of modern “box” beehive versus 90% of traditional or log hives (Hausser, pers.comm. 2018).

Furthermore, a stockage space hosting tens of traditional beehives (cf. figure 9 & 10) has been discovered. VGS decided to pinpoint the coordinates on GPS so that they will come later patrolling, expecting then an even bigger storage of traditional beehives (harvest period was not over at that time) to destruct them, as well as catching some of the offenders.

Figure 9: Storage place for tens of traditional beehives.
Source: Present survey

Figure 10: Traditional beehive, foregone by a beekeeper.
Source: Present survey.

With regards to the **poaching activities**, and despite law enforcement being accomplished in recent years, the activity is still taking place within the Mlele BKZ. For instance, while reaching M5-08 CT point, we encountered not less than three mammal's traps (cf. figures 11 & 12).

According to the applicable law, they have been destroyed in situ, and ropes used to catch large mammals have been set on fire.

Figure 11: Trap for big mammal's poaching.
Source: Present survey

Figure 12: Trap for illegal poaching activities.
Source: Present survey.

Few meters away, bones of a large ungulate, certainly a *Syncerus caffer*, have been found, fleshless, with blade marks on them (cf. figures 13 & 14). According to Mr. Malembeka (pers.comm., 2018), they were only a few days old and were the result of illegal poaching activities having taken place nearby.

Figure 14: Bones discovered nearby the mammal's trap.
Source: Present survey.

Figure 13: Hoof of a *Syncerus caffer* discovered nearby the traps.
Source: Present survey

In addition, big fires had been started nearby this area to bend the animals into poachers' trap (Malembeka, VGS' head, pers.comm., 2018).

These data have been digitalised and added to the respective GIS layer.

Finally, **patrols activities**, which occurs twice in a month, have been digitalised through ArcGIS layer and been reckoned, considering 1km range from each CT site. The result is shown hereunder (cf. tables 19 to 22).

It is worth noticing that some of the sites were patrolled up to five times during the 2017-2018 seasons, whereas most of them had no patrol activities during the same period.

Table 19: Number of patrol activities within M1 Grid, given a 1km range around each CT site. Source: Present survey.

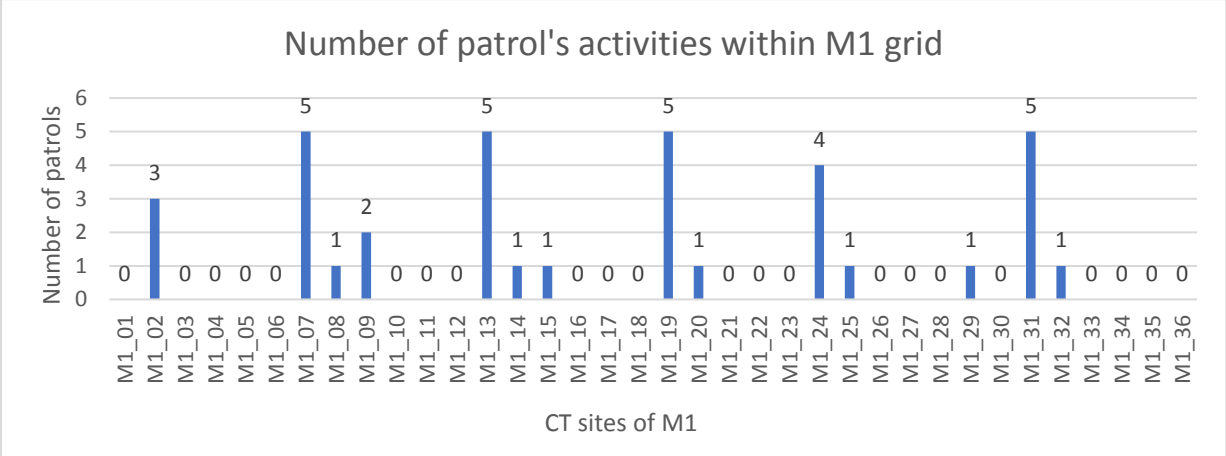


Table 20: Number of patrol activities within M2 Grid, given a 1km range around each CT site. Source: Present survey

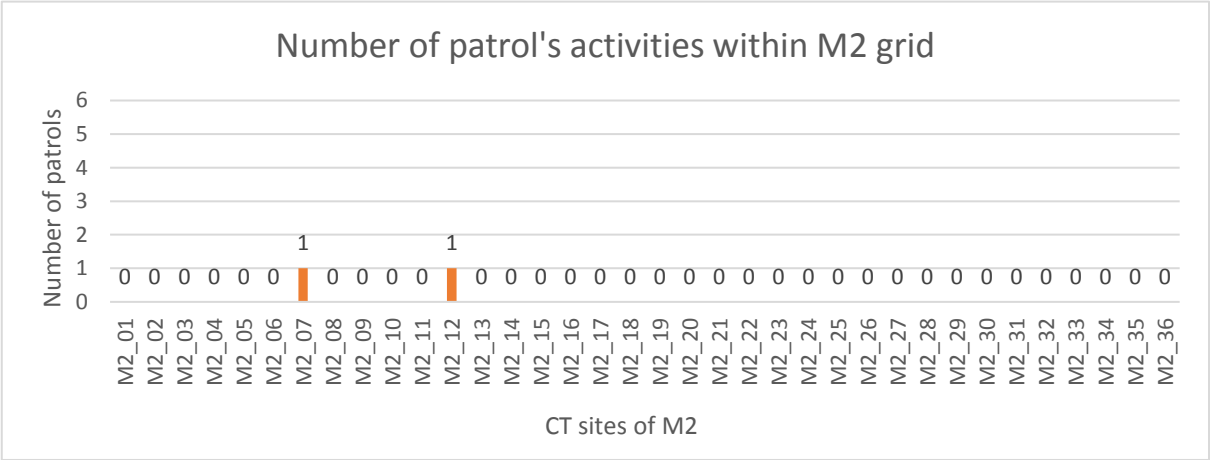


Table 21: Number of patrols activities within M3 Grid, given a 1km range around each CT site. Source: Present survey

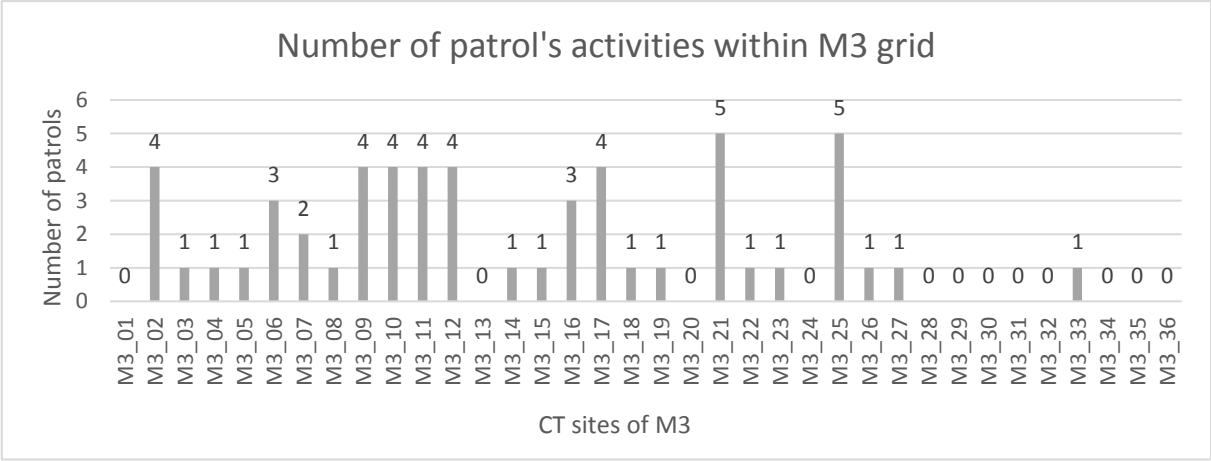
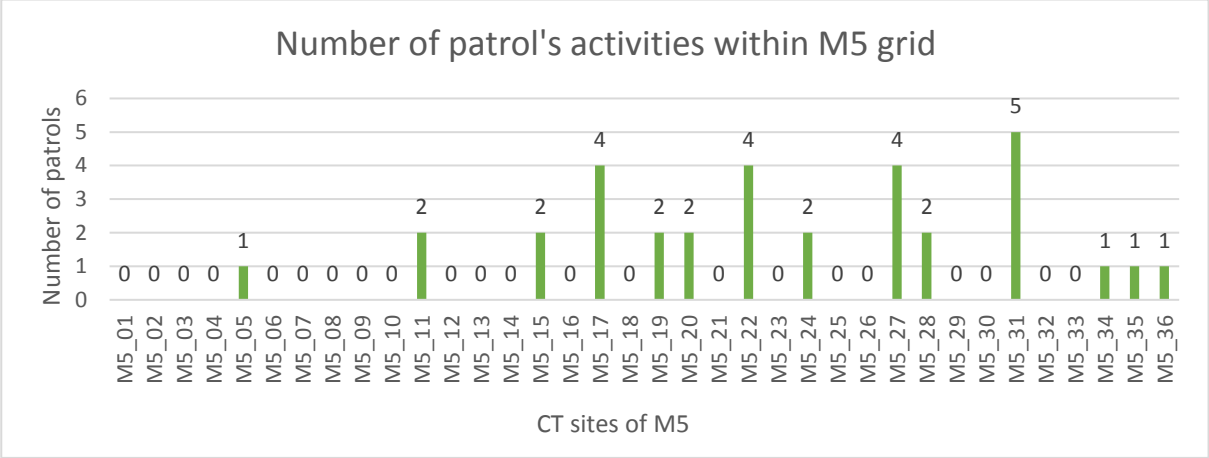


Table 22: Number of patrols activities within M5 Grid, given a 1km range around each CT site. Source: Present survey



Thus, the results above show that, considering the whole Mlele BKZ, only 37.5% of the area has been covered by patrols (54 CT sites), leaving 62.5% (90 CT sites) without being patrolled at all (cf. Appendix 10 for Patrols map).

3.2.2 Environmental factors

According to the PCA analysis constraints, qualitative data such as the landscape covering has been converted into continuous quantitative values, attributing a “1” when the camera matches the corresponding landscape, a “0” when the landscape was not corresponding to the effective camera trapping site. This has been done through excel, using “*as if*” function on database previously extracted from ArcGIS layer.

In the same way, patrols activities have been outnumbered, given a 1 km range around each CT site, and a “1” value added each time the patrols were beyond this distance from a CT site. This has been done using ArcGIS as well.

It is here to precise that observations extracted from patrols reports from 2017-2018 have been integrated into this digitalisation and analysis, but only those which reported events along with their GPS points could be really embedded. Other reported events, as interesting as they can be, couldn’t be considered as their location was too vague to be mapped.

3.2.3 Management factors

The survey was made up of 26 questions (cf. Appendix 5), some of them were targeting some specific tasks and therefore have not been asked to all interviewee. The talks last between 50 to 80 minutes. Several queries came deliberately twice, in diverted forms, so as to evaluate the truthfulness of their statement and cross-checking answers given

by the decision-makers. Each question hinted steps already adopted or those that will be, asking who, by what means and at which timeframe they could be implemented.

- Questions 1, 2 and 3 assessed the relationship between TFS and IBA (furthermore with ADAP).
- Question 4 focused on a potential threat that degazetting could weigh in on MBKZ.
- Questions 5, 10, 24 and 26 targeted ADAP and IBA's communication, popularisation and outreach towards the villagers as well as for some government staff on the tasks that are conducted in the MBKZ, this at various decision-making levels.
- Question 6 and 17b aimed to evaluate how clear the scheme of benefits' redistribution is (if existing) to villagers.
- Question 7 was to switch the topic, though answers brought unexpected interesting point of view.
- Question 8, 16 and 22 were focusing on VGS' various duties, appraising organisation, training, means, results and effectiveness. Furthermore, question 22 introduced the Intelligence-led Law Enforcement topic and assessed their experience (if any) and the feasibility of its implementation.
- Question 9 which was to analyse both Central Committee (CC) proactiveness towards income redistribution and fine collecting through offenders.
- Questions 11 and 12 were respectively at an IBA Management team and Mlele District council decision-making levels, taking up some points of question 8 and question 9.
- Question 13 assessed the inter-sectorial linkage, means used and objectives planned to set-up/maintain such linkage.
- Question 14 was to check answers to questions regarding VGS' organisation and assessed the very separation of powers.
- Questions 15, 20 and 25 were evaluating the financial sustainability of IBA institution, trainings beekeepers are receiving, means committed to these topics. Question 25 intends more specifically to gather personal appreciation from the interviewees.
- Question 17 was to change the topic, analysing roads maintenance.
- Question 18 inquired on Human Resources training, highlighting potential lack of employee's formation.
- Question 19 was directly to check if the interviewee were in touch with key objectives that are set-up in the MP since 2016.

- Questions 20b and 23 were about fine collecting and the scheme of income redistribution.
- Question 21 targeted the legal hunting and the Wildlife Division potential process of income's redistribution.

Interviews have been conducted on four decision-makers of both ADAP (one member), IBA (two members) and VGS staff (one member), recorded through a mobile phone, then reported on Word. They can be read in full, anonymised, in Appendix 6.

It appears firstly on the analysis of these questionnaires that the level of knowledge of the MP is somehow limited. Moreover, the very person in charge of its implementation were doubting about its relevance.

3.3 Data mining

As explained in chapter 2.4, data mining has been done using R software and several packages dedicated to such assessments. These packages have been loaded from CRAN server in April 2018.

```
# Installing R packages

install.packages("factoextra")

install.packages("FactoMineR")

install.packages("ade4")

install.packages("vegan")

# Charging R packages

library(factoextra)

library(FactoMineR)

library(vegan)
library(ade4)
```

3.3.1 Characterisation of the Cameras traps through "R" software

Firstly, data had to be prepared in order enable R to process them. Thus, the following points have been executed (Kassambara 2018):

- First row has been used to name the columns, which represent variables. In our case, the "explanatory" and the "response factors".
- The first column has served for raw names. In our case, each CT sites
- Duplicates names have been avoided

- No blank space has been left in names, underscore sign (_) has been used instead
- No special symbols has been used, such as: ?, $, *, +, #, (,), -, /, }, {, |, >, <
- Variables are not beginning with a number, but a letter
- Blank rows have been removed from the database
- NA (for not available) has replaced any missing value
- Exported file from excel has been using the .txt format (tab-delimited text file)
- No comments have been left on the .txt file

Then, the following R codes have been subsequently used:

In R terminology, the imported data is to be qualified as a class of data.frame.

```
# Import data into R (.txt tab separated values)

Database <- read.delim("d:/qualif_ct.txt", row.names=1, h=T)
```

The next code allowed a preliminary visual audit of the assessed data to check if there are missing values or errors.

```
# Read the loaded .txt file

Database
```

As the initial data set in Excel was inverted (explanatory and response factors), this step was to be made before launching the data mining, to meet above recommendations.

```
# Transpose data frame, i.e. rows becoming columns

Database.t <- t(Database)
```

PCA analysis conducted with R is sensitive to scale variations (Kassambara 2018). It means that distances, which are represented by largely wider ranges compared to other variables, had to be standardised. These lines below allowed variables to be compared by avoiding some of them to become dominant just because of their large measurement.

```
# Mitigate scales variations through natural logarithm (base e), a.k.a (ln), for distances variables only

Database.dist <- Database.t[,c(1:5,12:15)]
Database.ln <- log1p(Database.dist)
```

```
# Combine data
Datafull.ln <- cbind(Database.ln,Database.t[,c(6:11)])
```

For the same reasons as for distance, altitude values had to be mitigated as well, this to avoid an over-representation on PCA analysis. This has been done by dividing their value per 1'000.

```
# Mitigate scales variations for altitude (/1000)
Database.a <- Database.t[,6]
Altitude <- Database.a/1000

# Combine data
Database.full <- cbind(Datafull.ln[,-10], Altitude)
```

The next step was to visualise the results on the PCA analysis. For this purpose, several tools were used. Firstly, eigenvalues, which represent the variance of the principal components, has been used to determine the number of principal components to retain after the PCA analysis.

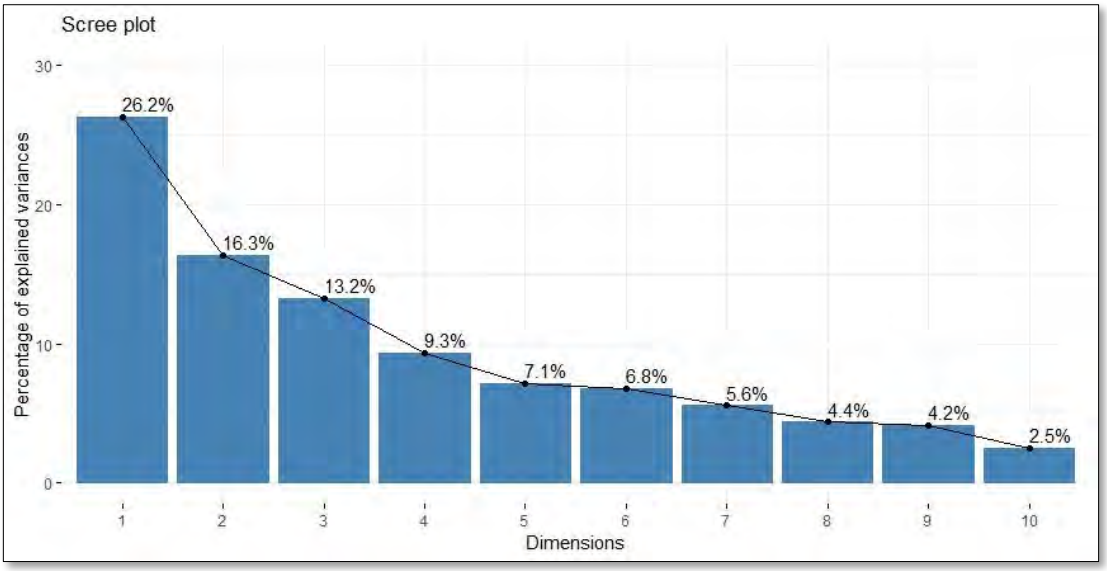
```
# Performing PCA analysis with dudi.pca()
Database.pca <- dudi.pca(Database.full, scannf = FALSE, nf = 8)
             scanf = False is to hide the screenplot
             nf = 8 is to determine the number of graded axes
```

The below code enables a graphic showing the results to be produced.

```
# Visualisation of the dimensions' variances
fviz_eig(Database.pca, addlabels = TRUE, ylim = c(0, 30))
             addlabels = TRUE shows the percentage on top of the barplot
             ylim = c(0, 30) fixes the scale on Y axis, here up to 30%
```

The table below (cf. table 23) indicates that 42.5% of the variance can be explained with the first two axes only: the first axe explains on itself more than a quarter of the overall variance (26.2%), whereas the second one explains 16%.

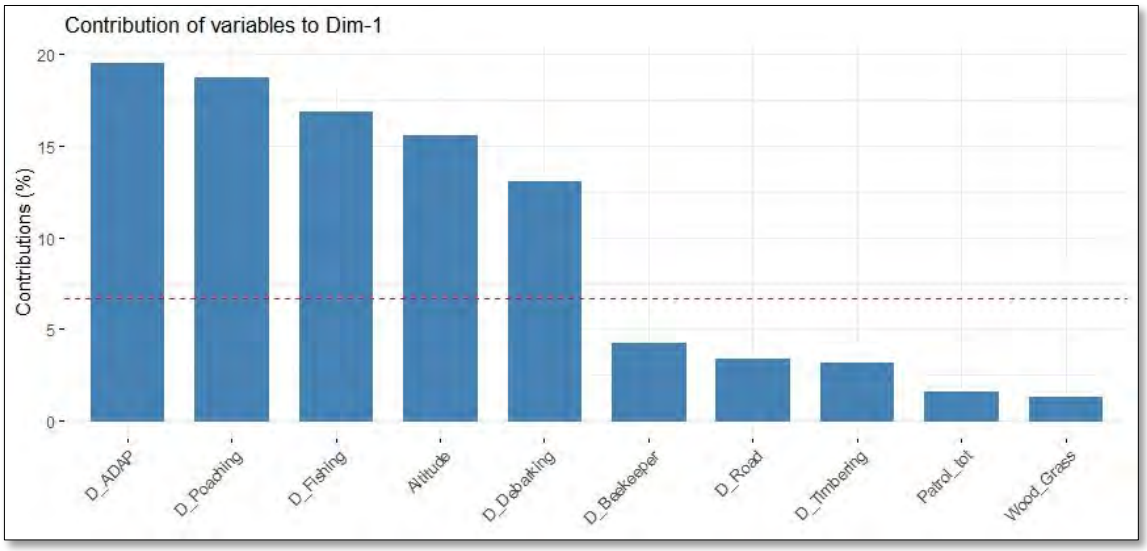
Table 23: Eigenvalues of the PCA analysis for the Camera Traps' characterisation.
Source: Present survey



Then, assessing which of the explanatory factors are the most contributors of this characterisation, below charts enables the visualisation of the top 10 contributors on axe 1, then on axe 2.

```
# Contributions of variables to axe 1

fviz_contrib (Database.pca, choice = "var", axes = 1, top = 10)
```

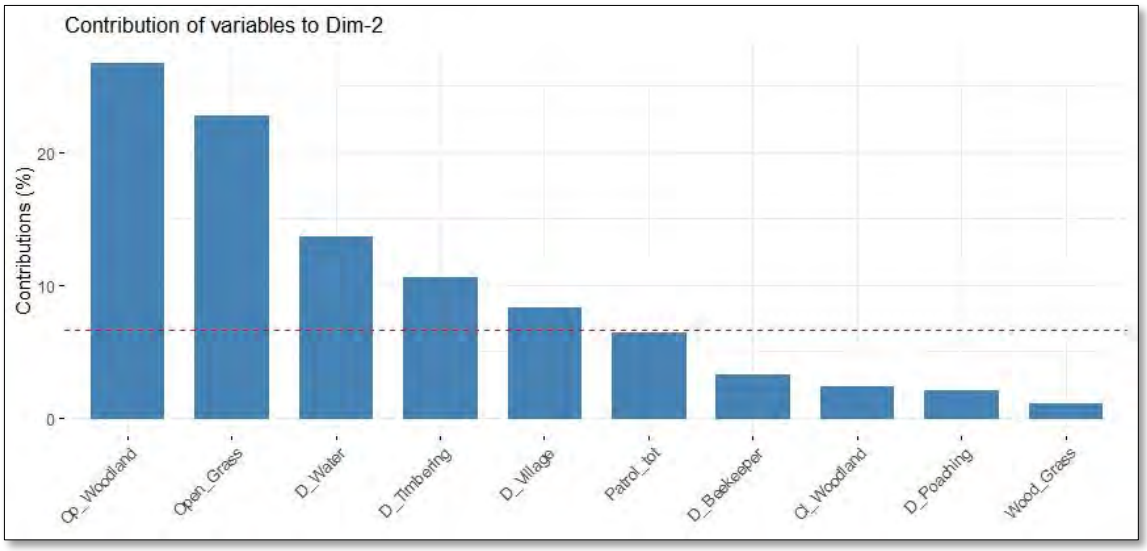
Table 24: Contribution of variables to PC1.
Source: Present survey



Taking a closer look to the first ten explanatory factors, the graphic above (cf. table 24) shows that distances to anthropic factors are driving the first axe (Dim-1) for a total of around 76% of the top ten variables.

```
# Contributions of variables to axe 2

fviz_contrib (Database.pca, choice = "var", axes = 2, top = 10)
```

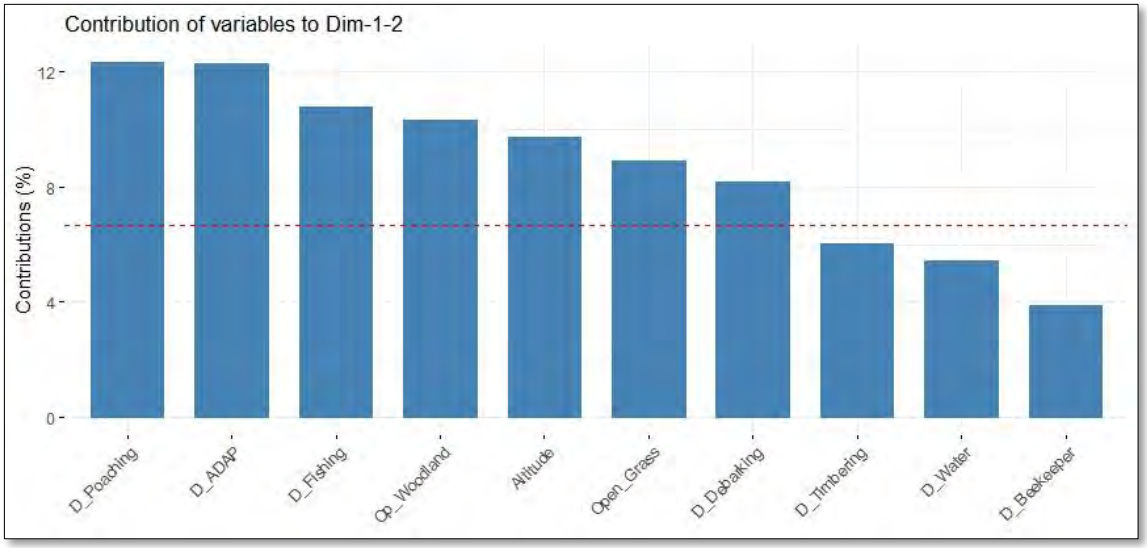
Table 25: Contribution of variables to PC2.
Source: Present survey



Considering the second axe (Dim-2), Environmental factors are characterising around 71% of the top-10 contributing variables (cf. table 25). Then, the graphic below is considering both axes at once (cf. table 26).

```
# Contributions of variables to axes 1 and 2

fviz_contrib (Database.pca, choice = "var", axes = 1 : 2, top = 10)
```

Table 26: Contribution of variables to PC1 and PC2.
Source: Present survey



The result here is quite similar to previous graphs although it indicates a more mixed combination of drivers – or explanatory factors – to explain the variance in both axes. However, anthropic variables are still toping at a 53% of the top-10 contributors to the overall variance, driven by poaching activities.

At this stage it might be interesting to represent the contribution of each one of these explanatory factors to the overall variance in a different visual manner. The graph hereunder (cf. table 27) shows in red the most contributing variables (explanatory factors) and in blue the less contributing ones.

It aggregates variables positively correlated on the same side of the graph, ones negatively correlated in the opposite directions. Once again, we can notice that most contributing factors (in red, with a long arrow) are the anthropic ones.

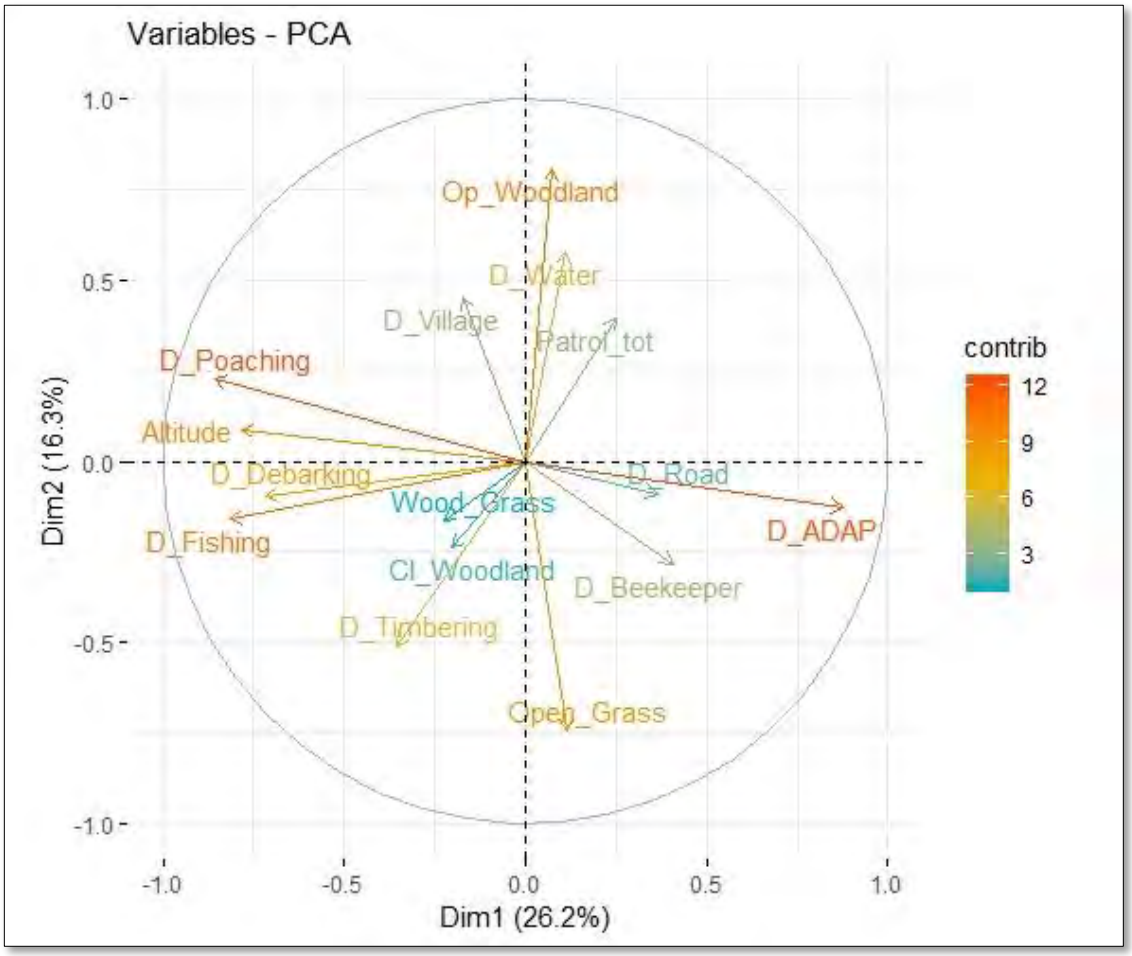
It is worthwhile here to note that on axe 1 (Dim-1) distance to ADAP (D_ADAP), distance to beekeepers' camps (D_Beekeepers) and distance to roads (D_Road) are together positively correlated but show a strong negative correlation with distance to anthropic strains, such as poaching activities (D_Poaching), tree debarking (D_Debarking) and illegal fishing activities (D_Fishing).

Furthermore, the Altitude shows a significant positive correlation with the distance to anthropic strains such as Poaching (D_Poaching), Tree debarking (D_Debarking) and Fishing activities (D_Fishing).

In the same way, on axe 2 (Dim-2) the distance to timbering activities (D_Timbering) is positively correlated with the presence of landcovers that are closed woodlands (Cl_Woodland) and wooded grassland (Wood_Grass), even though this correlation is little (in blue).

```
# Visualisation of the contribution quality of the variable

fviz_pca_var(Database.pca, axes = c(1, 2),  col.var = "contrib",
             gradient.cols = c("#00AFBB", "#E7B800", "#FC4E07"), repel
             = TRUE)
```

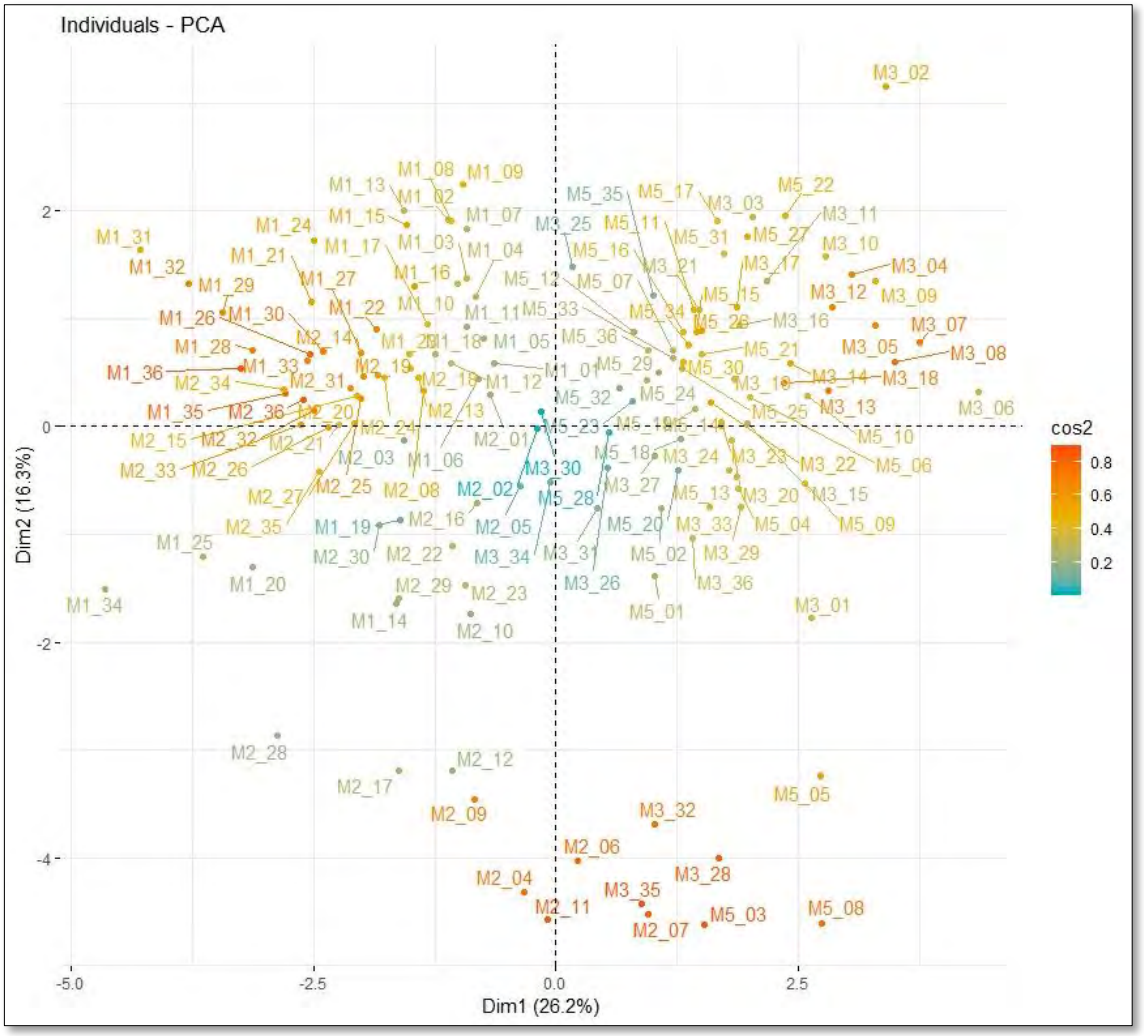
Table 27: Graphic of the contribution quality of the variables.
Source: Present survey



Considering the individuals (i.e. the Camera Traps) a graphic with the same logic of representation has been produced but using their cos2 (cf. table 28).

```
# Visualisation of the representation's quality of the individuals

fviz_pca_ind(Database.pca, col.ind = "cos2", gradient.cols =
c("#00AFBB", "#E7B800", "#FC4E07"), repel = TRUE)
```

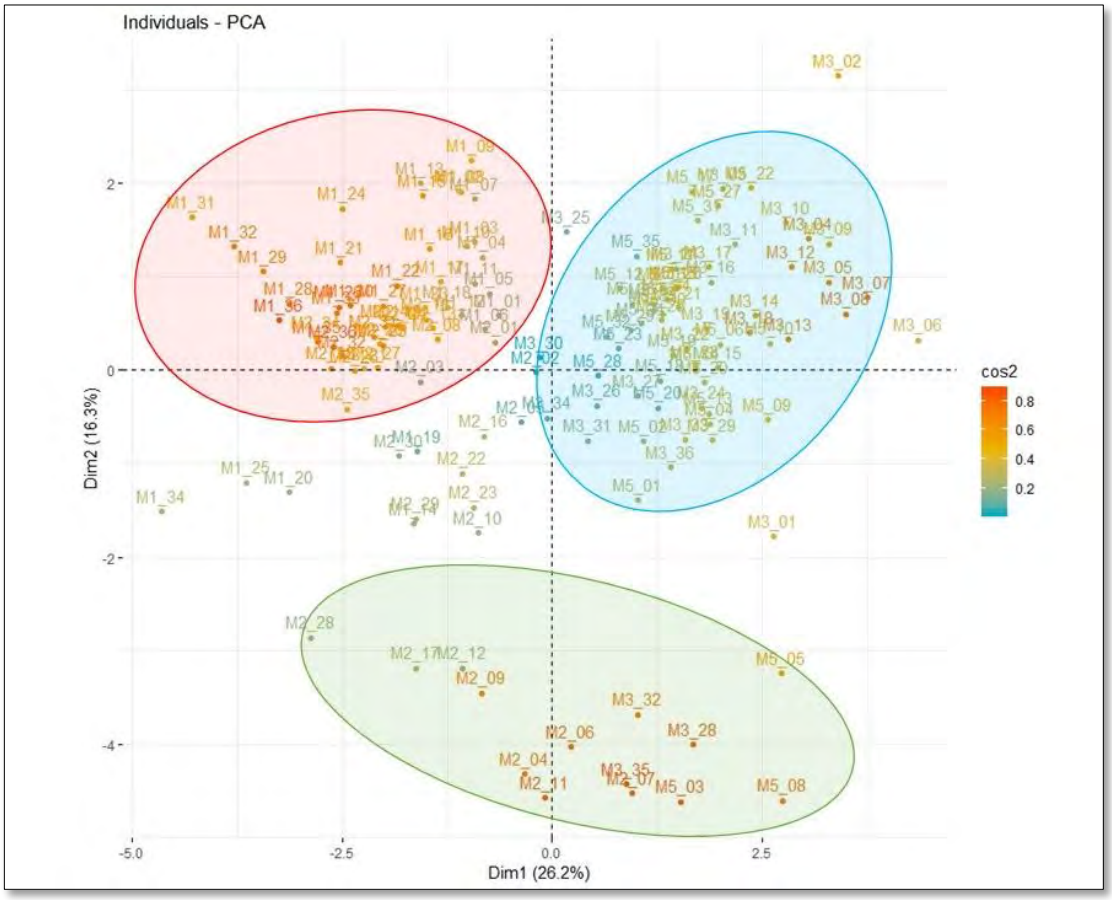
Table 28: Graphic of the representation's quality of the individuals.
Source: Present survey



The cos2 values in tables 28 are corresponding to their quality of representation on the factor map, showing their contributions to the definition of the principal dimensions (dimensions 1 and 2).

Then, representing individuals in another way around (cf. table 29) through the iris.pca function, three main groups of CT's are distinguishable, showing a similar characterisation one another.

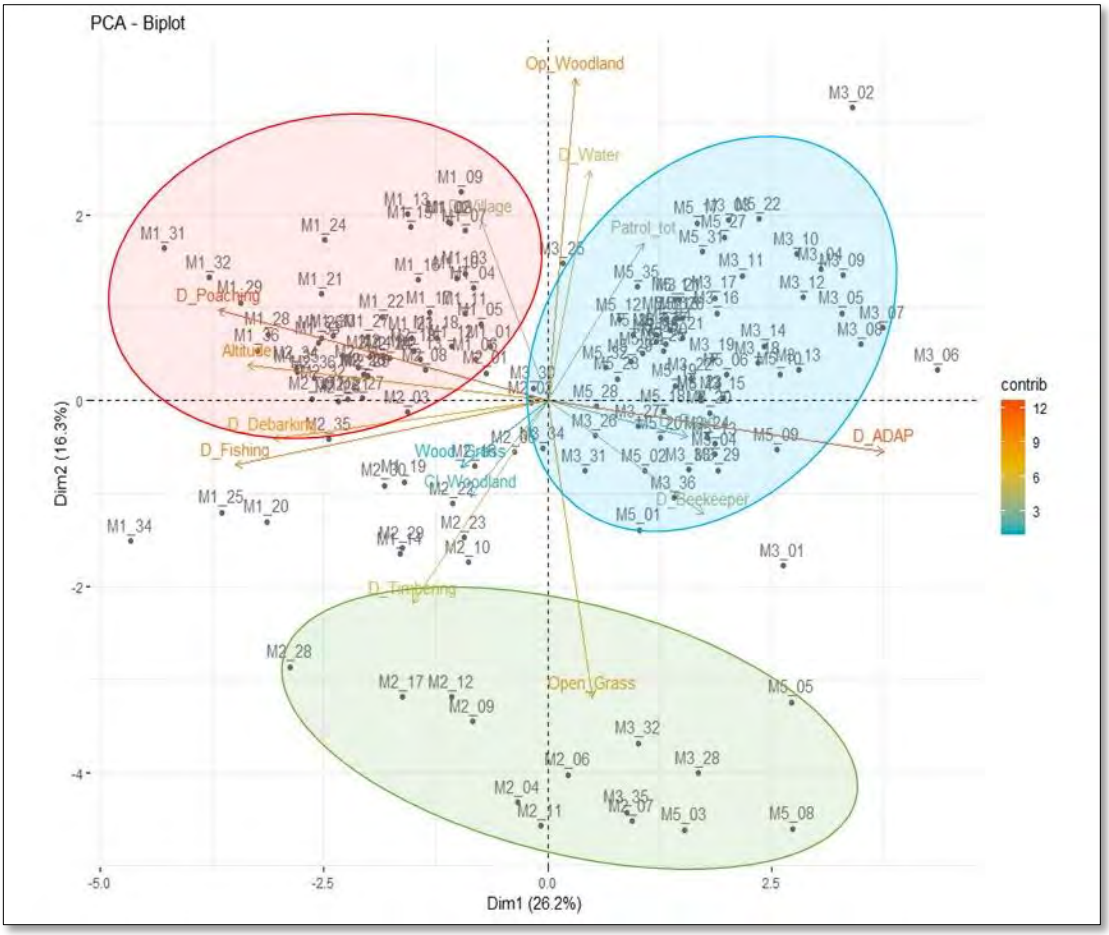
Table 29: Graph of groups of CT showing a similar characterisation.
Source: Present survey.



Finally, a graph superposing both information – that is individuals and variables – can help to assess the qualification of the CTs and sum-up the analysis (cf. table 30).

```
# Visualisation of the representation's quality of the variable (biplot)

fviz_pca_var(Database.pca, axes = c(1, 2),  col.var = "contrib",
             gradient.cols = c("#00AFBB", "#E7B800", "#FC4E07"), repel
             = FALSE)
```

Table 30: Biplot of individuals and variables.
Source: Present survey



Then, it is possible to assess the main variables that are qualifying the CT's. Cameras contained in the blue circle are mainly negatively correlated with the distance to timbering activities (D_Timbering), but positively correlated with the number of patrols (Patrol_tot).

Cameras present within the red circle are positively correlated with the distance to poaching activities (D_Poaching), the altitude (Altitude), the distance to tree debarking activities (D_Debarking). They are negatively correleted with the distance to the ADAP permanent camp (D_ADAP) as well as with the distance to beekeepers' camps (D-Beekeepers).

Cameras appearing in the green circle are positively correlated with the presence of the open grassland landcover (Op_Grassland), but negatively correlated with open woodland (Op_Woodland) and the distance to water sources (D_Water).

3.3.2 Response of RAI to anthropogenic and environmental factors

Data had to be prepared in a similar manner than for CT characterisation, and then split into two distinct databases: one including explanatory factors (i.e. environmental and

anthropogenic factors, named rai_env.txt), the second containing Response factors only (i.e. the rai for each assessed mammal, named rai_esp.txt).

```
# Import data into R (.txt tab separated values)

rai_esp <- read.delim("e:/rai_esp.txt", row.names=1, h=T)

rai_env <- read.delim("e:/rai_env.txt", row.names=1, h=T)
```

From these databases have been removed CT that did not work and returned artificial "0" values in terms of RAI (NA). According to the same line of reasoning, species with a frequency of less than 10% of representation have been removed, so as to avoid results being distorted by these extremes, as for *Smutsia terminalii (VU),* which has been pictured once by one CT only in the 2016-2017 campaign.

Then, names' length had to be shortened to facilitate the reading of graphics results. This has been done through excel, using function "gauche", keeping only the first three letters of the gender and the three first letter of the specie's name.

For these tables to be comparable, they must have the same number of columns. This is checked with the "dim" command line

```
# Checking the dimensions of the tables

dim(rai_env)

dim(rai_esp)
```

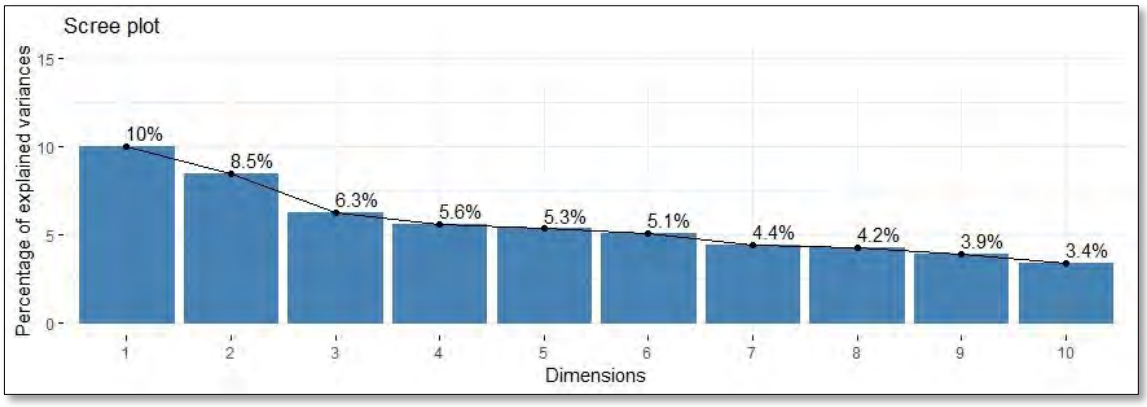
Results returned 15 lines and 132 columns for the explanatory factors, 40 lines and 132 columns for the response factors. Tables could then be assessed, firstly with an ACP in order to characterise the predominant factors influencing the mammal's RAI.

```
# ACP calculation with dudi.pca

rai_env.acp <- dudi.pca(t(rai_env), scannf = FALSE, nf = 8)
```

The % of variance of each axis is then determined by plotting their eigenvalues (cf. table 31).

```
# Visualisation of the results through their eigenvalues

fviz_eig(rai_env.acp, addlabels = TRUE, ylim = c(0, 15))
```

Table 31: Assessment of the eigenvalues for the mammal's RAI
Source: Present survey

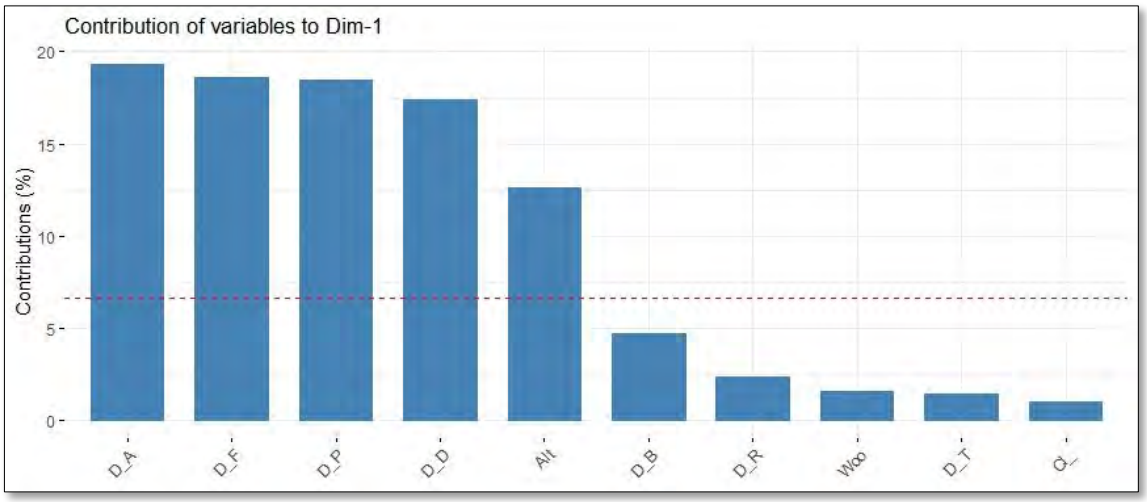


The above graphic shows that the first two axis are only explaining 18.5% of the overall variation. This number is small and, in light of this chart, following results should then be seriously moderated.

Then, contribution to axes 1 and 2 could be plotted (cf. table 32 and 33) expressing the % for each explanatory factor and the order of their contribution.

```
# Visualisation of the contribution of variables for axe 1 and axe 2

fviz_contrib(rai_env.acp, choice = "var", axes = 1, top = 10)

fviz_contrib(rai_env.acp, choice = "var", axes = 2, top = 10)
```

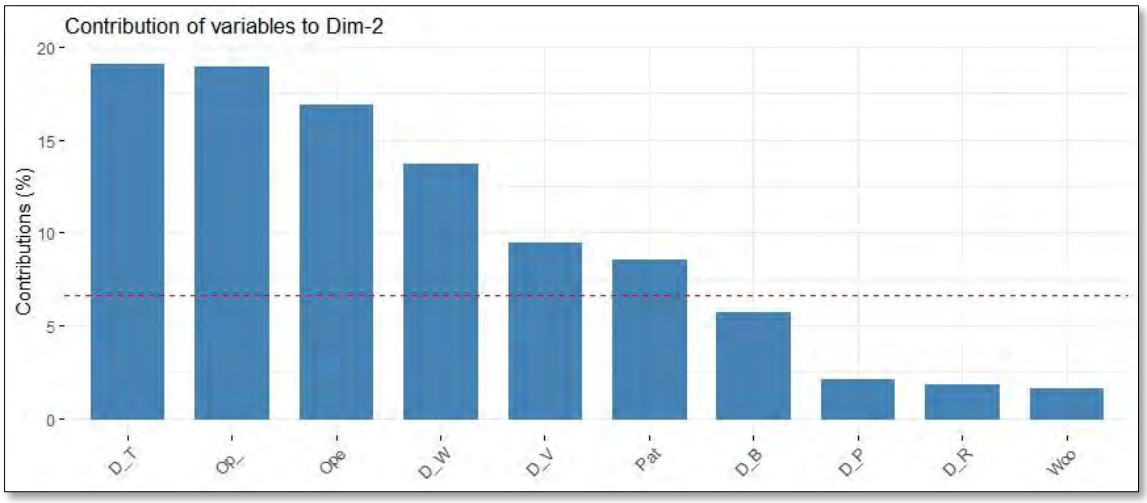
Table 32: Contribution of Explanatory factors to RAI axis 1.
Source: Present survey.



It is interesting to notice that, as for the CT's qualification, anthropogenic' factors are driving the first axis. Distance to ADAP permanent camp (D_A), distance to fishing activities (D_F), distance to poaching activities and distance to tree debarking (D_D) are

resuming around 75% of the overall variance within axe 1. However, it is important here to remember that the first axis explains only 10% of the overall variance.

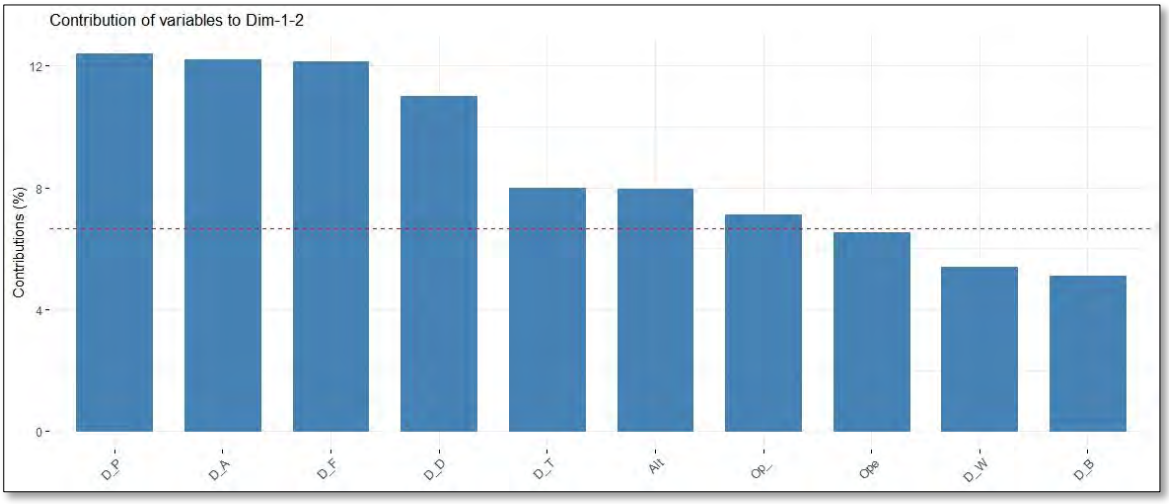
Table 33: Contribution of explanatory factors to RAI axis 2.
Source: Present survey.



The second axis is characterised with a more mixed set of drivers (cf. table 33). Anthropogenic factors are explaining 48% of the overall variance, environmental ones 52%. Again, this second axis explains only 8.5% of the overall variance within the 40 dimensions of this study, results are to be moderated.

Contributions to axe 1 and to axe 2 altogether has been plotted as well (cf. table 34).

Table 34: Contribution of explanatory factors to the RAI, axis 1 and 2 altogether.
Source: Present survey.



This graph shows little difference with the one produced for axis 1, only the % of contribution is moving as variables are spread. Thus, it shows that anthropogenic factors such as the distance to poaching activities (D_P), the distance to ADAP's permanent camp (D_A), the distance to illegal fishing activities, distance to tree debarking (D_T) and distance to beekeeper's camps (D_B) are contributing for a total of around 60% of the overall variance in both axes.

Mining data further, tables of explanatory factors and Response factors could then be assessed and a CCA analysis to be launched.

```
# Performing CCA analysis

rai.cca <- cca(t(rai_env), t(rai_esp))
```

Interrogating the results, they return eigenvalues for both constrained (Response) and unconstrained (explanatory) factors (cf. table 35):

Table 35: Inertia calculated for the CCA analysis on RAI.
Source: Present survey

	Inertia	Proportion	Rank
Total	0.19691	1	
Constrained	0.08667	0.44012	13
Unconstrained	0.11025	0.55988	13

Inertia is here a scaled Chi-square. In our case, the inertia is very small. Some constraints have been automatically aliased because they were collinear (redundant).

Table 36: Results of the eigenvalues of the CCA analysis on RAI.
Source: Present survey

Eigenvalues for constrained axes:													
	CCA1	CCA2	CCA3	CCA4	CCA5	CCA6	CCA7	CCA8	CCA9	CCA10	CCA11	CCA12	CCA13
	0.06187	0.01302	0.00453	0.0035	0.0022	0.0009	0.00045	0.00021	0.00001	0	0	0	0
Eigenvalues for unconstrained axes:													
	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8	CA9	CA10	CA11	CA12	CA13
	0.0623	0.02191	0.00996	0.0072	0.0042	0.003	0.00091	0.00071	0.00004	0.00001	0.00001	0.00001	0

These eigenvalues (cf. table 36) show the proportion – within the 40 dimensions of this analysis – of variables belonging to response factors that are linked to environmental factors.

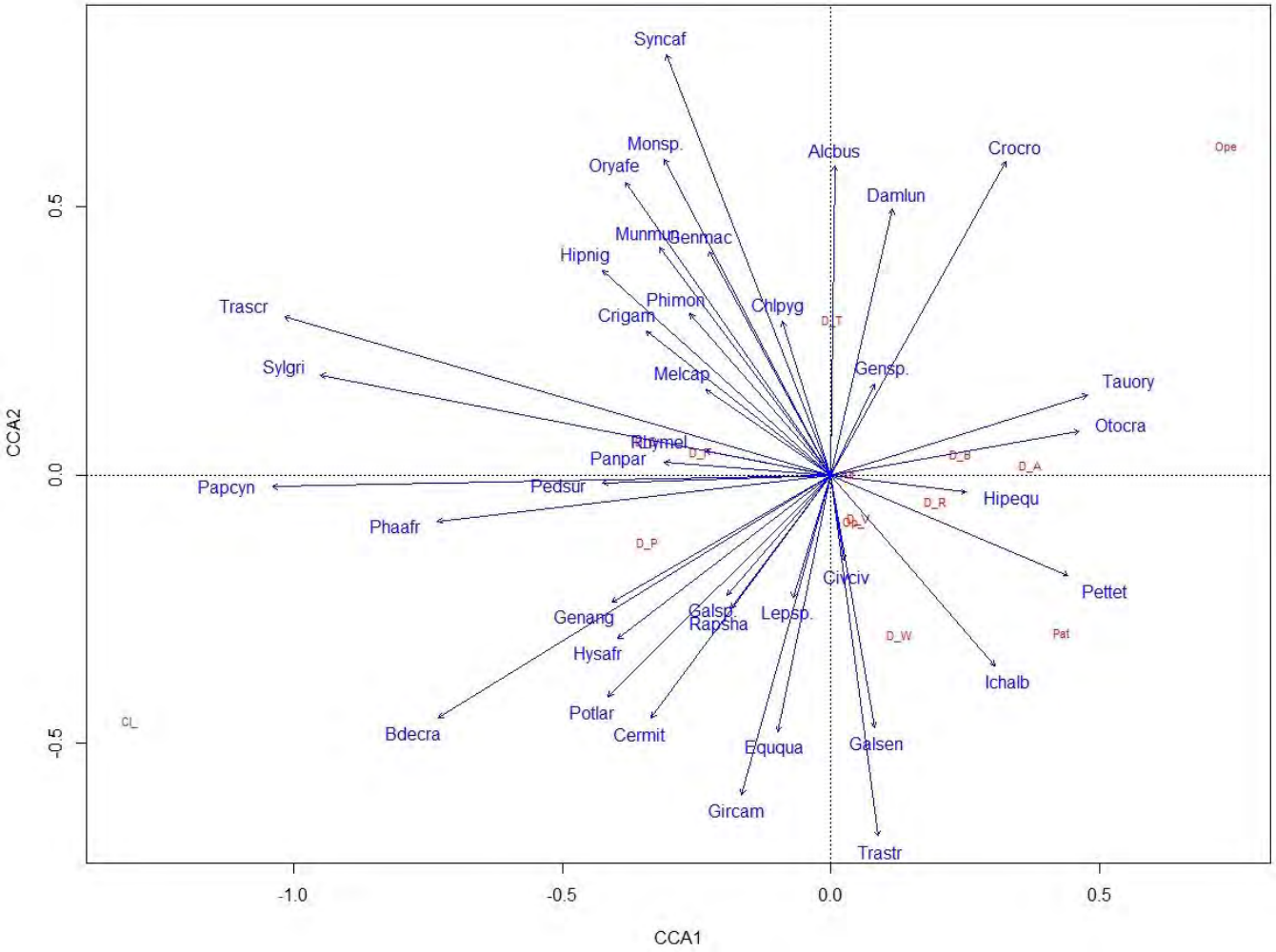
Plotting the graphic, it has been noticed that the landscape cover “wooden grassland” was stretching the graph. It is then considered as an extreme data and had to be removed from the assessment for a better reading of the results. The CCA analysis could be processed again but without this extreme value:

```
# Performing CCA analysis without extreme values

rai.cca <- cca(t(rai_env[-9,]), t(rai_esp))
```

Then, the graphic of the CCA analysis could be plotted (cf. table 37)

```
# Plotting CCA analysis

plot(rai.cca, type="text", display=c("sp","bp"))
```

Table 37: Graphic of results from the CCA analysis, correlating RAI and explanatory factors. Source: Present survey



At first, these results show that RAIs of mammals have little to no correlation with the altitude (Alt), positioned in the centre of the graphic. Furthermore, distance to villages (D_V), distance to roads (D_R) as well as the landscape cover open woodland (Op_) seem not to be strongly correlated with the relative abundance index of the assessed mammals.

However, Patrols (Pat), which have a significant contribution to axis 1 and 2, seem to be negatively correlated with the RAI of a set of mammals, such as *Mellivora capensis, Cricetomys gambianus, Hippotragus niger, Mungos mungo, Orycteropus afer, Genetta maculata, Philantoba monticola*. An explanation's attempt cannot be proceeded here.

Distance to poaching activities (D_P) shows a strong negative correlation with the RAI of the *Taurotragus oryx*.

The distance to water points (D_W) shows a strong negative correlation with the *Syncerus caffer*, indicating that this mammal's ecological niche is strongly linked with the presence of water.

However, distance to water shows also a strong positive correlation with *Tragelaphus strepsiceros*, which is in opposition with its ecological niche, closely depending of water (Kingdon, 2015).

Hippotragus equinus' RAI presents a positive correlation with the distance to roads (D_R), whereas it presents a negative one with the distance to tree debarking activities and distance to fishing activities.

Alcelaphus buselaphus' RAI is positively correlated to the distance with Timbering (D_T).

Giraffa camelopardalis tipelskirshi's RAI has a negative correlation with the distance to timbering activities (D_T).

Finally, *Panthera pardus* (Panpar) shows a negative correlation with the distance to the roads (D_R), but also with the ADAP permanent camp.

3.3.3 Response of mammal's Distribution to anthropogenic and environmental factors

The same procedure of data mining has been conducted as to evaluate the response of mammal's distribution to environmental and anthropogenic factors, i.e. a methodical CCA analysis.

```
# Import data into R (.txt tab separated values)

dis_esp <- read.delim("e:/dis_esp.txt", row.names=1, h=T)

dis_env <- read.delim("e:/dis_env.txt", row.names=1, h=T)

# Performing CCA analysis

dis.cca <- cca(t(dis_env), t(dis_esp))
```

Interrogating the results (cf. tables 38 and 39), they return eigenvalues for both constrained (response) and unconstrained (explanatory) factors:

Table 38: Inertia calculated for the CCA analysis on Distribution.
Source: Present survey

	Inertia	Proportion	Rank
Total	0.19969	1	
Constrained	0.0826	0.4195	13
Unconstrained	0.1143	0.5805	13

Inertia is here a scaled Chi-square. In this case and as for the RAI, the inertia is very little. Some constraints have been automatically aliased because they were collinear (redundant).

Table 39: Results of the eigenvalues of the CCA analysis on Distribution.
Source: Present survey.

Eigenvalues for constrained axes:													
	CCA1	CCA2	CCA3	CCA4	CCA5	CCA6	CCA7	CCA8	CCA9	CCA10	CCA11	CCA12	CCA13
	0.05764	0.01295	0.00479	0.00341	0.00225	0.00085	0.00049	0.00021	0.00001	0	0	0	0
Eigenvalues for unconstrained axes:													
	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8	CA9	CA10	CA11	CA12	CA13
	0.06683	0.02169	0.01004	0.00699	0.00406	0.00299	0.00092	0.00073	0.00004	0.00001	0.00001	0.00001	0

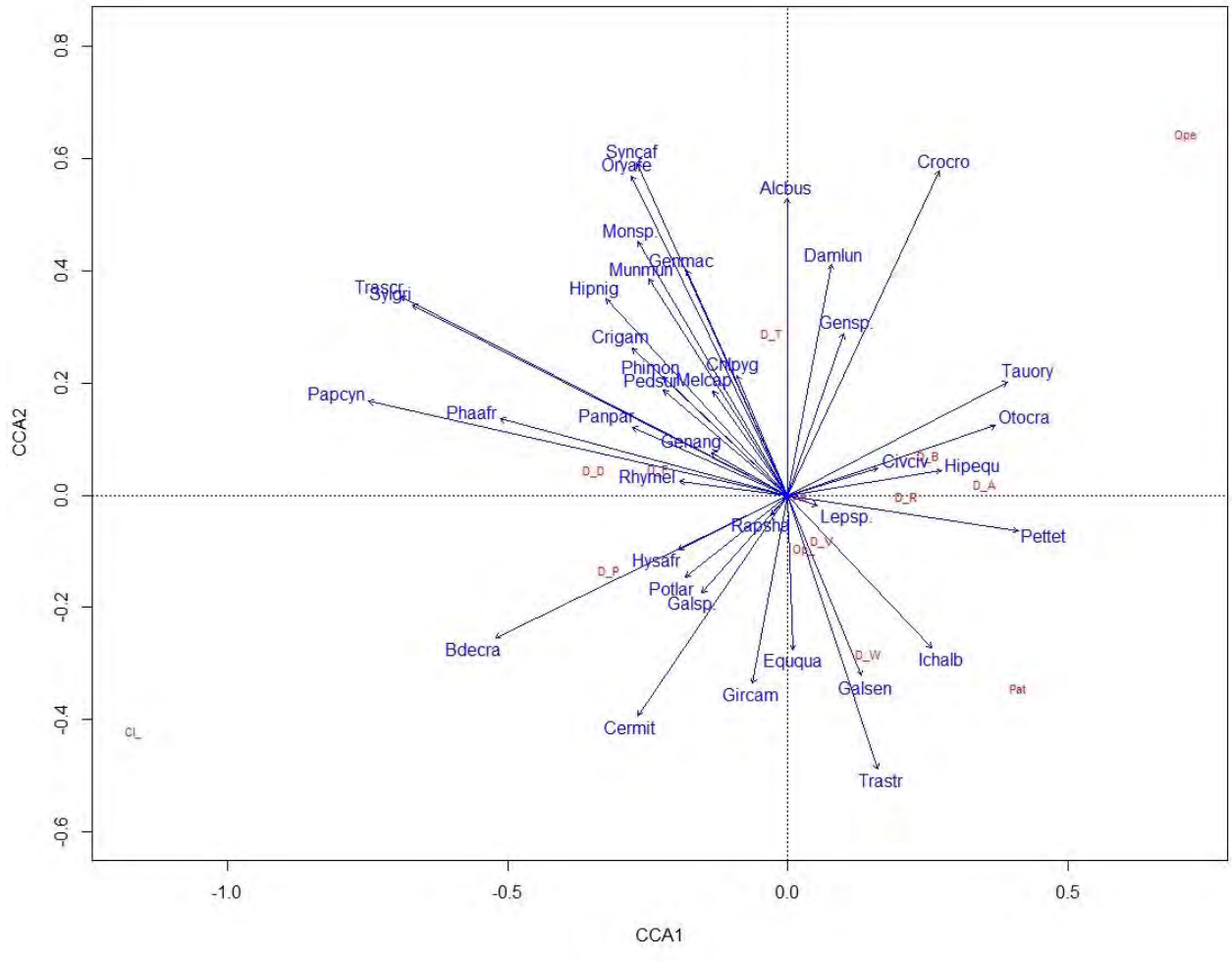
Plotting the graphic, it has been noticed that the landscape cover “wooden grassland” was stretching the graph, as for the RAI. It is then considered as an extreme data and had to be removed from the assessment for a better reading of the results. The CCA analysis could be processed again but without this extreme value.

```
# Performing CCA analysis without extreme values

dis.cca <- cca(t(dis_env[-9,]), t(dis_esp))
```

Then, the graphic of the CCA results have been plotted (cf. table 40)

```
# Plotting CCA analysis

plot(dis.cca, type="text", display=c("sp","bp"))
```

Table 40: Graphic of results from the CCA analysis, correlating Distribution and explanatory factors.
Source: Present survey



This table shows strong similarities with the RAI's one, which is quite normal considering that data are related and assessed through the same methodology. However, this graph expresses some slight differences.

The first one concerns *Orycteropus afer* (Oryafe) which present now a strong negative correlation with the distance to water (D_W).

The second one concerns *Equus quagga bohemi* (Eququa) which shows a direct negative correlation with the distance to timber activities (D_T).

The distribution of *Hippotragus equinus* seems now positively correlated with the distance to beekeepers' camps(D_B), such as for *Civettictis civetta.*

3.3.4 Response of Specific richness to anthropogenic and environmental factors

To evaluate the response of the Specific richness to explanatory factors, previous statistical models (i.e. PCA and CCA) did not show relevant information. As the y axis contained only one source of data and x axis the 40 species, a Generalised Linear Model (GLM) was more suitable to make numbers meaningful (McCullagh & Nelder, 1989).

As our dataset contain counts from a set of continuous predictors variables (y axis), the Poisson regression (Consul & Famoye, 1992) will allow us to assess the data. Indeed, this model assumes the natural logarithm (ln) of its expected value being modelled by a linear combination of unknown parameters.

As for previous analysis, the dataset had to be prepared in order to fit into R :

```
# Import data into R (.txt tab separated values)

rsp.dat <- read.delim("e:/rsp.txt", row.names=1, h=T)

# Transpose X and Y axis

rspt.dat <- t(rsp.dat)
```

Then the GLM could be launched on the dataset:

```
# GLM with all variables

rspt.glm <- glm(Rich.Sp. ~ . , family = poisson(), data =
as.data.frame(rspt.dat))
```

The next command line enables the visualisation of the results (cf. table 41)

```
# Overview of the results

summary(rspt.glm)
```

Table 41: Results of the Poisson regression on Specific richness.
Source: Present survey

Deviance Residuals:					
Min	1Q	Median	3Q	Max	
-3.7352	-1.5221	-0.3645	0.8493	3.7321	
Coefficients: (1 not defined because of singularities)					
	Estimate	**Std. Error**	**z value**	**Pr(>|z|)**	
(Intercept)	-2.79E+00	1.29E+00	-2.169	0.030084	*
D_Road	8.25E-05	4.67E-05	1.768	0.077137	.
D_Beekeeper	-1.37E-05	2.78E-05	-0.491	0.62341	
D_Village	1.46E-05	1.76E-05	0.83	0.406784	
D_Water	-6.46E-05	3.92E-05	-1.648	0.099335	.
D_ADAP	-2.69E-06	1.45E-05	-0.185	0.853231	
Altitude	3.12E-03	8.95E-04	3.487	0.000488	***
Cl_Woodland	-5.45E-02	3.25E-01	-0.168	0.866664	
Op_Woodland	1.91E-01	1.69E-01	1.129	0.258819	
Wood_Grass	5.39E-01	3.10E-01	1.741	0.081722	.
Open_Grass	NA	NA	NA	NA	
Patrol_tot	-3.80E-02	3.52E-02	-1.078	0.280998	
D_Timbering	-5.33E-05	2.54E-05	-2.102	0.03555	*
D_Debarking	6.01E-06	2.24E-05	0.268	0.788459	
D_Poaching	-5.70E-05	3.33E-05	-1.714	0.086465	.
D_Fishing	4.03E-05	2.31E-05	1.744	0.081154	.

Signif. codes: 0 '*' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1**					
(Dispersion parameter for poisson family taken to be 1)					
Null deviance: 440.23 on 131 degrees of freedom					
Residual deviance: 358.25 on 117 degrees of freedom					
AIC: 791.79					
Number of Fisher Scoring iterations: 5					

In most cases the asymptotic significance, a.k.a. P value (Pearson, 1900), is below the 0.05, which is encouraging for the following data process to provide robust results.

The next step is to retain only significant variables. To proceed, the MASS library (Venables *et al*., 2002) had to be charged into R.

```
# Loading MASS library

require(MASS)
```

Then the selection could be operated through stepAIC function:

```
# Stepwise selection of variables

rspt.step <- stepAIC(rspt.glm)
```

The process of variables' selections proceeds by successive deletions of variables and automatically stops when the model best fits with the lowest AIC value possible: lower value of AIC suggests "better" model. The Akaike information criterion (AIC) (Akaike 1973) is an estimator of the relative quality of statistical models for a given set of data. AIC estimates the quality of each model, relative to each of the other models. The results are shown in table 42.

Table 42: Results after the AIC' selection for the best model.
Source: Present survey.

Step:	AIC=781.68											
Rich.Sp.	~	D_Road	+	D_Water	+	Altitude	+	Wood_Grass	+	D_Timbering	+	
	D_Poaching	+	D_Fishing									
	Df	Deviance	AIC									
<none>	362.14	781.68										
-	Wood_Grass	1	364.15	781.68								
-	D_Water	1	364.46	782								
-	D_Poaching	1	365.59	783.12								
-	D_Fishing	1	366.56	784.1								
-	D_Timbering	1	369.37	786.9								
-	D_Road	1	370.57	788.11								
-	Altitude	1	386.49	804.02								

Then, the Poisson linear regression calculation could be launched again on the "best" model, through the following command line:

```
# Final model of Poisson linear regression through AIC model

rspt.glm.final <- glm(Rich.Sp. ~ Altitude + D_Road + D_Timbering +
D_Fishing + D_Poaching + D_Water + Wood_Grass, family = poisson(),
data=as.data.frame(rspt.dat))
```

Then the results could be plotted (cf. table 43):

```
# Results overlook of the AIC model

summary(rspt.glm.final)
```

Table 43: Final results on Poisson linear regression, after having performed an AIC selection on variables.
Source: Present survey.

Deviance Residuals:					
Min	1Q	Median	3Q	Max	
-3.7251	-1.5709	-0.3108	0.8483	3.7103	
Coefficients:					
	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-3.09E+00	8.33E-01	-3.704	0.000213	***
Altitude	3.66E-03	7.44E-04	4.921	8.59E-07	***
D_Road	9.78E-05	3.33E-05	2.936	0.003322	**
D_Timbering	-5.88E-05	2.19E-05	-2.685	0.007251	**
D_Fishing	3.90E-05	1.85E-05	2.106	0.035229	*
D_Poaching	-4.39E-05	2.36E-05	-1.862	0.06263	.
D_Water	-5.76E-05	3.79E-05	-1.519	0.128666	
Wood_Grass	3.42E-01	2.32E-01	1.474	0.14043	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1					
(Dispersion parameter for poisson family taken to be 1)					
Null deviance: 440.23 on 131 degrees of freedom					
Residual deviance: 362.14 on 124 degrees of freedom					
AIC: 781.68					
Number of Fisher Scoring iterations: 5					

This chart indicates that the Specific Richness is greater (in sequence, and deducted from the +/- sigh before the "estimate" coefficient):

1) In altitude
2) Away from the roads
3) Near Timbering activities
4) Away from Fishing activities
5) Near Poaching activities (P>0.05, not significant)
6) Near water (P>0.05, not significant)
7) Where Wooded grassland are present (P>0.05, not significant)

The results seem to be significant, however, the residual deviance might be considered as still high (362,14). It may be then meaningful to assess the deviance table, through an ANOVA analysis (Fisher, 1921). Results can be seen in table 44.

```
# Final ANOVA analysis

anova(rspt.glm.final, test="Chisq")
```

Table 44: Table of results of the ANOVA analysis on deviance table. Source: Present survey.

Analysis of Deviance Table						
Model: poisson, link: log						
Response: Rich.Sp.						
Terms added sequentially (first to last)						
	Df	Deviance	Resid. Df	Resid. Dev	Pr(>Chi)	
NULL			131	440.23		
Altitude	1	51.76	130	388.5	6.26E-13	***
D_Road	1	15.53	129	372.9	8.11E-05	***
D_Timbering	1	2.513	128	370.4	0.1129	
D_Fishing	1	2.206	127	368.2	0.1375	
D_Poaching	1	1.891	126	366.3	0.1691	
D_Water	1	2.179	125	364.2	0.1399	
Wood_Grass	1	2.005	124	362.1	0.1568	

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1						

The residual deviance dropped from 440 to 362, that means that 18% only of the overall variation is explained by the model itself, which can be qualified as satisfactory. This last number confirms that 18% of the variation is explained by the set of data analysed, which is significant enough to discuss about meaningful correlations in the following chapters.

4 Discussion

4.1 Limitation of this survey

Although extensive efforts have been made to assess as far as possible quantitative and qualitative data from this 2018 survey, its results should be considered as a snapshot and cannot reflect the overall and accrual biodiversity that takes place in the MBKZ. Gathered data can therefore only be considered as partial ones.

Firstly, and even though the new CT places are covering the overall MBKZ, results are considering only one camera-trap session of a duration of 21 days, moreover taking place during the dry season. As an example, no *Hippopotamus amphibius* (status VU) has been pictured, as it only moves through the assessed area during the rain season, when ground is flooded, and rivers watered.

Also, the special late rain season that occurred during the year of this study could have an ecological impact as animals were not already concentrated around water places. They can be scattered, which led to a lower number of individuals recorded per independent event.

Furthermore, the implemented grid (2km x 2km) is a compromise for meeting the maximum of ecological niches of small, medium and large animals. It has not been designed specifically for this survey, which focuses on medium and large mammals only.

Then, given the home range size of certain species, they may not cross the area for weeks and may therefore return a false absence response. This is the case for large carnivores such as *Panthera leo* (status VU), though reported as present by direct observations (pawn print) throughout recent patrols – which take place throughout the year – but were not pictured during this survey.

This point underlines that fields observations, when conducted throughout the year as it is the case in the MBKZ, can be significantly helpful and bring contribution to such assessment, alike a Camera Trap survey.

Moreover, sound-science based data cannot be separated from management needs in the case of monitoring programs. Although the former brings interesting hard information, but which are more or less instantaneous, the latter is the recipient of them and shall benefit from these studies.

Finally, the bias (cf. chapter 2.5) might be strongly considered as they are, for some of them, severely impacting the results, as for the set-up of the cameras that has been partially rushed in M5 and especially in M3 grids and returned consequently insufficient

results. As a result, the research effort is lessened, and indicators might be artificially lower than they could have been if the Trap session had occurred correctly. Statistical analysis conducted in point 3.3 might have been also severely impacted by these biases as the comprehensiveness of their data is directly linked to the research effort.

4.1.1 Ecological inference fallacy

The risk of misinterpretation of aggregated data applied to a species behaviour, or individual has been documented since tens of years as for now. This problematic has been well documented (Robinson, 1950) and the demonstration that correlations – driven by the interpretation of statistical data – measured between two or more characteristics in a binomial manner at an individual-level did not show the same results if they were considered at a group-level, and vice-versa.

Thus, using geographic-related data can be source of considerably rich opportunities of analyses, but also be a threat leading to misinterpretations as statistical units are made of aggregated individuals, and results extrapolated from it.

4.1.2 Simpson Paradox

The less the contributions to the variance, the higher the risk to misinterpretation exists. The combination order of the assessed groups of mammals can drastically change the results produced, and even lead to reverse the conclusion deducted from the study.

A confounding factor such as a non-depending factor (and therefore unassessed) might be hidden in between the results, although apparently obvious, and driving the deducted correlations in a deviated pathway (Simpson, 1951).

4.2 Management

The interviews highlighted interesting information, such as the difficulties encountered in achieving the target of sustainability.

4.2.1 IBA legitimacy contested

At first, and what would be here qualified as the major problem, the legitimacy of IBA's management over the MBKZ has been challenged since TFS took over the responsibilities of FDB in 2010. Indeed, this lead to serious worsening of relationships between the two parties: TFS still refuses to recognise IBA's management's rights over the area, did not recognise the previous MoU signed with FDB and is reluctant to sign a new one. IBA is not considered as a partner, but as a rival.

One of the outcome is that IBA is denied the right of collecting fines from offenders practicing illegal activities within the MBKZ. While this item was collecting lots of funds until recently (Halfani, pers.comm. 2018), it is reduced to zero since 2010.

Another impact is TFS and Wildlife Division directly emitting permits to Beekeepers and collecting revenues from this. Although this can be considered a small amount (i.e. 10'000 TZS per Beekeeper), this is also a source of income that has been cut down for IBA.

Furthermore, timber products are necessary to construct modern beehives. Buying these pieces of wood can be costly. Therefore, an arrangement had been reached in the past years between TFS and IBA for the later to collect rejected timber products for free, or at a very low price. Despite this, no wood has been collected, making modern beehives still expensive to produce, almost unaffordable for beekeepers (i.e. ~80'000 TZS as for sale price).

The recent cleaning operated by the Tanzanian Prime Minister within the official institutions (as well as for TFS) has complicated even more the situation as IBA has no longer contact person within TFS institution. But in the meantime, it represents also an opportunity to create new links with them, to a good start.

4.2.2 Inter-sectorial linkage and cooperation

Despite being judged essential by interviewees, inter-sectorial linkage is qualified as rambling or disjointed. Recent changes within institutions has even more complicated the task of the Management team to improve this situation.

The Project Supervisor estimated though that it is possible to improve this situation, but the process remains contested at an Executive-Committee-level. It consists on "helping" them by paying allowances (for ex. Fuel for their car) as they consider IBA/ADAP institution as very wealthy. However, with the accrual fixed budget, this process cannot be started.

4.2.3 Income generated by legal hunting

Exclusive hunting quotas allotted in the MBKZ to the Tanzanian Big Game Safari are gathering money for the company, 25% being reassigned to TAWA. However, no retrocession is allotted to IBA. Considering then an imbalanced situation of the costs of conservation (material, training, fuel, VGS salary, …) at the expense of IBA and the profits for the benefits of the Wildlife Division and the TBGS (safaris), this leads to a market distortion, depriving IBA of a serious source of income.

Despite recent several attempts to improve this situation (Hausser, pers.comm., 2018), no agreement has been set up.

More anecdotally, some of the interviewee were unaware that legal hunting was practiced within the MBKZ, stating the zone was free from hunting. This outlines again the lack of synergies between the parties (WD, TBGS and IBA).

4.2.4 Awareness of the population on IBA activities and sharing benefits

This survey brought to light that the villagers seems to be aware on what IBA is conducting in the MBKZ since information has been spread for years now.

Considering the scheme of benefit's redistribution to local populations, it is considered as stalled because of TFS problems, but planned in the MP and By Laws, which have been discussed in the villages. Indeed, as IBA has not reached its sustainability, it has no benefits to redistribute. This stands the risk of a deleterious situation where villagers, deprived of right to gather products in the MBKZ and receiving poor or no benefits from the activities conducted there, will overcome the prohibition and practice illegal activities such as poaching, fishing or illegal logging.

4.2.5 Beekeepers training

Beekeepers trainings provided by IBA have been qualified as a success by the interviewee as the quality of honey has considerably improved over the past years. The cost for these trainings are qualified as huge, though.

4.2.6 Village Game Scout

All interviewee gave a different number of VGS that are assigned for either patrols or for Camera Trap setting' session. It seems unclear what is the actual number of them, ranging from 18 to 25. This gap probably originates from non-employed VGS but still on the human resources listing. Last held meeting (August 2018) confirmed 20 VGS.

However, they all agreed that fewer of them, but provided with a highest training and correct equipment would lead to improve their implication and their effectiveness. Again, opinions differ from what is the correct number to maintain, ranging from 15 to 20.

Considering the patrols activities, a problem arose as they don't seem to be randomised in terms of timeframe. All interviewees confirmed that they are currently occurring twice a month, i.e. the first and the last week of the month. Although it is requested that patrols are to be randomised, this seems not possible to implement as VGSs are not salaried

employees of IBA but mandated ad hoc. Consequently, they pile a second job up and cannot change their work days, as requested for such a patrol's randomisation.

In addition, patrols are mainly made by car, and VGSs seem to be reluctant to walk although it is considered as more efficient than car patrolling by all interviewees. Chapter 3.2.3 shows that only 37,5% of the area has been covered by patrols, and mainly near roads (cf. Appendix 10). This should and could be improved as proactive propositions have been made for that purpose by Mr. Dickson Malenbeka and Mr. Shabani Halfani (cf. Appendix 6).

Finally, another weakness has been revealed as the VGS team leader (Mr. Dickson Malenbenka) has no official assistant. This exposes IBA to a serious loss of knowledge in the event the team leader was to be absent or to quit the institution. This point has been qualified as a low threat by some of the interviewees as they consider other VGSs able to handle the job as correctly as it is done now thanks to the training sessions operated yearly (GPS, map reading, …). This may be correct for Patrols, but the response remains uncertain for CT activities as only a few (5 to 6) are capable and sufficiently trained to produce a quality job (Mr. Malenbeka, pers.comm. 2018).

4.2.7 Proactiveness and power centralisation

It has been pointed out that, despite the specific responsibilities of each Management team, all decisions seem to be finally taken at a Project-Supervisor-level.

This can though partly be explained by the turn-over the institution had to face recently, such as the accountant being dismissed for not having done its job in due time. Another reading could come from the fact that English is poorly spoken by IBA's Management team, with the exception of the DMCO, ADAP Project Supervisor and VGS' head, which reduces the opportunity for other employees to interact directly with the stakeholders. Conversely, it has been judged that only one member of the Executive committee can fully express himself in Kiswahili, limiting the "bottom-up" feedbacks to one person only.

Except for the above-mentioned, reasons of this power's centralisation couldn't be defined properly but the consequences might be serious as proactivity within each Management team member can be cut down by these practices. This could lead to a kind of opacity (or judged so) whereas clarity is needed, especially when the project is remotely headed from outside the country it takes place.

4.3 Lepus software

Originally developed to facilitate the pictures' processing, Lepus turned out being time consuming, when remotely used. Connections available (i.e. edge or 3g) in Inyonga village were not suitable for such a purpose, and even back in Geneva, optical fibre shew its limits when it comes to transferring tens of Gb. The question arises then whether the previous method using excel sheets on a local PC would not be more suitable for future similar remote conditions.

4.4 Batteries

Batteries are not stored in proper conditions, leading to complications while engaging them (cf. chapter 2.5.3). The dedicated wooden box is part of the solution for their storage between field's missions but is not suitable for field's constraints. Thus, plastic storage boxes for 8 batteries should be provided in sufficiency (i.e. ad minima 72 boxes for two grids) and a special budget allotted to this accounting item. For example, they can be found at a low price of CHF 3.90 each, summing approximately CHF 280.- (https://fr.officeb2b.ch).

4.5 VGS training

Regarding the Camera Trapping, VGS training is considered as insufficient (cf. chapter 2.5.4). As these CT sessions take place once or twice a year only, and considering the VGS turn-over as well as the contradictory information they might have received, a compulsory training session before each CT session is to be considered. In addition, as almost none of them can speak nor write English, a pocket leaflet with pictures resuming the camera set-up and written in Kiswahili can be produced and provided to them to emphasise the chance of a correct Camera Trapping session. This would improve VGS abilities and avoid some of the disappointment faced in this survey.

4.6 Patrols

Only 37.5% of the overall area has been covered by patrols since VGS systematically track their moves through GPS. This leaves nearly two-thirds of the area without being patrolled at all. A proper randomisation in terms of timescale and geographic scope is to be implemented as soon as possible, this to avoid huge lands free from protections. Tables 19 to 22 can help considering unattended areas for future patrols.

Furthermore, patrols activities could be complemented by the Intelligence-led Law Enforcement (ILLE) or Intelligence-led policing (ILP) in wildlife protection. This emerging mean of protecting areas from offences has shown its results in various conditions, even

in Tanzania where such methods are taking place since 2014 (Taverner & Scott, 2018). First implemented in 1987 in South Africa, it consists of developing an extensive informant network in and around the protected areas (i.e. in surrounding villages also, not only inside the protected area). The wildlife criminality in Tanzanian's protected areas where ILLE has been set-up dropped then by an impressive two thirds within the first years, and 84% of criminals who reached the trial court were convinced.

However, as efficient as these methods can be and impressive the results presented, they require means in terms of time to be implemented and in terms of budget to be carried on. That might be a severe limitation, even an impediment, if considering the overall limited budget ADAP is having to protect the MBKZ.

Finally, considering that most of the patrols were, in regard to the data of this survey, done by car, it would be preferable in a near future to focus on walking transcets. But the process of gathering a second firearm license is to be urged as it is considered as necessary by all the interviewees that each of the two teams can have a weapon for their defence.

4.7 Research effort

The chapter 3.1.1 shows a considerable lower research effort for grids M3 and M5 than for M2 or even M1 (respectively 48% and 18% for M3, 45% and 13% for M5). Assessment of the mammal's community might therefore be less effective than expected, impacting directly the results in terms of Specific richness, RAI and Independent capture events.

4.8 Specific richness

The number of taxa in M1, M3 and M5 grids is significantly lower to M2 grid results (respectively 19%, 16% and 14% lower). Except for the reasons explained above, this might also be due to the seasonality's difference between M2 assessment (during the rain season) and M1, M3 and M5 (during the dry season).

4.9 Independent capture events

These results were the most impacted by the low Research effort. The ratio for M1, M3 and M5 reaches respectively a 37%, 70% and 48% below M2 one.

4.10 Data mining

4.10.1 Characterisation of the Cameras traps through "R" software

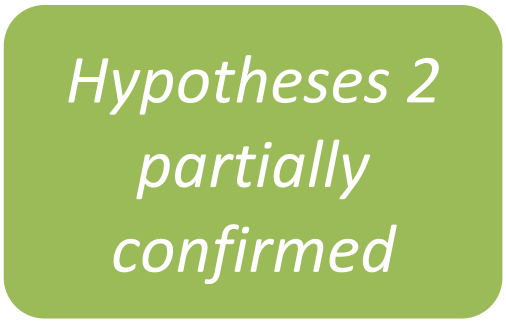
The characterisation of the Cameras sites through R has brought to light interesting information. At first, anthropic variables are explaining more than 50% of the heterogeneity (variance) within cameras sites. Three rough groups of cameras sites can be designed, each group having a particular spectrum of characterisation. Furthermore, the heterogeneity of the 144 CT's assessed here can be visually judged as obvious.

Assessing explanatory factors altogether brought to light that poaching activities and trees debarking are certainly mainly carried out away from roads. The altitude, which is positively correlated with these two illegal activities, could also indicate that the higher it is, the lesser those are carried out. This finding intends to confirm conclusion of a similar study (Joppa & Pfaff, 2009), but this point will be more explicit in chapter 4.10.4.

However, an existing bias cannot be excluded from this reflexion as at the time of this study, most of the patrols had been carried out alongside roads. This might emphasise the number of observations near tracks at the expense of ones away from roads. Thus, this conclusion shall be assessed again once patrols have increased inland coverage.

Then, the distance with the ADAP permanent camp (positively correlated with the distance to beekeeper's camps) is negatively correlated not only with the distance of these two above-mentioned anthropic strains (poaching and tree debarking), but also with the distance to illegal fishing activities. This can mean that such illegal activities might take place away from an area well known for its permanent VGS basement, regular research activities and patrols, which may act as a threat for offenders.

This point, along with the interviewee's responses (cf. questions 5, 10, 24 and 26) tends to confirm the hypotheses 2 of this survey and submit similar conclusion than the recent study conducted by Piel *et al*. (2015). However, a test site should have been assessed (as a comparison) in the meantime – or time series data considered – to be able to safely confirm these results. Therefore, the hypotheses 2 is only considered as partially confirmed.



The distance to prohibited timbering activity is positively interlinked with Closed woodland and Wooded grassland land covers, but negatively with Open Woodland. The latter is where this activity is expected to be the most conducted. It is worth underlining

the strong negative correlation between the number of patrols and the distance to timbering activities. This might also reflect recent success of catching offenders that were practicing timber activities in the Mlele Forest reserve.

4.10.2 Response of RAI to anthropogenic and environmental factors

Distance to poaching activities (D_P) shows a strong negative correlation with the RAI of the *Taurotragus oryx*, which could lead to the statement that this species itself might be one of the poachers' favourites. This point matches one of the two major threats for this taxon, which is poached because of its superior meat (IUCN 2018). Another possible reading can be found in chapter 4.10.4, in the light of further results.

The distance to water points (D_W) shows a strong negative correlation with the *Syncerus caffer*, indicating that this mammal's ecological niche is strongly linked with the presence of water. This point is confirmed by its ecology (Kingdon 2015) which indicates browsing activities preferably in swamp's vegetation areas. The same conclusion can be drawn for *Chlorocebus pygerythrus*, whose RAI also show a negative correlation with the distance to water. This matches also its ecology, as riverine strips are its primary habitat (Kingdon 2015).

Furthermore, distance to water shows also a strong positive correlation with *Tragelaphus strepsiceros*, which can be explained by the water it finds in the eaten vegetation (Kingdon 2015). This is no surprise considering the especially late rain season this year. Whereas *Crocuta crocuta's* RAI is negatively correlated with the distance to water, and its RAI map (cf. Annexe 8) is confirming a presence along the riverbanks. As it is an opportunistic specie, it tends to feed where preys species are more vulnerable rather than where they show a high relative abundance, mudfish being part of its food-taken range (Kingdon 2015).

Hippotragus equinus' RAI presents a positive correlation with the distance to roads (D_R), whereas it has a negative one with the distance to tree debarking activities and distance to fishing activities. It could mean that they are fleeing poaching activities conducted nearby roads and escape into areas where debarking and fishing activities are taking place.

Alcelaphus buselaphus' RAI is positively correlated with the distance to tree debarking. This can indicate that this illegal activity could be considered as having a negative impact for this specie, attempting to avoid as much as possible this anthropogenic strain.

Giraffa camelopardalis tipelskirshi's RAI has a negative correlation with the distance to timbering activities (D_T), which might be explained by their feeding regime taking place

in the areas where trees are abundant and interesting for timbering (such as *Acacias sp., Commiphora sp.* and *Terminalia sp*.) (Kingdon 2015). Its RAI has a negative correlation also with Crocuta crocuta's one which could reflect that the former tends to escape places where the latter predator is present.

Panthera pardus (Panpar) shows a negative correlation with the distance to the roads (D_R). This is confirmed by regular observations of panthers moving along roads (Zurkinden, 2017). A recent observation during a patrol took place early July this year (Malenbeka, com.pers, 2018), where a dead panther along the road was found, its head being hit by a car.

Indeed, these figures must be put in brackets as they reflect only 18.5% of the overall RAI variation. However, they tend to confirm – on a RAI aspect – the first hypotheses of this survey which is "Anthropological factors are the key determinant of the distribution and abundance, regardless of habitat quality and resource availability (that can be subsequently influenced by the management)". This needs to be confirmed and cross-checked with the other response factors that are the species richness and the distribution.

4.10.3 Response of mammal's Distribution to anthropogenic and environmental factors

Results provided with this evaluation are quite similar to the RAI's ones. This is considered as normal, even comforting as sets of data are directly related (even inter-linked) and statistical tools to analyse them were similar.

Nevertheless, these analyses revealed interesting complementary information, such as for *Orycteropus afer* (Oryafe), which shows a strong negative correlation with the distance to water (D_W). This result is matching its ecology, i.e. avoiding flooded areas (Kingdon 2015).

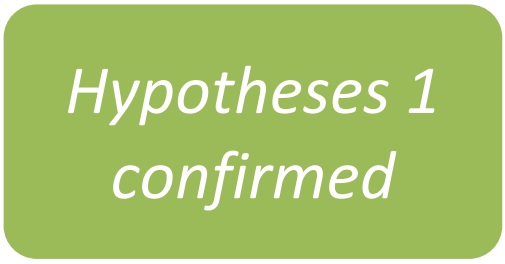
The second one is concerning *Equus quagga bohemi* (Eququa) which shows a direct negative correlation with the distance to timber activities (D_T). Although considered as an adaptive grazer (Kingdon 2015), the destruction of the forest cover conducted in open woodlands through high timber activities could impact over time the ecological niche of the Zebra.

Finally, the distribution of *Hippotragus equinus* seems positively correlated with the distance to beekeepers' camps, such as for *Civettictis civetta.* This could indicate that these species could be considered as human avoiders (Riggio *et al*, 2018).

4.10.4 Response of Specific richness to anthropogenic and environmental factors

Along with the characterisation of the CT sites, this assessment revealed itself being the most adapted one to highlight significant and meaningful correlations between mammal's diversity and environmental and anthropogenic factors.

At first, it confirms that the two first drivers of mammal's specific richness are the altitude and the distance to roads. This tends to confirm the findings of Joppa & Pfaff (2009). However, these two factors, although one to be environmental one, are not the exclusive ecological niches of the mammal's assessed. One reading could be that mammal's community is escaping from these anthropic strains that are conducted near roads and in easily accessible plains. This is taking over and supporting results from chapter 4.10.2. These results altogether lead to the conclusion that the first hypotheses of this survey can be confirmed in the light of these results.



Timber activities are mainly conducted in open woodland landcover, as it has been assessed previously. And it is also near this activity that the specific richness is high. Disturbances and damages caused by this illegal activitie must be then seriously reconsidered and the means in term of protection (patrols) adapted accordingly, this to achieve an efficient protection of the mammal's community. Patrols should concentrate on open woodlands where timber activities are conducted.

Poaching activities take place where the specific richness is the higher, which seems to be common sense. However, knowing precisely the sites where the specific richness shows its highest level might help to focus anti-poaching patrols where they are the most efficient, and limit the risks for the mammal's community to be illegally hunted. Based on these results, a map encompassing the distances to the road and to the poaching activities has been produced, indicating the areas where poachers are most likely to practice their illegal activities (cf. Appendix 11). This can serve as a referential for further patrols.

Results show also that distance to roads and altitude are driving most notably the specific richness. This confirms the High and Far theory (Joppa & Pfaff, 2009) already partially spotted in chapter 4.10.1.

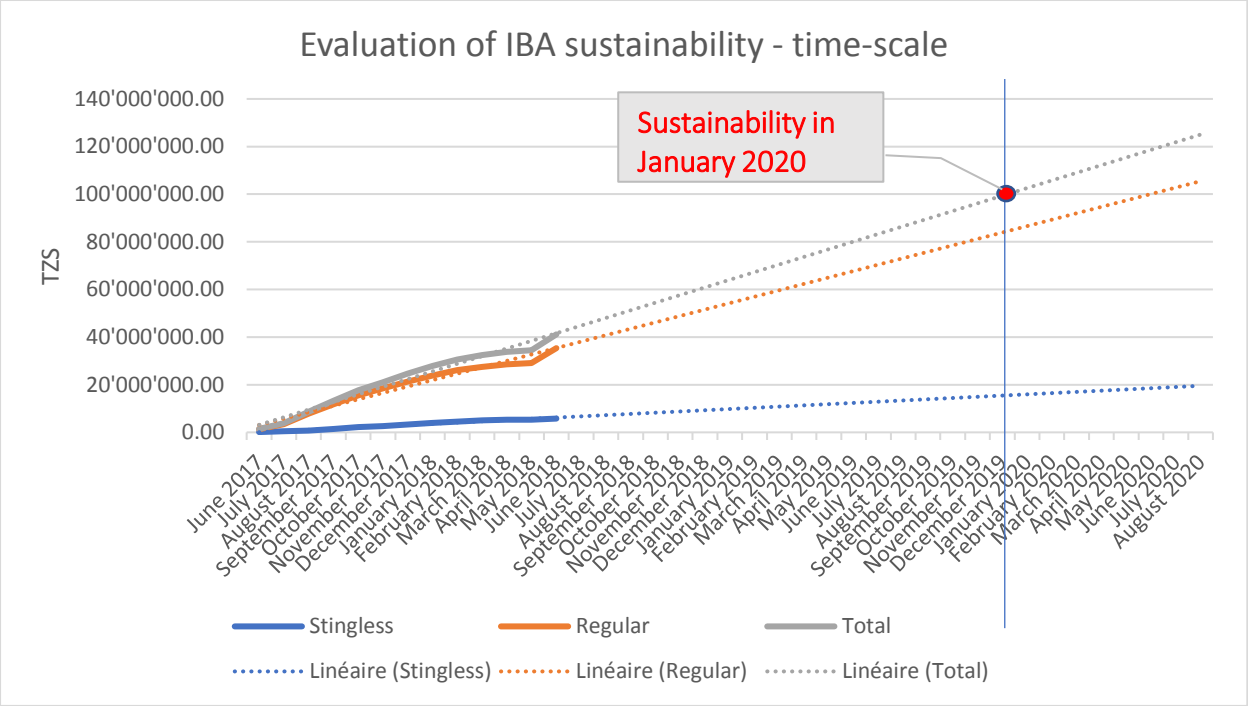
Finally, it is interesting to note that, although the water is positively correlated with a high Specific richness, fishing activities tend to wield a repulsive effect on mammal's

communities, this repulsive effect being stronger than the attractiveness of water (AIC results shew a higher negative correlation with fishing activities than with the proximity of water sources).

4.11 Reaching IBA's sustainability

Considering the above-mentioned obstacles that IBA is facing in achieving a sustainable financial situation (cf. chapter 4.2), measures are to be taken, at different decision-making levels and within several timeframes.

Table 45: Time-scale to reach IBA' sustainability with the support of the actual honey selling only. Source: Present survey



Firstly, incomes are mainly – if not exclusively – generated by honey's selling. Assuming a purchase/selling trend at least similar to this year – during which nearly no product harvesting has been recorded in the 2018 dry season – and considering a necessary TZS 100'000'000 yearly budget (Hausser 2016), the sustainability would be reached near January 2020 (cf. table 45). That is beyond the ADAP's financial support deadline that will occur within months, and therefore is not a valid alternative.

Then, IBA shall be considered as a company as well and needs means in term of income to be independent from any external financial support. This will allow financial benefits to be distributed to local populations as an example and to finance their conservation's operations.

Honey is IBA's core business. It needs to be more actively developed, at different levels:

- A Jurist shall be contacted to evaluate the lawfulness of TFS' MoU rejection.

- TFS is to be contacted and, depending on Jurist's answer, either urged to comply with the law, or invited to sign a new MoU before the 2020 dead-line (accrual status quo is not an option).
- Source of wood at low price – or for free such as rejected timber – for the manufacturing of modern beehives, is to be found rapidly.
- The manufacture of modern beehives is to be started, at a high volume of production (1'000 beehives). Part of the production will be owned and operated by IBA directly (600), the rest (400) will be lent for free to Beekeepers in return for 20% of their production.
- Collecting sites in the bush shall be reintroduced to ensure the highest collection percentage of honey.
- Beekeepers are to be informed that traditional beehives will be tolerated in the MBKZ one more year only.
- New markets are to be prospected, beginning with regional and district-level lodges, hotels, restaurants, supermarkets, and in a second time even foreign market.
- An accountant is to be hired.

The table below (cf. table 46) is encompassing the issues and proposes objectives to improve IBA' sustainability, the measures to be taken, specifying within which time-scale they should operate, and finally provides indicators to track the progress.

Table 46: Table of objectives for IBA to reach its sustainability.
Source: Present survey

Objectives	Measures	Impacts	Time-scale	Indicators	Estimated costs	Estimated incomes
1. Evaluation of the lawfulness of TFS' MoU rejection	**1.A** Set up a meeting with a Jurist	Being able to rebound to TFS after its evaluation	Immediat	Meeting arranged	-	-
2. Changing the accrual status quo with TFS	**2.A** Set up a meeting with TFS	Either urge them to apply the law, or sign a new MoU before the maturity of the acrual one (2020)	September 2018	Meeting arranged	-	-
3. Being able to manufacture hundreds of modern beehives	**3.A** Find a free sources of timber (rejected timber)	Perpetuation of the activity over the time	Depending on the arrangements possibly found with TFS. In any case, by October 2018 the latest	Contractual timber volume	-	-
	3.B Hire a woodworker to produce hundreds of modern Beehives	Being able to exploits modern Beehives	October 2018	Hiring of a carpenter/woodworker	TZS 10'000.- per day. 440'000.- for two months (22 days a month)	-
	3.C Produce 1'000 modern beehives	Increase the stock of production means	During October 2018 and November 2018	Number of modern beehives produced per day	TZS 3'000.-/beehive. TZS 3'000'000.- for 1'000 beehives*	-
4. Income gathering from modern Beehives' production	**4.A** Lend 400 of modern beehives for free to Beekeepers against 20% of their production	Argumenting for modern beehives, pulling beekeepers together with IBA	Since October 2018, along with beekeepers needs	Number of modern beehives lent	Initial cost TZS 1'200'000.-	Per havesting season TZS 8'400'000.-. Per year TZS **16'800'000.-****
	4.B Exploit 600 modern beehives for the account of IBA directly	Reaching a sustainable source of income at each havesting period	Ready for the next summer harvesting season	Number of modern Beehives exploited by IBA	Initial cost TZS 1'800'000.-	Per havesting season TZS 63'000'000.-. Per year TZS **126'000'000.-****
	4.C Reintroduce honey collecting sites in the bush	Ensure the highest collection of honey, pulling beekeepers together with IBA.	At each harvest season	Increasing honey's volume gathered	Fuel	-
5. Reduction of traditional Beehives	**5.A** Inform the beekeepers that traditional beehives will be tolerated within the MBKZ one more year only	Reduce the threat to landscape wood cover. Lead beekeepers to collect at IBA free modern beehives	Since October 2018	Decreasing number of traditional beehives noted during the patrols	-	-
6. The improvement of income gathering through honey selling	**6.A** To prospect new markets, such as lodges, hotels, restaurants, supermarkets and even foreign markets	Rise selling volumes, collude the risks linked to the accrual niche market	Since January 2019, to be ready for the next summer harvesting season	Number of new clients, contractuals volumes of selling	Fuel	-
7. Power decentralisation, risks of collusion lessen	**7.A** Hire an accountant	Clear company scheme	September 2018	Hiring of an accountant	Accountant salary	-
				Total (excl. VAT)	TZS 3'440'000.-	TZS 142'800'000.-

* At a pace of 3 modern beehives produced per hours, eight hours a day, 22 days a month. Excluding nails and glue costs.

** At a 15L average production per modern beehive and per harvesting season, priced at TZS 7'000.-/L. Excluding beekeepers salaries.

5 Conclusion and prospects

The analysis of the results arising from the assessment of the mammal's community as brought to light interesting information. At first, it confirms that some mammals' groups have already modified their ecological niche, certainly in response to anthropogenic strains (hypothesis 1). For example, the highest Specific richness has been strongly positively correlated with the distance to the roads but also positively with the altitude, whereas ecological niche of the assessed mammal's overlaps plains as well.

In addition, this survey tends to prove that poaching operations are mainly undertaken away from the roads, so as trees debarking. For the latter, and along with the fishing activities, this study suggests also that ADAP permanent camp and Beekeepers camps together play a repulsive effect on these illegal practices (hypothesis 4).

Accurate patrols maps that would consolidate these findings could certainly improve the effectiveness of the mammal's protection and facilitate upstream route planning. Therefore, a map indicating the potential places where poaching activities are the most likely to occur has been issued to serve as a guideline for future patrols.

Furthermore, in light of the results of this survey, Open woodlands and Wooded grassland shall be considered first as scoring the highest Species Richness as well as the most binding anthropic strains. Another immediate focus point could be to pinpoint all the new tracks and roads that are, at the time of this study, not already mapped. In this regard, insisting on random walking transects would be more suitable than going on with car transects. The process of gathering a second weapon license for the VGS shall be then speeded up at once.

Considering IBA sustainability, this study provided suggestions to improve the economic situation of the institution in order not to stop the protection of the mammal's communities because of a lack of funds or even a bankruptcy. While ambitious, this would also enable the institution to reconnect with its objectives and promises in terms of local development.

Finally, with respect to the time-series data, it could be worthwhile to orient a further Bachelor or Master thesis towards the assessment and the data-mining of time-series data only, this to potentially bring new interesting results, such as the assessment of demographic trends over the time, thus enabling to advise science-based and realistic hunting quotas. In addition, assessing the real occupancy of the mammal's community could lead to more accurate and reliable results, or even to different conclusions.

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APPENDICES

Bachelor Thesis presented by:

Fabrice BUFFARD

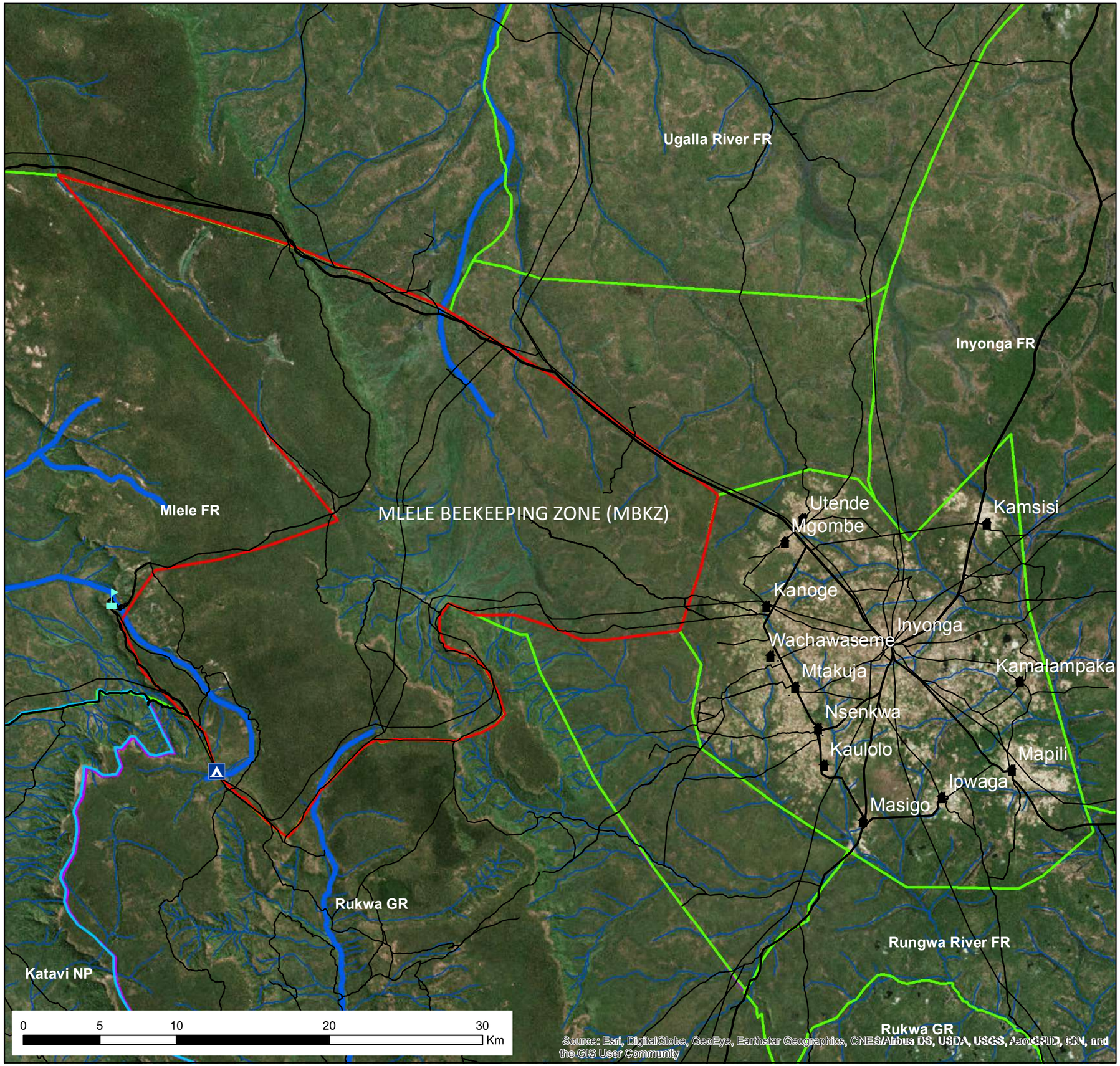
In the purpose of obtaining a UAS - WS Bachelor's degree in
Natural Resources Management

List of Appendices

Appendix 1: Study Area

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 1: Study area



Legend

- Villages

Roads

- Tracks
- Secondary
- Main
- Mlele BKZ
- Katavi National Park
- Forest Reserve
- Game Reserve
- Main rivers
- Rivers secondary

Source : SITG

Author : Buffard Fabrice. Août 2018

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Appendix 2: New CT sites

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 2: New CT sites

Legend

Quadrat

- M1
- M2
- M3
- M4
- M5

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Appendix 3: Previous CT sites

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 3: Previous CT sites

Legend

Quadrat

- M1
- M2
- M3
- M4
- M5

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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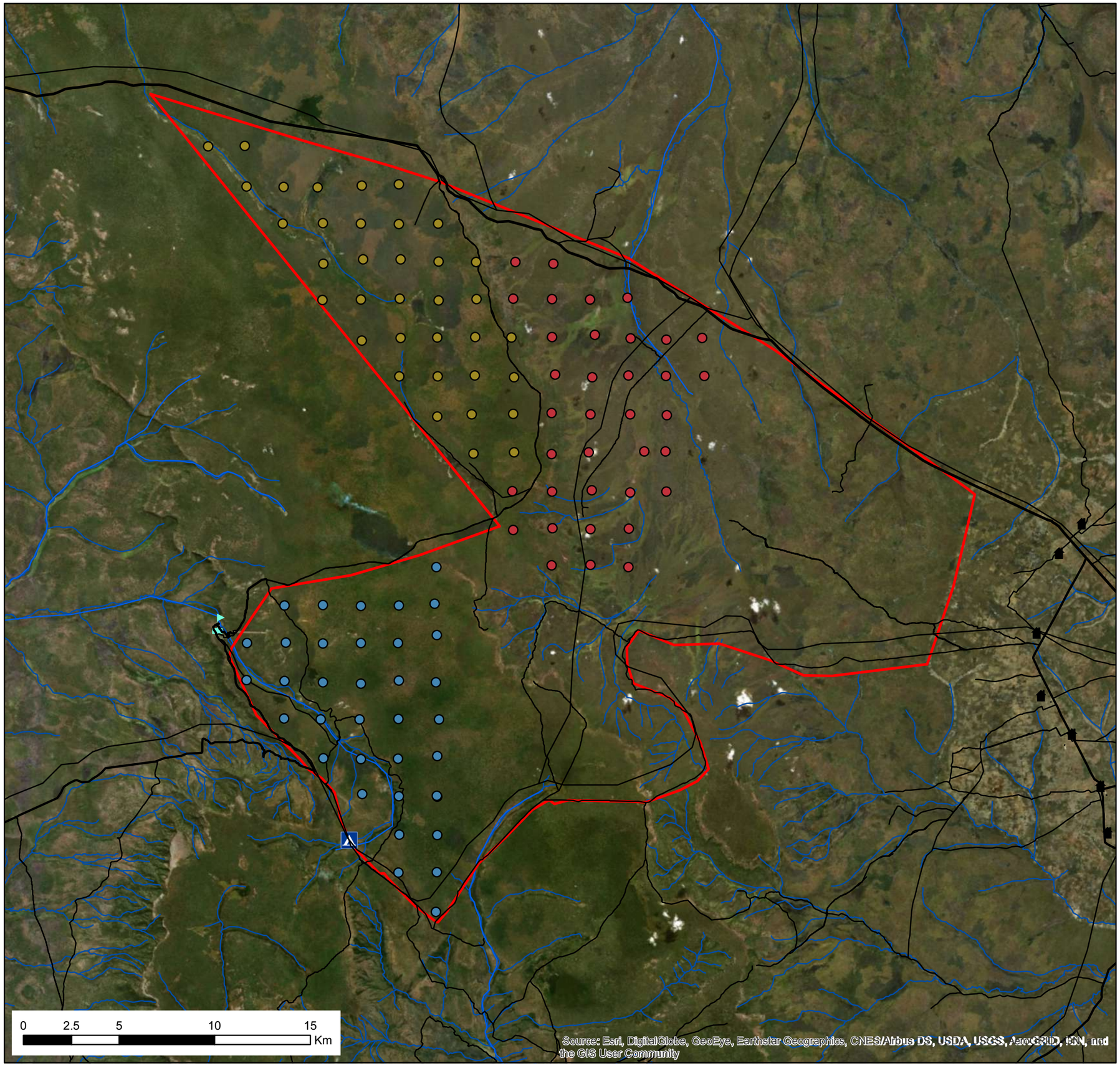
0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Appendix 4: Effective CT positions for Mlele 2018 campaign

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 4: Effective CT sites



Legend

Effective CT sites 2018

Quadrat

- M1
- M2
- M3
- M4
- M5
- Mlele BKZ
- TZA_roads
- Main rivers

Source : SITG

Author : Buffard Fabrice. Août 2018

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Appendix 5: Survey questionnaire

All these questions are driven by the accrual Management Plan (2016-2010) and they all addressed subject that are listed in this document.

A
B

1. TFS aims to develops and manage forests and bee resources. How do you consider their role within the MBKZ?
    A. Are they providing technical support to IBA?
    B. Are they monitoring the beekeeping activities conducted by IBA?
    C. If yes, by which means?
    D. Are they struggling to prevent illegal harvesting of forest product?
    E. Are they of any help to maintain communication with all involved stakeholders?
    F. As an example, during the past years?

A
B

2. Does the switch of management responsibilities from FDB to TFS in 2014 has led to complications, improvement or led to no changes?
    A. Is there a new MoU signed by TFS or does the previous was taken over?
    B. Does the MoU still carry the same objectives, i.e. a mutual desire of sustainable use of the forest plants?
    C. Is the mandate of 10 years attributed in 2010 to IBA to manage the MBKZ still respected?
        - Are there any new issues arising since TFS direct participation?
        - What kind of conflict can you identify?
        - What could be the solutions or action to be taken?
        - At which level?

A
B

3. Recently, the prime minister has operated a cleaning within the governmental institutions, which led to fire employee, such as within TFS.
    A. How do you consider this cleaning?
    B. Is this leading to issue for IBA or will that make future collaboration easier?
    C. What could be done to IBA taking advantage of this situation?
    D. What could be your role in that process?
    E. At which timescale?

A
B

4. Land use plans established for all villages are becoming soon obsolete (if not already)
    A. Is the de-gazetting of portion of forest into village land threatening the MBKZ?
    B. What kind of solution do you recon to curb this land-expand inflation?
        - Law enforcement
        - VGS patrols increment
        - Other
    C. Who/which stakeholders/actors should be involved to act finding a solution?
    D. What could be your role in that process?

A
B

5. Awareness of the population or some government staff of what is really the MBKZ
    A. Is the communication and the dialogue between IBA, District officers, local communities and the government established?
    B. How would you qualify this dialogue?
    C. Do you consider as important villagers to be informed on the tasks conducted by IBA into the MBKZ?
    D. Is it occurring on a regular basis?

E. At which timescale?
F. Which risk do you forecast in case this awareness cannot be improved?
G. How soon these risks will increase?
H. On your opinion, how can this awareness be improved?
I. By whom?
J. What could be your role in that process?

6. Do you think the income redistribution and sharing of benefits for local population has a clear scheme?

A
B

A. Which amount (%) has been redistributed to villages, for ex. In 2017?
B. What could be improved?
C. How can these improvements be executed?
D. Within which time-table?
E. Which risk do you foreseen in case this sharing cannot be improved?
F. How soon these risks will increase?
G. Does the Village Council made report available to villagers to see?

7. How do you consider important staff stability?

A
B

A. Is the turnover recorded past years an issue or a necessary chore/evil?
B. On your opinion, how can this turn-over be reduced?

8. What is the effective number of VGS under contract with IBA?

A
B
V

A. Do you consider this number as too little, rocket or too big?
B. Do you think it would be sustainable to reduce the number of VGS meanwhile increasing their training and providing them with a fix contract?
C. At which occurrence are they engaged into patrols?
D. How long do they last?
E. In your opinion, which way of transects is the most efficient in terms protection, walk transects, car transects or a mix of both means?
F. Are the patrols randomised of any kind?
G. Dixon is the team leader, who is the assistant leader?
H. Considering the possibility of absence, illness or even death, is there any VGS now capable to handle the team leader's responsibilities as good as he is now handling them?
I. Is this a risk of loss of knowledge if such event occurs (severe sickness, death)?
J. Do you consider English language a necessary mean to communicate with stakeholders?
K. Are VGS having lessons or training of any kind?
L. As an example, during year 2017?
M. Has ever an external expert mandated to conduct the process of evaluations on VGS' capacities?
N. Have they insurances of any kind?
O. How many VGS have the right to carry weapons?
P. Is this sufficient in your opinion?
Q. To whom patrols report is presented to?
R. At which frequency?
S. Are actions taken after the report's publications?
T. By whom?
U. Of which kind?
V. As an example, in past year?

A B

9. The Central Committee meeting is held on a quarterly basis
    A. Is it receiving any income from the fines paid by offenders?
    B. As an example, for year 2017?
    C. Are these incomes issuing profits to the villages?
    D. As an example, for year 2017?
    E. Has CC already mandated external parties to undertake projects related to management or conservation of the MBKZ?
    F. In which cases?
    G. Has the CC provided advices on environmental issues at village level?
    H. As an example, in the recent years?
    I. How has it been perceived by villagers?

B

10. MBKZ committee is holding monthly meetings
    A. Is it organising a meeting as well with Village Government to exchange about MBKZ management?
    B. What are the outputs of these meetings?
    C. Are there any points coming repetitively?
    D. What could be improved in term of arise issues?
    E. What could be your role in that process?

B V

11. IBA Management team
    A. Is the management team planning by itself the patrols of VGS?
    B. Who oversees the choose of the VGS to operate such patrols?
    C. Is the management team in charge of permit deliverance?
    D. Is it collecting fines from offences?
    E. Is conducting monitoring of beekeepers' practices?
    F. How are they conducting this monitoring?
    G. Who is conducting the survey?
    H. With which means?
    I. What is the estimated overall amount collected past years through fines for offences?
    J. Are VGS receiving part of these fine paid by every person they arrested?
    K. As an example, in year 2017?
    L. Do you consider this process of retrocession as an encouragement for VGS to pursue their duty?

A B V

12. Mlele District Council
    A. Are they providing IBA with technical advices on implementation issues concerning conservation and natural resources' management?
    B. As an example, what was their last support?
    C. Have they joined VGS patrols at any time?
    D. At which frequency are they sending an officer to these patrols?
    E. How are they reallocating funds (if any) derived from the management to villages?
    F. As an example?

A

13. Inter sector linkage and cooperation
    A. Do you consider inter sector linkage and cooperation as an essential part of the success in the conservation of the MBKZ?
    B. How are set-up /maintain links between all the above-mentioned institutions?
    C. Which tools are used to do so?

D. Who is involved in that process?
E. What could be your role in that process?
F. In your opinion, what should be improved?
G. How and by which means?
H. In which timescale?

14. Who is taking part on planning the management activities for MBKZ protection?
    A. On which basis (quarterly, monthly)?

15. Beekeepers training to shift from traditional to modern beehives and techniques
    A. What kind of training is provided?
    B. At which frequency?
    C. Is this a success or not?
    D. What is the cost of a training session? (IBA/beekeepers)
    E. At your opinion, is it worth the amount? (return in investment)
    F. What would you recon to improve this situation?
    G. Are VGS assessing the number of harvested beehives compared to declared ones?
    H. What is the magnitude of this number?
    I. How are they proceeding to do so?
    J. Which number of regular camps is located within the MBKZ?
    K. Are VGS recording non-registered camps?
    L. Which number of illegal camps is located? (approximate)
    M. Are they fining non-registered camps owner of any kind?
    N. As an example, for 2017?
    O. Is Msima training centre supported by IBA? (House rent, staff…)
    P. Is there any return on investment done so far?

16. Fire management
    A. No dry area shall be burnt and a turn-over is to be done: is this respected/feasible in your opinion?
    B. How are trained VGS?
    C. Have been the District Natural Resources Officer and the District Beekeeping Officer of any help on that matter in the recent years?
    D. As an example?

17. Are roads and tracks repaired when damages are observed?
    A. When have been processed these controls lately?
    B. What are the means engaged to do so?
    C. Who is executing the work?
    D. Support to income generating activities
    E. What are the means in term of support IBA provides to local population to engage in conservation actions?
    F. Are meetings or trainings provided/held by IBA to engage surrounding MBKZ villages to participate to these conservations actions?
    G. In your opinion, are these means sufficient?
    H. What could be enhanced?
    I. By which means?
    J. Is benefit sharing possible?
    K. How would you organise this sharing?

A
B
V

18. Training of human resources
    A. Do you consider HR training a key to improve performances capacities?
    B. Have you personally been involved in such training?
    C. As an example, what was the last training you received?
    D. At which recurrence you consider these training shall be conducted?
    E. Have you personally expectations for your next training?
    F. Who should you refer to in case you need a training?
    G. Has a request been already refused?
    H. What was the reason of this refusal?

A
B
V

19. Are you aware of any yearly time table for the overall activities?

	Tagreted period											
Field Activites	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Patrols	■	■	■	■	■	■	■	■	■	■	■	■
Beekeeping facilitation and camp assesement							■				■	
Fire management					■	■						
Boarder maintenance				■								■
Roads maintenance						■						
Flora assesement and monitoring								■				
Wildlife assessement and monitoirng (camera traps)			■			■			■			■
Support to income generating activites	■	■	■	■	■	■	■	■	■	■	■	■
Strengthing of Village institution	■	■	■	■	■	■	■	■	■	■	■	■
Training of management staff		■	■							■		
Training of Village scouts							■	■				
Evaluation of human resources performance	■											

    A. Did you make personally recommendations for its improvement?
    B. What could have been the reasons for not following the schedule planned on this time table?

A
B
V

20. Modern beehives – traditional beehives
    A. Do you consider new beehives as an essential part of the future success for IBA sustainability?
    B. Only sitting of new modern beehives should be tolerated. Considering that it has been years since it is not permitted to site traditional beehives, and the short durability of them (i.e. 2 years) would you consider any traditional beehive as a new one?
    C. What is the action to be taken when traditional beehives are sited?
    D. Are you allowed/encouraged/prompted to take any action?
    E. Taxation of honey/non-timber products
    F. Is there any income gathered from the taxation of beekeeping activities (except for IBA permit)?
    G. How is managed this 10% tax on beekeeping activities and products?

H. By which means do you collect it?
I. Is there a risk of fraud from the beekeepers trying to diminish the value of their harvest?

21. Hunting

A
B

A. Does the Wildlife division communicate in advance the hunting quotas/locations to IBA central committee?
B. On which basis are they establishing such quotas?
C. Considering the costs at the expense of IBA (patrols), and the money for the benefits of the Wildlife Division (hunting's permits), would you consider normal a retrocession of the hunting benefits to IBA?
D. What shall be this retrocession (in %/fix rate)?
E. Which amount would that grant IBA if so occurs?
F. What actions are to be taken to gather an agreement with WD?
G. Do you consider as pressing to initiate this process with the WD?
H. What could you do to improve this situation?
I. At which timescale?

22. Poaching activities and other illegal gathering of forest products

A
V

A. Do you consider patrols as an efficient way to counter poaching and illegal activities?
B. Are they randomised?
C. Shall they be reinforced of decreased?
D. Have you ever heard of Intelligence-led Law Enforcement for Wildlife protection?
E. Do you consider this feasible?
F. By which means?
G. At which timescale?

23. Manager, member of MBKZ Committee and District Officer are responsible to hear offender.

A
B

A. IBA Manager shall record the amount of fine paid, is it so?
B. Has it already occurred that an offender was not able to pay for the fine and be condemned to conduct manual work/community work for a duration corresponding to the debt amount?
C. If not, what are the difficulties encountered?

24. MBKZ committee and IBA manager are to conduct monthly meetings in villages to inform villagers on activities' implementation, and to discuss about management difficulties and success.

A
B

A. Generally, can these meetings be effectively held?
B. What are the recurring points coming up?
C. What actions have been taken to solve the arise issue?
D. Monitoring and evaluation are set around 5 objectives
E. To you, what are the key points of the framework, what it is it's mean?
F. Do you think these indicators of success are relevant?
G. Which one is the most relevant for you?
H. Which shall be removed/modified/added?

25. IBA might probably face a reduction of the existing financial support from ADAP

A
B

A. Do you consider this exiting support as essential for the future of IBA?
B. How sustainable is IBA on your opinion (at the time of this survey)
C. How sustainable can be IBA on your opinion?

D. On your opinion, which amount shall be collected on a yearly basis to allow IBA to be sustainable?
E. Do you have pathways to improve IBA sustainability?
F. What activities shall be reinforced, which shall be removed from IBA scope?
G. What could be your role in that process?
H. In what timeframe do you consider this possible?

26. Since the beginning of IBA and furthermore ADAP, how do you think has evolved villagers' consciousness about the exceptional biodiversity that takes place in the MBKZ?
A
B
A. How would you estimate the % of villagers that are aware of this biodiversity?
B. Do they have regrets of any kind?
C. Do they have expectations?

Appendix 6: Responses to interviews

All these questions are driven by the accrual Management Plan (2016-2010) and they all addressed subject that are listed in this document.

1. TFS aims to develops and manage forests and bee resources. How do you consider their role within the MBKZ?
   A. Are they providing technical support to IBA?
      - Yes, sometimes. But we don't have a good relation with TFS. They are just exploiting IBA. When we catched cattle, they don't cover our expanses.

   B. Are they monitoring the beekeeping activities conducted by IBA?
      - Yes. But it is like we have a conflict of interest. They provide permit whereas IBA is the manager.

   C. If yes, by which means?
   D. Are they struggling to prevent illegal harvesting of forest product?
      - I don't think so. During the rain season, this year, we found a lot of wood stamped by TFS although it is forbidden to harvest wood in a Forest reserve.

   E. Are they of any help to maintain communication with all involved stakeholders?
      - No.

   F. As an example, during the past years?
2. Does the switch of management responsibilities from FDB to TFS in 2014 has led to complications, improvement or led to no changes?
   - To me, since I'm new, I heard issues. With FDB, things were running good. Since TFS came, began the problems

   B. Is there a new MoU signed by TFS or does the previous was taken over?
      - We proposed a new MoU, but it is not yet implemented and still using the old one. But TFS refuse to recognise the former MoU as it is not signed by them

   C. Does the MoU still carry the same objectives, i.e. a mutual desire of sustainable use of the forest plants?
   D. Is the mandate of 10 years attributed in 2010 to IBA to manage the MBKZ still respected?
      - Are there any new issues arising since TFS direct participation?
        - Yes, the MoU is not respected. The new organ (TFS) thinks we are against their interests
      - What kind of conflict can you identify?
        - MoU
      - What could be the solutions or action to be taken?
        - Conflict of interest, in December 2017 we had a meeting in ADAP with TFS officers and tried to discuss to set-up things. They propose IBA to write a report to the Secretary of Ministry so TFS could advice how to implement changes. Since that time, everything is suspended and we don't know what is going on. For example, last week I visited the Ministry on Natural Resources at Dodoma but missed them. It should be retried.
      - At which level?

A
B

3. Recently, the prime minister has operated a cleaning within the governmental institutions, which led to fire employee, such as within TFS.
    A. How do you consider this cleaning?
        - It was right, employees where not working properly, just harvesting and other short term activities (illegal). Like havesting wood in a Forest reserve.
    B. Is this leading to issue for IBA or will that make future collaboration easier?
        - The former employees had a negative attitude with IBA. With new officer, it can only be better.
    C. What could be done to IBA taking advantage of this situation?
        - I think, we must sit together with the new officers, expose our issues. I am convinced they would be hearing us. We expect something bigger from these new officers.
    D. What could be your role in that process?
        - Actively organise a meeting.
    E. At which timescale?
        - As soon as possible, as we were considered stealing TFS property. We must sit together soon.

A
B

4. Land use plans established for all villages are becoming soon obsolete (if not already)
    A. Is the de-gazetting of portion of forest into village land threatening the MBKZ?
        - Mlele is increasing, Sukuma are unfriendly and moving to Sinianga to Katavi. If TFS don't take measures, the area would be in troube. We want to collaborate with TFS, but they were considerring us as enemies. Once ADAP will stop supporting IBA, MBKZ will be haversted within months. The ADAP support is helping to protect the area. Even at a ministry level they know that ADAP is working well protecting resources.
    B. What kind of solution do you recon to curb this land-expand inflation?
        - Law enforcement
        - VGS patrols increment
        - Other
            - Working with TFS, who should take their responsibilities.
    C. Who/which stakeholders/actors should be involved to act finding a solution?
        - The District Commissionnar, Executive Director, the Police also.
    D. What could be your role in that process?

A
B

5. Awareness of the population or some government staff of what is really the MBKZ
    A. Is the communication and the dialogue between IBA, District officers, local communities and the government established?
        - We have a long story, therefore they might have a mitigate opinion. Because of TFS, the picture might be darker and the communication becoming harder. We try to make them understand that we are doing something better. For the moment they know we are doing good. The District officer understand how IBA is working through ADAP support. We gave her enough information to go on trusting IBA.
    B. How would you qualify this dialogue?
    C. Do you consider as important villagers to be informed on the tasks conducted by IBA into the MBKZ?

- It is very important. They must understand that a protected MBKZ can help villagers as well to gather sustainable income.

D. Is it occurring on a regular basis?
   - We are conducting trainings, through Villages comities. The Representer of Villagers received information about IBA's activities, and we are pretty sure they informed villagers afterwards.

E. At which timescale?
F. Which risk do you forecast in case this awareness cannot be improved?
G. How soon these risks will increase?
H. On your opinion, how can this awareness be improved?
I. By whom?
J. What could be your role in that process?

A
6. Do you think the income redistribution and sharing of benefits for local population has a clear scheme?
   - At the moment, we have to income to redistribute coming from the MBKZ. A new MoU would stipulate the income's distribution to villagers, but it is not implemented yet, pending.

B
B. Which amount (%) has been redistributed to villages, for ex. In 2017?
C. What could be improved?
D. How can these improvements be executed?
   - A new MoU

E. Within which time-table?
   - It is at a Ministry level, therefore let's wait.

F. Which risk do you foreseen in case this sharing cannot be improved?
   - Villagers won't have alternatives and would go to the MBKZ harvesting the resources, since there is no redistribution.

G. How soon these risks will increase?
   - It is in silent, but the hardship of life is increasing, and the problem might occur at any time.

H. Does the Village Council made report available to villagers to see?
   - I don't think so.

A
7. How do you consider important staff stability?
   - Very important. Stability of the staff will dedermine IBA progression.

B. Is the turnover recorded past years an issue or a necessary chore/evil?
B
C. On your opinion, how can this turn-over be reduced?

A
8. What is the effective number of VGS under contract with IBA?
   - Currently, we have 15 active VGS. Not sure, but no more than 20. Formerly we had 25 VGS

B
B. Do you consider this number as too little, rocket or too big?
   - The number of VGS has decreased through years (fire, departure). I consider 15 is enough, hardworking, trained.

C. Do you think it would be sustainable to reduce the number of VGS meanwhile increasing their training and providing them with a fix contract?

V
   - This would be nice, as training shall not be once, but regular. Things are changing.

D. At which occurrence are they engaged into patrols?
    - Once per month
E. How long do they last?
    - 7 days
F. In your opinion, which way of transects is the most efficient in terms protection, walk transects, car transects or a mix of both means?
    - Walking transcets are very important. Car transects are not very efficient, therefore I recommended the VGS to walk more in the forest while patrolling.
G. Are the patrols randomised of any kind?
    - We propose this to Yves, but it is not yet implemented. Fix scheduled will facilitate illegal activities.
H. Dixon is the team leader, who is the assistant leader?
    - We don't have an official assistant. But we sit down and assess who has the Dixon's capabilities.
I. Considering the possibility of absence, illness or even death, is there any VGS now capable to handle the team leader's responsibilities as good as he is now handling them?
    - We have some criterias to choose who could be handling this responsibility. Yes, Feliciano is a good candidate, we have a list ready.
J. Is this a risk of loss of knowledge if such event occurs (severe sickness, death)?
    - Absolutely not, everything would be done.
K. Do you consider English language a necessary mean to communicate with stakeholders?
    - Of course it is important, but according to the level of education of some VGS, it would be difficult to implement. Maybe not possible to implement for everyone.
L. Are VGS having lessons or training of any kind?
    - Yes, training of GPS, reading a map, writing report. Feliciano was not able to use a GPS, and now he is a good team leader.
M. As an example, during year 2017?
N. Has ever an external expert mandated to conduct the process of evaluations on VGS' capacities?
    - No. To me I don't remember.
O. Have they insurances of any kind?
    - No.
P. How many VGS have the right to carry weapons?
    - All VGS are trained. Depending to ability, we choose. 4 to 5 are allowed (Sabaha, Feliciano, Masanmba, Riamba, Kasamaki). The owner of the gun is IBA Chairman, who is owning the permit on behalf of the association. The procedure for requesting a second weapon is under Manager process.
Q. Is this sufficient in your opinion?
    - This number gives us alternatives as not all VGS can be ill at the same moment. This number is correct to me.
R. To whom patrols report is presented to?
    - Dixon establish the report, I translate it and send it to Geneva.
S. At which frequency?
    - Once a month, through a narrative report.
T. Are actions taken after the report's publications?

- Of course, Yves is very active.

U. By whom?
- Then we discuss what should be done with the Project supervisor.

V. Of which kind?
- Wood stamped by TFS, then we decided to write a letter to complain about this issue.

W. As an example, in past year?

9. The Central Committee meeting is held on a quarterly basis

A

B

A. Is it receiving any income from the fines paid by offenders?
- No.

B. As an example, for year 2017?

C. Are these incomes issuing profits to the villages?

D. As an example, for year 2017?

E. Has CC already mandated external parties to undertake projects related to management or conservation of the MBKZ?
- Sometimes the CC visit the MBKZ. But I don't think so, since I'm in the office (one year)

F. In which cases?

G. Has the CC provided advices on environmental issues at village level?
- Yes, through Environmental training

H. As an example, in the recent years?

I. How has it been perceived by villagers?

10. MBKZ (executive) committee is holding monthly meetings

B

A. Is it organising a meeting as well with Village Government to exchange about MBKZ management?
- Through trainings only. No sitting around a table to discuss.

B. What are the outputs of these meetings?

C. Are there any points coming repetitively?

D. What could be improved in term of arise issues?

E. What could be your role in that process?

11. IBA Management team

B

V

A. Is the management team planning by itself the patrols of VGS?
- No, Dixon and myself, IBA manager arrange the patrols. We rotate VGS.

B. Who oversees the choose of the VGS to operate such patrols?

C. Is the management team in charge of permit deliverance?
- A special person has been assigned for this task (cashier)

D. Is it collecting fines from offences?
- This is where conflict between IBA and TFS comes from. We were expecting to fine offenders, but since TFS prohibited us to do so, we have to bring them to the police, so no income on fine.

E. Is conducting monitoring of beekeepers' practices?
- Through the training activities, sometimes we go there and assess what is going on.

F. How are they conducting this monitoring?
- Camp registration, count nbr of behives.

G. Who is conducting the survey?
    - Small contracts with Officers of the District Council to operate them. They give us a report, but we have to pay for this service.
H. With which means?
I. What is the estimated overall amount collected past years through fines for offences?
    - 0
J. Are VGS receiving part of these fine paid by every person they arrested?
K. As an example, in year 2017?
L. Do you consider this process of retrocession as an encouragement for VGS to pursue their duty?
    - This is sometimes discouraging them, but since they are paid by ADAP, we consider this as enough. We don't focus much on fines. TFS hasn't grant us the right to collect fines. IBA support the charges (fuel, training, manpower) and TFS is granted the benefit of IBA's work.

12. Mlele District Council

A
B

A. Are they providing IBA with technical advices on implementation issues concerning conservation and natural resources' management?
    - Yes, sometimes. We have meetings with them, we express our issues through steering committees, we exchange ideas and express our problems, sometimes they advice us what to do. It is a good relation.
B. As an example, what was their last support?

V

    - In December 2017, when we wanted to discuss with TFS at a Ministry level, they gave us advices.
C. Have they joined VGS patrols at any time?
    - Yes. Sometimes we do this collectively, and not only the purpose for comparaison.
D. At which frequency are they sending an officer to these patrols?
    - Once since I'm here (1 year)
E. How are they reallocating funds (if any) derived from the management to villages?
    - No fund collected.
F. As an example?

13. Inter sector linkage and cooperation

A

A. Do you consider inter sector linkage and cooperation as an essential part of the success in the conservation of the MBKZ?
B. How are set-up /maintain links between all the above-mentioned institutions?
C. Which tools are used to do so?
D. Who is involved in that process?
E. What could be your role in that process?
F. In your opinion, what should be improved?
G. How and by which means?
H. In which timescale?

14. Who is taking part on planning the management activities for MBKZ protection?

A

A. On which basis (quarterly, monthly)?

15. Beekeepers training to shift from traditional to modern beehives and techniques

A
B

A. What kind of training is provided?

- It involves many subjects such as harvesting, different products gathered from beehives, modern beehives, etc…

B. At which frequency?
- Every year

C. Is this a success or not?

V
- Yes, very successful. IBA honey quality is high now, thanks to the trainings.

D. What is the cost of a training session? (IBA/beekeepers)
- Huge money. Fee at the institute where we hire someone to give the training (120'000 per day). For a total of approximately 1mio per year. We pay as well beekeepers to attend the training 2'000 TZS each and per day.

E. At your opinion, is it worth the amount? (return in investment)
- Yes.

F. What would you recon to improve this situation?
- I don't think there is anything to add to this trainings session, as they are successful. Cost effective.

G. Are VGS assessing the number of harvested beehives compared to declared ones?
- VGS are not doing this, we are doing this through the Camp registration, every year. We count then the number of beehives hanging, which type, etc…

H. What is the magnitude of this number?
- No, I can't give this number.

I. How are they proceeding to do so?

J. Which number of regular camps is located within the MBKZ?
- We write a report on that subject, saying the number of camps, how many modern/traidtionnal beehives they have, together with the name of the owner. It is perfectly clear for us.

K. Are VGS recording non-registered camps?

L. Which number of illegal camps is located? (approximate)

M. Are they fining non-registered camps owner of any kind?
- No, we send them to the Police

N. As an example, for 2017?

O. Is Msima training centre supported by IBA? (House rent, staff…)
- When we want to train beekeepers, we go the village directly.

P. Is there any return on investment done so far?

16. Fire management

A
V

A. No dry area shall be burnt and a turn-over is to be done: is this respected/feasible in your opinion?

B. How are trained VGS?

C. Have been the District Natural Resources Officer and the District Beekeeping Officer of any help on that matter in the recent years?

D. As an example?

17. Are roads and tracks repaired when damages are observed?

A
V

A. When have been processed these controls lately?

B. What are the means engaged to do so?

C. Who is executing the work?

D. **(17b)** Support to income generating activities

E. What are the means in term of support IBA provides to local population to engage in conservation actions?
    - Yes we have women economical groups in many villages, where women are trained to make batiks, through ADAP support. Yes, it is worthwhile. Instead of going to the forest haversting, they do other things. More means in term of capital should be granted to support these activities.
F. Are meetings or trainings provided/held by IBA to engage surrounding MBKZ villages to participate to these conservations actions?
G. In your opinion, are these means sufficient?
H. What could be enhanced?
I. By which means?
J. Is benefit sharing possible?
    - It is impossible to share benefits as there is no benefice. At least they get knowledge.
K. How would you organise this sharing?

18. Training of human resources

A
B
V

A. Do you consider HR training a key to improve performances capacities?
    - Of course
B. Have you personally been involved in such training?
    - Not yet as training is offer after the first year within IBA, and I'm here since several months only.
C. As an example, what was the last training you received?
    - As a next training, I would attend to Management courses.
D. At which recurrence you consider these training shall be conducted?
    -
E. Have you personally expectations for your next training?
F. Who should you refer to in case you need a training?
    - Mr. Shabani, who will revert to the donor. At an ADAP level, we don't have the funds to finance such courses.
G. Has a request been already refused?
H. What was the reason of this refusal?

A

B

V

19. Are you aware of any yearly time table for the overall activities?

Tagreted period												
Field Activites	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Patrols												
Beekeeping facilitation and camp assesement												
Fire management												
Boarder maintenance												
Roads maintenance												
Flora assesement and monitoring												
Wildlife assessement and monitoirng (camera traps)												
Support to income generating activites												
Strengthing of village institution												
Training of management staff												
Training of Village scouts												
Evaluation of human resources performance												

- No.

B. Did you make personally recommendations for its improvement?
   - Of course. Regarding patrols, we suggested many time to make them randomly.

C. What could have been the reasons for not following the schedule planned on this time table?

A

B

V

20. Modern beehives – traditional beehives

A. Do you consider new beehives as an essential part of the future success for IBA sustainability?
   - Yes of course.

B. Only sitting of new modern beehives should be tolerated. Considering that it has been years since it is not permitted to site traditional beehives, and the short durability of them (i.e. 2 years) would you consider any traditional beehive as a new one?
   - Yes.

C. What is the action to be taken when traditional beehives are sited?
   - Maybe we had to drop them all. But once we drop them all, no harvest.

D. Are you allowed/encouraged/prompted to take any action?
   - Yes, it is our zone. Once we catch someone debarking trees, we take action. We want this zone to be free from any illegal actions. We are allowed to take action, but not to fine them.

E. **(20b)** Taxation of honey/non-timber products

F. Is there any income gathered from the taxation of beekeeping activities (except for IBA permit)?
   - Never.

G. How is managed this 10% tax on beekeeping activities and products?

- This is just a proposal, maybe we shall fix this in the new MoU with TFS.

H. By which means do you collect it?

-

I. Is there a risk of fraud from the beekeepers trying to diminish the value of their harvest?

21. Hunting

A

B

A. Does the Wildlife division communicate in advance the hunting quotas/locations to IBA central committee?
   - No legal hunting in our zone allowed. This zone is free of any activities, except for beekeeping. But if there were to do this, I agree that we shall receive money as pay-back for that.

B. On which basis are they establishing such quotas?

C. Considering the costs at the expense of IBA (patrols), and the money for the benefits of the Wildlife Division (hunting's permits), would you consider normal a retrocession of the hunting benefits to IBA?

D. What shall be this retrocession (in %/fix rate)?

E. Which amount would that grant IBA if so occurs?

F. What actions are to be taken to gather an agreement with WD?

G. Do you consider as pressing to initiate this process with the WD?

H. What could you do to improve this situation?

I. At which timescale?

22. Poaching activities and other illegal gathering of forest products

A

V

A. Do you consider patrols as an efficient way to counter poaching and illegal activities?

B. Are they randomised?

C. Shall they be reinforced of decreased?

D. Have you ever heard of Intelligence-led Law Enforcement for Wildlife protection?

E. Do you consider this feasible?

F. By which means?

G. At which timescale?

23. Manager, member of MBKZ Committee and District Officer are responsible to hear offender.

A

   - We bring them to the police, they are not allowed to hear offenders. We inform then TFS.

B. IBA Manager shall record the amount of fine paid, is it so?

B

C. Has it already occurred that an offender was not able to pay for the fine and be condemned to conduct manual work/community work for a duration corresponding to the debt amount?

D. If not, what are the difficulties encountered?

24. MBKZ committee and IBA manager are to conduct monthly meetings in villages to inform villagers on activities' implementation, and to discuss about management difficulties and success.

A

B

A. Generally, can these meetings be effectively held?
   - We trying to make sure we don't have conflict with villagers. They are very important, because, on our own it is impossible to protect the zone. But monthly meetings are not done. But the executive committee is visiting villages every month, talking with beekeepers.

B. What are the recurring points coming up?

- No, I am not in touch with recurring points that may rise from these meetings.

C. What actions have been taken to solve the arise issue?
D. Monitoring and evaluation are set around 5 objectives
E. To you, what are the key points of the framework, what it is it's mean?
F. Do you think these indicators of success are relevant?
G. Which one is the most relevant for you?
H. Which shall be removed/modified/added?

25. IBA might probably face a reduction of the existing financial support from ADAP

A

A. Do you consider this exiting support as essential for the future of IBA?
    - Yes, of course.

B

B. How sustainable is IBA on your opinion (at the time of this survey)
    - To my opinion, ADAP shall support on construction of IBA modern beehives.
C. How sustainable can be IBA on your opinion?
    - Within one year if all efforts would go to modern beehives production. All we lack of, is modern beehives. We consider them as a capital for IBA association. Since they are very few, IBA is not yet sustainable.
D. On your opinion, which amount shall be collected on a yearly basis to allow IBA to be sustainable?
    - I don't have an estimation.
E. Do you have pathways to improve IBA sustainability?
    - We tried to produce modern beehives at the lowest cost possible. We gave the builder 3000 TZS per modern beehive. Since we have machine, they can produce from 7 to 10 beehives per day. We expected to have free rejected timbers from TFS, this to reduce the price of each beehive. We could have transport them into the bush, then collected by beekeepers. The biggest problem is where to get timber for free. If we solve, this would be perfect. We need more ADAP support on this specific issue. The exchange with beekeepers would be Modern beehives against honey (no money). This point has been discussed with the central committee and the executive committee. Since, we are facing another problem which is the low harvest of this spring season is. I will write a letter to TFS in order to accelerate this issue on this specific point.
F. What activities shall be reinforced, which shall be removed from IBA scope?
    - Every activity is important. We shall focus though on beekeeping issues only, that is modern beehives production and training, as well as honey business (finding new markets)
G. What could be your role in that process?
H. In what timeframe do you consider this possible?
    - 3 months of time, this is urgent.

26. Since the beginning of IBA and furthermore ADAP, how do you think has evolved villagers' consciousness about the exceptional biodiversity that takes place in the MBKZ?

A

    - They know how it is important. It is like a rent.

B

A. How would you estimate the % of villagers that are aware of this biodiversity?
B. Do they have regrets of any kind?
C. Do they have expectations?

- More support from ADAP support through IBA. Specially from switch from traditional to modern beehives. They got enough training.

27. Extra question : Is there any collecting point for collecting honey from the bush ?
    - No, only at the office. When we find a client, we tell the villager's representatives and ask them to send honey to be bought by IBA, at the office.
    - IBA has budget to collect honey to beekeepers, but it never occurred that we went to the bush to collect it.

All these questions are driven by the accrual Management Plan (2016-2010) and they all addressed subject that are listed in this document.

A
B

1. TFS aims to develops and manage forests and bee resources. How do you consider their role within the MBKZ?
    A. Are they providing technical support to IBA?
    B. Are they monitoring the beekeeping activities conducted by IBA?
    C. If yes, by which means?
    D. Are they struggling to prevent illegal harvesting of forest product?
    E. Are they of any help to maintain communication with all involved stakeholders?
    F. As an example, during the past years?

A
B

2. Does the switch of management responsibilities from FDB to TFS in 2014 has led to complications, improvement or led to no changes?
    A. Is there a new MoU signed by TFS or does the previous was taken over?
    B. Does the MoU still carry the same objectives, i.e. a mutual desire of sustainable use of the forest plants?
    C. Is the mandate of 10 years attributed in 2010 to IBA to manage the MBKZ still respected?
        - Are there any new issues arising since TFS direct participation?
        - What kind of conflict can you identify?
        - What could be the solutions or action to be taken?
        - At which level?

A
B

3. Recently, the prime minister has operated a cleaning within the governmental institutions, which led to fire employee, such as within TFS.
    A. How do you consider this cleaning?
    B. Is this leading to issue for IBA or will that make future collaboration easier?
    C. What could be done to IBA taking advantage of this situation?
    D. What could be your role in that process?
    E. At which timescale?

A
B

4. Land use plans established for all villages are becoming soon obsolete (if not already)
    A. Is the de-gazetting of portion of forest into village land threatening the MBKZ?
    B. What kind of solution do you recon to curb this land-expand inflation?
        - Law enforcement
        - VGS patrols increment
        - Other
    C. Who/which stakeholders/actors should be involved to act finding a solution?
    D. What could be your role in that process?

A
B

5. Awareness of the population or some government staff of what is really the MBKZ
    A. Is the communication and the dialogue between IBA, District officers, local communities and the government established?
    B. How would you qualify this dialogue?
    C. Do you consider as important villagers to be informed on the tasks conducted by IBA into the MBKZ?
    D. Is it occurring on a regular basis?

E. At which timescale?
F. Which risk do you forecast in case this awareness cannot be improved?
G. How soon these risks will increase?
H. On your opinion, how can this awareness be improved?
I. By whom?
J. What could be your role in that process?

6. Do you think the income redistribution and sharing of benefits for local population has a clear scheme?

A

B

A. Which amount (%) has been redistributed to villages, for ex. In 2017?
B. What could be improved?
C. How can these improvements be executed?
D. Within which time-table?
E. Which risk do you foreseen in case this sharing cannot be improved?
F. How soon these risks will increase?
G. Does the Village Council made report available to villagers to see?

7. How do you consider important staff stability?

A

B

A. Is the turnover recorded past years an issue or a necessary chore/evil?
B. On your opinion, how can this turn-over be reduced?

8. What is the effective number of VGS under contract with IBA?

A

- 18 VGS

B

B. Do you consider this number as too little, rocket or too big?
   - It is not too big. 20 would be enough
C. Do you think it would be sustainable to reduce the number of VGS meanwhile increasing their training and providing them with a fix contract?

V

   - Yes, it might be good, but the problem is, when they get a job somewhere, they stop working for IBA. Reducing their number will expose IBA to a risk of understaffed, as they might be fired or quit their job if they find another one, more attractive. 15 should be considered as a minimum. However, a fix contract could motivate them.
D. At which occurrence are they engaged into patrols?
   - Per month, 15 days of patrols. First patrol in the beginning of the month (7 days), and at the end of the month, 7 days as well.
E. How long do they last?
F. In your opinion, which way of transects is the most efficient in terms protection, walk transects, car transects or a mix of both means?
   - Mix of both.
G. Are the patrols randomised of any kind?
   - They are not randomised. But randomising can lead to recruitment problem as they might have another job, relatives or friends and need to plan their activities in advance. Changing the date of patrols (randomise) to improve the results, can help improving the them in term of catching the poachers for example. Special patrols are organised from time to time, when we get special information from the villagers of Inyonga about illegal activities in the MBKZ. Mpanda is too far.
H. Dixon is the team leader, who is the assistant leader?

- I don't have an assistant. I thinking about who could be a good one, at using GPS, patrols, setting up cameras, wright good report, …

I. Considering the possibility of absence, illness or even death, is there any VGS now capable to handle the team leader's responsibilities as good as he is now handling them?
   - Yes. I have somebody in mind.

J. Is this a risk of loss of knowledge if such event occurs (severe sickness, death)?
   - Some of the VGS have a military training, Few are not good. Camera trap are few to be able to do correct job, not more than 5 or 6 can handle this part alone.

K. Do you consider English language a necessary mean to communicate with stakeholders?
   - Yes, very important. They can understand but cannot speak. No other can speak English correctly enough, but me and Yahaya.

L. Are VGS having lessons or training of any kind?
   - Yes.

M. As an example, during year 2017?
   - In Urafi. Military training, and law of conservation.

N. Has ever an external expert mandated to conduct the process of evaluations on VGS' capacities?
   - Yes. In 2015, I remember. In Mlele, one Ranger Mr Villa trained the VGS about weapon (new weapon).

O. Have they insurances of any kind?
   - No, maybe as a private, but a few only. Even me, I am not working with an insurance.

P. How many VGS have the right to carry weapons?
   - They are all supposed to have this right as they are all trained. But we have selected 6 that are allowed to carry weapons (always the same). But we have to get the permit from the IBA Chairman (Mr. Richard Andrea is responsible to delegate the permission to VGS). When they want to get a weapon at the Police station, they have to ask the Chairman of IBA's permission. For the bullet, you have to get to the cashier (of IBA), who handle the report of how they have been used (if so)

Q. Is this sufficient in your opinion?

R. To whom patrols report is presented to?
   - DMCO, who send it to Yves.

S. At which frequency?
   - After each patrol.

T. Are actions taken after the report's publications?
   - The comments are followed. As example, when we catch the cattle, we asked to go along the border to check if there were others, which was granted. About material, they write to Yves and action is taken.

U. By whom?

V. Of which kind?

W. As an example, in past year?

9. The Central Committee meeting is held on a quarterly basis

A

A. Is it receiving any income from the fines paid by offenders?

B

B. As an example, for year 2017?

C. Are these incomes issuing profits to the villages?
D. As an example, for year 2017?
E. Has CC already mandated external parties to undertake projects related to management or conservation of the MBKZ?
F. In which cases?
G. Has the CC provided advices on environmental issues at village level?
H. As an example, in the recent years?
I. How has it been perceived by villagers?

10. MBKZ committee is holding monthly meetings

B

A. Is it organising a meeting as well with Village Government to exchange about MBKZ management?
B. What are the outputs of these meetings?
C. Are there any points coming repetitively?
D. What could be improved in term of arise issues?
E. What could be your role in that process?

11. IBA Management team

B

V

A. Is the management team planning by itself the patrols of VGS?
    - We are sharing the decision between the management and me.
B. Who oversees the choose of the VGS to operate such patrols?
    - The decision is shared with DMCO, manager and me.
C. Is the management team in charge of permit deliverance?
D. Is it collecting fines from offences?
    - Sometimes. As example, the last time (2018) we catch the cattle, we bring them to the police, they were condemned to 2'500'000 fine, but TFS gave to Mr Henry the money, who gave back to VGS 7'000 only. After complaining, Mr.Shabani informed Yves about this abnormal situation (TFS eating our money).
E. Is conducting monitoring of beekeepers' practices?
    - It is difficult to know, I don't know about it.
F. How are they conducting this monitoring?
G. Who is conducting the survey?
H. With which means?
I. What is the estimated overall amount collected past years through fines for offences?
    - I don't remember.
J. Are VGS receiving part of these fine paid by every person they arrested?
    - Yes, but little money only.
K. As an example, in year 2017?
L. Do you consider this process of retrocession as an encouragement for VGS to pursue their duty?
    - Yes, definitely. But when offenders are brought to the police or to court, we don't get money back. They sometimes forget about the VGS… The percentage is very low (33%) but I'm not sure.

12. Mlele District Council

A

B

A. Are they providing IBA with technical advices on implementation issues concerning conservation and natural resources' management?
    - Never from my eyes.

B. As an example, what was their last support?

V

C. Have they joined VGS patrols at any time?
   - Yes, in 2016, once. The Wildlife Commissionner, his assistant, and two gards of TFS, we made a joined patrol. Once only. They wanted to compare the results from IBA with other forest reserves, but they paid for the VGS at least.

D. At which frequency are they sending an officer to these patrols?

E. How are they reallocating funds (if any) derived from the management to villages?

F. As an example?

A

13. Inter sector linkage and cooperation
    A. Do you consider inter sector linkage and cooperation as an essential part of the success in the conservation of the MBKZ?
    B. How are set-up /maintain links between all the above-mentioned institutions?
    C. Which tools are used to do so?
    D. Who is involved in that process?
    E. What could be your role in that process?
    F. In your opinion, what should be improved?
    G. How and by which means?
    H. In which timescale?

A

14. Who is taking part on planning the management activities for MBKZ protection?
    A. On which basis (quarterly, monthly)?

A

B

15. Beekeepers training to shift from traditional to modern beehives and techniques
    A. What kind of training is provided?
       - How to harvest good honey, how to make modern beehives, beeswax, lot of training.
    B. At which frequency?
       - Mr Nataï (TAWIRI Tabora, teacher) instruct Beekeepers on these points last year.

V

C. Is this a success or not?

D. What is the cost of a training session? (IBA/beekeepers)

E. At your opinion, is it worth the amount? (return in investment)

F. What would you recon to improve this situation?

G. Are VGS assessing the number of harvested beehives compared to declared ones?
   - No. They report to the cashier, when they get their permit, the number of beehives they have (traditional or moderns)

H. What is the magnitude of this number?

I. How are they proceeding to do so?

J. Which number of regular camps is located within the MBKZ?
   - More than 35, this number was assessed conjunctly with me and Mr. Benkamba, District Team Beekeepers Officer (DTBO)

K. Are VGS recording non-registered camps?

L. Which number of illegal camps is located? (approximate)
   - Not answered.

M. Are they fining non-registered camps owner of any kind?
   - No, it is now difficult for IBA to aask for fine. As when they are catch, we bring them to the police → court.

N. As an example, for 2017?

O. Is Msima training centre supported by IBA? (House rent, staff…)
P. Is there any return on investment done so far?

16. Fire management

A
V

A. No dry area shall be burnt and a turn-over is to be done: is this respected/feasible in your opinion?
   - Yes, early burning is the one we practice (May and June)
B. How are trained VGS?
   - They are trained thanks to a training.
C. Have been the District Natural Resources Officer and the District Beekeeping Officer of any help on that matter in the recent years?
   - No. We get this training when VGS went to Burunge
D. As an example?

17. Are roads and tracks repaired when damages are observed?

A
V

A. When have been processed these controls lately?
   - Every year during dry season.
B. What are the means engaged to do so?
   - Two days during a patrol as example.
C. Who is executing the work?
   - VGS
D. (17b) Support to income generating activities
E. What are the means in term of support IBA provides to local population to engage in conservation actions?
F. Are meetings or trainings provided/held by IBA to engage surrounding MBKZ villages to participate to these conservations actions?
G. In your opinion, are these means sufficient?
H. What could be enhanced?
I. By which means?
J. Is benefit sharing possible?
K. How would you organise this sharing?

18. Training of human resources

A
B
V

A. Do you consider HR training a key to improve performances capacities?
   - Yes, very important
B. Have you personally been involved in such training?
   - Yes, the last training was in 2017 in February. It was about military training (as well about law conservation, use of GPS, how to read a map, use of weapon).
C. As an example, what was the last training you received?
D. At which recurrence you consider these training shall be conducted?
   - Every year.
E. Have you personally expectations for your next training?
   - The same training as above mentioned in Burunge, this time to get an advanced training.
F. Who should you refer to in case you need a training?
   - The donor, Mr Yves, though Mr. Shabani.
G. Has a request been already refused?
   - Yes.

H. What was the reason of this refusal?
   - The budget.

19. Are you aware of any yearly time table for the overall activities?

A
B
V

Tagreted period												
Field Activites	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Patrols												
Beekeeping facilitation and camp assesement												
Fire management												
Boarder maintenance												
Roads maintenance												
Flora assesement and monitoring												
Wildlife assessement and monitoirng (camera traps)												
Support to income generating activites												
Strengthing of village institution												
Training of management staff												
Training of Village scouts												
Evaluation of human resources performance												

   - No, but it seems right to me.

B. Did you make personally recommendations for its improvement?
C. What could have been the reasons for not following the schedule planned on this time table?

20. Modern beehives – traditional beehives

A
B
V

A. Do you consider new beehives as an essential part of the future success for IBA sustainability?
   - Yes.

B. Only sitting of new modern beehives should be tolerated. Considering that it has been years since it is not permitted to site traditional beehives, and the short durability of them (i.e. 2 years) would you consider any traditional beehive as a new one?
   - Yes, I agree.

C. What is the action to be taken when traditional beehives are sited?
   - We never talked about this situation, but when it is on the ground, we have to burn it. When it is hanging, it is difficult as we have no tools. We have asked to IBA Chairman for a special training to beekeepers in order to reduce the number of traditional beehives that are sited.

D. Are you allowed/encouraged/prompted to take any action?
   - We are not allowed to take action. This is according to our believes that we don't do this.

E. Taxation of honey/non-timber products

F. Is there any income gathered from the taxation of beekeeping activities (except for IBA permit)?
G. How is managed this 10% tax on beekeeping activities and products?
H. By which means do you collect it?
I. Is there a risk of fraud from the beekeepers trying to diminish the value of their harvest?

21. Hunting

A
B

A. Does the Wildlife division communicate in advance the hunting quotas/locations to IBA central committee?
B. On which basis are they establishing such quotas?
C. Considering the costs at the expense of IBA (patrols), and the money for the benefits of the Wildlife Division (hunting's permits), would you consider normal a retrocession of the hunting benefits to IBA?
D. What shall be this retrocession (in %/fix rate)?
E. Which amount would that grant IBA if so occurs?
F. What actions are to be taken to gather an agreement with WD?
G. Do you consider as pressing to initiate this process with the WD?
H. What could you do to improve this situation?
I. At which timescale?

22. Poaching activities and other illegal gathering of forest products

A
V

A. Do you consider patrols as an efficient way to counter poaching and illegal activities?
   - Yes, it is very important. Last year, when the project stopped, we see a lot of illegal activities taking suddenly place as villagers knew that patrols had been stopped (within 2-3 months)
B. Are they randomised?
C. Shall they be reinforced of decreased?
   - Reinforced
D. Have you ever heard of Intelligence-led Law Enforcement for Wildlife protection?
   - Yes, it is a good way of catching weapons for example. If we had informer (and a budget) this would work well for fighting illegal activities.
E. Do you consider this feasible?
   - Yes, it could be set-up.
F. By which means?
   - Money, but the budget shall be considered firstly. But I don't have an idea of the overall budget that might be needed. We need to find a good informer in order to avoid double-play (poachers and VGS). I believe I cold play a role in this process of recruitment.
G. At which timescale?

23. Manager, member of MBKZ Committee and District Officer are responsible to hear offender.

A
B

A. IBA Manager shall record the amount of fine paid, is it so?
B. Has it already occurred that an offender was not able to pay for the fine and be condemned to conduct manual work/community work for a duration corresponding to the debt amount?
C. If not, what are the difficulties encountered?

A
B

24. MBKZ committee and IBA manager are to conduct monthly meetings in villages to inform villagers on activities' implementation, and to discuss about management difficulties and success.
    A. Generally, can these meetings be effectively held?
    B. What are the recurring points coming up?
    C. What actions have been taken to solve the arise issue?
    D. Monitoring and evaluation are set around 5 objectives
    E. To you, what are the key points of the framework, what it is it's mean?
    F. Do you think these indicators of success are relevant?
    G. Which one is the most relevant for you?
    H. Which shall be removed/modified/added?

A
B

25. IBA might probably face a reduction of the existing financial support from ADAP
    A. Do you consider this exiting support as essential for the future of IBA?
    B. How sustainable is IBA on your opinion (at the time of this survey)
    C. How sustainable can be IBA on your opinion?
    D. On your opinion, which amount shall be collected on a yearly basis to allow IBA to be sustainable?
    E. Do you have pathways to improve IBA sustainability?
    F. What activities shall be reinforced, which shall be removed from IBA scope?
    G. What could be your role in that process?
    H. In what timeframe do you consider this possible?

A
B

26. Since the beginning of IBA and furthermore ADAP, how do you think has evolved villagers' consciousness about the exceptional biodiversity that takes place in the MBKZ?
    A. How would you estimate the % of villagers that are aware of this biodiversity?
    B. Do they have regrets of any kind?
    C. Do they have expectations?

27. Addition question
    - Material is insufficient, specially for Camera Setting team. They need shoes as they walk a lot and shoes don't last more than one year in these conditions. As well, during the rain season, they need two pairs so that one can dry while the other is used. Two pairs in two years.
    - Another weapon (currently at Dodoma under process to get the permit), a second one, Richard Andrea is handling this process. The initial request was three years ago. It takes a long time. Then, the two teams can have each a weapon.

All these questions are driven by the accrual Management Plan (2016-2010) and they all addressed subject that are listed in this document.

A
B

1. TFS aims to develops and manage forests and bee resources. How do you consider their role within the MBKZ?
    A. Are they providing technical support to IBA?
    B. Are they monitoring the beekeeping activities conducted by IBA?
    C. If yes, by which means?
    D. Are they struggling to prevent illegal harvesting of forest product?
    E. Are they of any help to maintain communication with all involved stakeholders?
    F. As an example, during the past years?

    A. NO.
    B. IF WE INVITE TFS FOR A SURVEY, IBA HAS TO PAY TFS PER DAY, AS EXAMPLE FOR CAMP REGISTRATION.
    C. IT CONSIST TO ASSESS THE HONEY PRODUCTION PER SEASON
    D. NO.
    E. NO.
    F. VOID

A
B

2. Does the switch of management responsibilities from FDB to TFS in 2014 has led to complications, improvement or led to no changes?
    A. Is there a new MoU signed by TFS or does the previous was taken over?
    B. Does the MoU still carry the same objectives, i.e. a mutual desire of sustainable use of the forest plants?
    C. Is the mandate of 10 years attributed in 2010 to IBA to manage the MBKZ still respected?
        - Are there any new issues arising since TFS direct participation?
        - What kind of conflict can you identify?
        - What could be the solutions or action to be taken?
        - At which level?

    A. IT IS NOT BETTER FOR IBA SINCE TFS HAS TAKEN OVER THE RESPONSIBILITY. THEY ARE NOT SUPPORTING IBA, AS FDB WAS DOING PREVIOUSLY. REGARDING THE MOU, IT HAS NOT BEEN ACCEPTED BY TFS, AND THEY REJECTED IT.
    B. THE NEW MOU IS STILL WAITING FOR TFS' SIGNATURE. IT IS NOT SIGNED SINCE 2014. TFS IS NOT FOLLOWING THE SAME OBJECTIVES THAN FDB WAS.
    C. THE MANDATE IS, SOMEHOW, RE-CONDUCTED. BUT THERE ARE SO MANY PROBLEMS. AS AN EXAMPLE, IN APRIL THIS YEAR, VGS OF IBA CATCH A LOT OF CATTLE. THE FINE FOR THIS OFFENCE WAS BENEFITING TFS, WHO RECEIVED THE MONEY, BUT IT WASN'T REFUND TO IBA.
        - WE WRIGHT LETTERS TO THE DISTRICT AND OTHER OFFICES IN ORDER TO SOLVE THIS ISSUE, BUT THE RECENT CLEANING OPERATED BY THE PRIME MINISTER HAS RESET THE PROCESS.

A
B

3. Recently, the prime minister has operated a cleaning within the governmental institutions, which led to fire employee, such as within TFS.
    A. How do you consider this cleaning?
    B. Is this leading to issue for IBA or will that make future collaboration easier?

C. What could be done to IBA taking advantage of this situation?
D. What could be your role in that process?
E. At which timescale?

A. NOT GOOD FOR IBA. IN FEBRUARY, WE CATCH A LOT OF TIMBER AND WOOD EXTRACTION, FOR WHICH TFS HAD ALLOTTED A PERMIT, WHEREAS IT IS NOT ALLOWED TO EXTRACT WOOD FROM A FOREST RESERVE.
B. YES, I THINK THE COLLABORATION WITH TFS CAN OCCUR IN THE FUTURE. EVEN THE NATURAL RESOURCES MINISTER SAW THAT IBA WAS EFFECTIVELY DOING CONSERVATION, WHEREAS TFS WAS NOT.
C. YES. BEFORE THIS CLEANNESS, IBA WROTE MANY LETTERS TO TFS TO SOLVE ISSUES. NOW THIS PROCESS RE-STARTS FROM ZERO.

A
B

4. Land use plans established for all villages are becoming soon obsolete (if not already)
   A. Is the de-gazetting of portion of forest into village land threatening the MBKZ?
   B. What kind of solution do you recon to curb this land-expand inflation?
      - Law enforcement
      - VGS patrols increment
      - Other
   C. Who/which stakeholders/actors should be involved to act finding a solution?
   D. What could be your role in that process?

A. THERE IS A THREAT FOR MBKZ. THIS PLAN HELPS FOR SETTLEMENT, CATTLE KEEPERS AND AGRICULTURE TO SEPARATE PLACES FROM ONE OTHER. FOR EXAMPLE, IN MAY, WE DISCOVERED A SETTLEMENT WITHIN THE MBKZ, AND TFS TOOK ACTION TO REMOVE THEM

A
B

5. Awareness of the population or some government staff of what is really the MBKZ
   A. Is the communication and the dialogue between IBA, District officers, local communities and the government established?
   B. How would you qualify this dialogue?
   C. Do you consider as important villagers to be informed on the tasks conducted by IBA into the MBKZ?
   D. Is it occurring on a regular basis?
   E. At which timescale?
   F. Which risk do you forecast in case this awareness cannot be improved?
   G. How soon these risks will increase?
   H. On your opinion, how can this awareness be improved?
   I. By whom?
   J. What could be your role in that process?

A. POPULATION KNOW THE ACTION THAT IBA TAKES WITHIN THE MBKZ, BUT DUE TO A BAD COMMUNICATION BETWEEN THE DISTRICT AND IBA, SOME OF THE VILLAGERS THINK THAT IBA IS NOT SUPPORTING THE BEEKEEPERS : NO POINT FOR COLLECTING BEE PRODUCTS IN THE VILLAGES, NO MARKETING
B. THE DIALOGUE IS GOOD. FOR EXAMPLE, THE PRODUCTION OF BATIKES IS COLLECTED

C. YES. SOME OF THE VILLAGERS CONSIDER THE MBKZ NOT THE PROPERTY OF IBA. THEREFORE, THEY DON'T RECOGNISE IBA'S PERMIT AND ALLOW THEMSELVES TO GATHER PRODUCTS FROM THE FOREST.

6. Do you think the income redistribution and sharing of benefits for local population has a clear scheme?

A

B

   A. Which amount (%) has been redistributed to villages, for ex. In 2017?
   B. What could be improved?
   C. How can these improvements be executed?
   D. Within which time-table?
   E. Which risk do you foreseen in case this sharing cannot be improved?
   F. How soon these risks will increase?
   G. Does the Village Council made report available to villagers to see?

A. IF THERE IS A MEETING (OR OTHER ACTIVITIES) WITH VILLAGERS, WE COLLECT THE VILLAGERS AND MONEY IS GIVEN TO THEM. AS AN EXAMPLE, EACH VILLAGER RECEIVED TZS 5'000 IN SUCH MEETING. VILLAGERS FROM ALL AROUND INYONGA RECEIVED MONEY FROM IBA : NGOMBE, USEKA, CANONGE, …, TAKUDGA, SEMGUA, KAOLOLO, MASSIGO, IMPUAGA, MAPIRI. REDISTRIBUTION TO VILLAGERS IN WORKING WELL.

A

7. How do you consider important staff stability?

B

   A. Is the turnover recorded past years an issue or a necessary chore/evil?
   B. On your opinion, how can this turn-over be reduced?

A. STABILITY IS IMPORTANT. FOR NOW, THERE IS NO ACCOUNTANT ANYMORE.

A

8. What is the effective number of VGS under contract with IBA?
   - 25 VGS

B

   B. Do you consider this number as too little, rocket or too big?
      - Too big, because not all the VGS are called for working, sometimes for a long period. This is bad, because they don't get money and are not trained anymore.
   C. Do you think it would be sustainable to reduce the number of VGS meanwhile increasing their training and providing them with a fix contract?

V

      - Yes, the remaining ones would be more trained and more motivated. What's more, costs for material (like boots, suits) could be reduced for IBA.
   D. At which occurrence are they engaged into patrols?
   E. How long do they last?
   F. In your opinion, which way of transects is the most efficient in terms protection, walk transects, car transects or a mix of both means?
      - Mix. Mountains and Mbuga cannot be assessed by car. Car can drive the VGS to a point, and they continue the patrol by foot.
   G. Are the patrols randomised of any kind?
      - Patrols are occurring twice a month, one in the beginning and one at the end of the month. Between the patrols, we can see that many illegal activities have occurred. We have a proposal to improve this situation, that is for example to go on patrol two days, remaining in the bush for a few days, and going again two

days after. This can help to discover illegal activities (like traditional beehives production). In two weeks without patrols, we can see that many many traditional beehives have been product.

H. Dixon is the team leader, who is the assistant leader?
   - Yes, he is. No assistant. We work together, if we want to choose for VGS, we make a proposition together (with Dixon) and give it to Mr Shabani for approval/suggestions.

I. Considering the possibility of absence, illness or even death, is there any VGS now capable to handle the team leader's responsibilities as good as he is now handling them?
   - Yes. Myself, I can go and help the other VGS.

J. Is this a risk of loss of knowledge if such event occurs (severe sickness, death)?
   - No. For now, the number of VGS trained by Dixon is sufficient (GPS, map reading, etc…).

K. Do you consider English language a necessary mean to communicate with stakeholders?
   - Yes, it is important. For example, staff can get the special budget for training for weeks.

L. Are VGS having lessons or training of any kind?
   - Yes. They get training in Burunge and got a certificate for that.

M. As an example, during year 2017?
   - Training for forest issues, like catching offenders, organising patrols, use of GPS, map reading. But no English lessons.

N. Has ever an external expert mandated to conduct the process of evaluations on VGS' capacities?
   - Dixon is choosing (through a proposal) which VGS is good or not suitable for a mission. We can test them on the filed to assess the list.

O. Have they insurances of any kind?
   - No, they have no insurances.

P. How many VGS have the right to carry weapons?
   - All of them know, they all get training to use a weapon. If we want to borrow a weapon from the police, we suggest one of the VGS to handle this responsibility (Kasamaki, Edgar). They can keep the weapon or give it to another VGS.

Q. Is this sufficient in your opinion?

R. To whom patrols report is presented to?
   - After Dixon wrote the report, it is given to the DMCO, and after it is sent to the Executive committee.

S. At which frequency?
   - Every times after a patrol.

T. Are actions taken after the report's publications?
   - No. It depends on the budget, which is yearly allotted. If there are no more budget, no action is taken (out of budget)

U. By whom?

V. Of which kind?

W. As an example, in past year?

9. The Central Committee meeting is held on a quarterly basis

A

- Yes, but we have a meeting every month with the Executive Committee, they take ideas and problems and bring them to the Steering (Central) committee for discussion. But in the Central Committee, each village is represented.

B. Is it receiving any income from the fines paid by offenders?

B

- No. If we bring the poachers to the Police Station, they go to prison, and they is no income from that.

C. As an example, for year 2017?

D. Are these incomes issuing profits to the villages?

- No, as no income.

E. As an example, for year 2017?

F. Has CC already mandated external parties to undertake projects related to management or conservation of the MBKZ?

- Yes. They bring new propositions of what can be done for the protection of the MBKZ.

G. In which cases?

H. Has the CC provided advices on environmental issues at village level?

- Sometimes, they tell the villagers what is allow or not. It is not regular. But some of the villagers don't understand what is the role of IBA.

I. As an example, in the recent years?

J. How has it been perceived by villagers?

- We noticed that some of them understand the importance of conserving the MBKZ. The education of villagers has improved the situation, specially in Inyonga. But there is still problem with the people from Simbo (other district). We asked for a special budget to educate the villagers from Simbo as we noticed they were still producing traditional beehives, and seeds flowers to improve their honey.

10. MBKZ committee (executive committee) is holding monthly meetings

B

- Yes.

B. Is it organising a meeting as well with Village Government to exchange about MBKZ management?

C. What are the outputs of these meetings?

D. Are there any points coming repetitively?

- Problems are changing regularly. As an example, VGS use of GPS was a problem, but I asked for a special budget to train the VGS. I made the trainings when Dixon was absent.

E. What could be improved in term of arise issues?

F. What could be your role in that process?

11. IBA Management team

B

V

A. Is the management team planning by itself the patrols of VGS?

- Yes, but it is reviewed by Mr. Shabani

B. Who oversees the choose of the VGS to operate such patrols?

- Me and Dixon.

C. Is the management team in charge of permit deliverance?

- Yes.

D. Is it collecting fines from offences?

- No. Not a source of income.

E. Is conducting monitoring of beekeepers' practices?
   - No.

F. How are they conducting this monitoring?
G. Who is conducting the survey?
H. With which means?
I. What is the estimated overall amount collected past years through fines for offences?
   - No money.

J. Are VGS receiving part of these fine paid by every person they arrested?
K. As an example, in year 2017?
L. Do you consider this process of retrocession as an encouragement for VGS to pursue their duty?

12. Mlele District Council

A
B

A. Are they providing IBA with technical advices on implementation issues concerning conservation and natural resources' management?
   - No.

B. As an example, what was their last support?

V

C. Have they joined VGS patrols at any time?
   - No, never.

D. At which frequency are they sending an officer to these patrols?
E. How are they reallocating funds (if any) derived from the management to villages?
F. As an example?

13. Inter sector linkage and cooperation

A

A. Do you consider inter sector linkage and cooperation as an essential part of the success in the conservation of the MBKZ?
B. How are set-up /maintain links between all the above-mentioned institutions?
C. Which tools are used to do so?
D. Who is involved in that process?
E. What could be your role in that process?
F. In your opinion, what should be improved?
G. How and by which means?
H. In which timescale?

14. Who is taking part on planning the management activities for MBKZ protection?

A

A. On which basis (quarterly, monthly)?

15. Beekeepers training to shift from traditional to modern beehives and techniques

A
B

A. What kind of training is provided?
   - How to make modern beehives, bee products such as good honey, use of beeswax, the way of beekeeping.

B. At which frequency?
   - There is so many villagers around, so the training can last one or two days in a village, related to the number of beekeepers attending.

V

C. Is this a success or not?
   - Yes, it is a success. Many beekeepers have improved the quality of honey since we started educating them.

D. What is the cost of a training session? (IBA/beekeepers)
   - The budget is decided by DMCO and Mr. Shabani, so I don't know the budget.

E. At your opinion, is it worth the amount? (return in investment)
F. What would you recon to improve this situation?
G. Are VGS assessing the number of harvested beehives compared to declared ones?
    - Modern beehives number is increasing, whereas traditional ones are decreasing. We use the camp registration to monitor the number of beehives that are announced by beekeepers. A modern beehive can produce 10 to 14 litres of quality honey whereas traditionals can produce 8 to 10 litres of medium quality of honey.
H. What is the magnitude of this number?
I. How are they proceeding to do so?
J. Which number of regular camps is located within the MBKZ?
    - I know the number. I have this number at the office.
K. Are VGS recording non-registered camps?
    - Yes, during the patrols (compared with the camp registration)
L. Which number of illegal camps is located? (approximate)
    - I think it is one (discovered from the last camera session)
M. Are they fining non-registered camps owner of any kind?
    - When we catch them, we bring them to the police. There is no money collected from that.
N. As an example, for 2017?
O. Is Msima training centre (camp) supported by IBA? (House rent, staff…)
    - IBA pays (unclear)
P. Is there any return on investment done so far?

16. Fire management

A
V

A. No dry area shall be burnt and a turn-over is to be done: is this respected/feasible in your opinion?
B. How are trained VGS?
C. Have been the District Natural Resources Officer and the District Beekeeping Officer of any help on that matter in the recent years?
D. As an example?

17. Are roads and tracks repaired when damages are observed?

A
V

A. When have been processed these controls lately?
B. What are the means engaged to do so?
C. Who is executing the work?
D. Support to income generating activities
E. What are the means in term of support IBA provides to local population to engage in conservation actions?
F. Are meetings or trainings provided/held by IBA to engage surrounding MBKZ villages to participate to these conservations actions?
G. In your opinion, are these means sufficient?
H. What could be enhanced?
I. By which means?
J. Is benefit sharing possible?
K. How would you organise this sharing?

18. Training of human resources

A
B
V

A. Do you consider HR training a key to improve performances capacities?
   - Yes.

B. Have you personally been involved in such training?
   - Yes.

C. As an example, what was the last training you received?
   - Computer lessons and Business administration, Beekeeping training. For me, when I ask for a special training, I normally get it.

D. At which recurrence you consider these training shall be conducted?

E. Have you personally expectations for your next training?
   - English lessons.

F. Who should you refer to in case you need a training?
   - Mr. Shabani, which communicate with Yves.

G. Has a request been already refused?
   - No.

H. What was the reason of this refusal?

19. Are you aware of any yearly time table for the overall activities?

A
B
V

	Tagreted period											
Field Activites	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
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Roads maintenance												
Flora assesement and monitoring												
Wildlife assessement and monitoirng (camera traps)												
Support to income generating activites												
Strengthing of village institution												
Training of management staff												
Training of Village scouts												
Evaluation of human resources performance												

   - Yes.

B. Did you make personally recommendations for its improvement?
   - Yes. And my recommendations were followed.

C. What could have been the reasons for not following the schedule planned on this time table?

20. Modern beehives – traditional beehives

A
B
V

A. Do you consider new beehives as an essential part of the future success for IBA sustainability?
   - Yes, traditional beehives are not sustainable.

B. Only sitting of new modern beehives should be tolerated. Considering that it has been years since it is not permitted to site traditional beehives, and the short durability of them (i.e. max. 2 years) would you consider any traditional beehive as a new one?
    - Yes.
C. What is the action to be taken when traditional beehives are sited?
    - It is difficult to take down these beehives, as production would be lost. I f we could replace traditional by modern ones, then we an bring down the traditional beehives. We cannot remove traditional beehives without replacing them by modern ones. As an example, many beekeepers depend on traditional haverting to pay their fees to get an IBA permit, or event to pay their clothes, they depend on it. So we don't bring down traditional beehives because of these reasons.
D. Are you allowed/encouraged/prompted to take any action?
    - We tell the beekeepers not to produce traditional beeheives, so if we catch them, we bring them to the police.
E. **(20b)** Taxation of honey/non-timber products
F. Is there any income gathered from the taxation of beekeeping activities (except for IBA permit)?
    - No.
G. How is managed this 10% tax on beekeeping activities and products?
    - I was not aware of this tax. But how can we ask them money if we don't provide them with modern beehives? They would not accept it.
H. By which means do you collect it?
I. Is there a risk of fraud from the beekeepers trying to diminish the value of their harvest?

21. Hunting

A
B

A. Does the Wildlife division communicate in advance the hunting quotas/locations to IBA central committee?
    - I have no data. But the poaching activities are decreasing. The president (Mr Magufuli) is against hunting. Event the Chinese are not making business of hunting activities (ivory).
B. On which basis are they establishing such quotas?
C. Considering the costs at the expense of IBA (patrols), and the money for the benefits of the Wildlife Division (hunting's permits), would you consider normal a retrocession of the hunting benefits to IBA?
    - I think there is no money collected for hunting by the Wildlife Division. I don't consider that IBA shall receive money from these huntings.
D. What shall be this retrocession (in %/fix rate)?
E. Which amount would that grant IBA if so occurs?
F. What actions are to be taken to gather an agreement with WD?
G. Do you consider as pressing to initiate this process with the WD?
H. What could you do to improve this situation?
I. At which timescale?

22. Poaching activities and other illegal gathering of forest products

A
V

A. Do you consider patrols as an efficient way to counter poaching and illegal activities?
B. Are they randomised?
C. Shall they be reinforced of decreased?

D. Have you ever heard of Intelligence-led Law Enforcement for Wildlife protection?
E. Do you consider this feasible?
F. By which means?
G. At which timescale?

A 23. Manager, member of MBKZ Committee and District Officer are responsible to hear offender.

- We are not allowed, we bring them to the police station. If we were taking fines, it would be considered as corruption. IBA is here for conservation, that is if we were taking fines, they would come back within short months and do their offences again. We prefer to bring them to the police. For example, VGS catch poachers with Giraffe meat, they have been convinced to 20 years prison, IBA got no money from that.

B. IBA Manager shall record the amount of fine paid, is it so?

B C. Has it already occurred that an offender was not able to pay for the fine and be condemned to conduct manual work/community work for a duration corresponding to the debt amount?

D. If not, what are the difficulties encountered?

A 24. MBKZ committee and IBA manager are to conduct monthly meetings in villages to inform villagers on activities' implementation, and to discuss about management difficulties and success.

B

A. Generally, can these meetings be effectively held?

- Yes, we tell the CC the points to talk about.

B. What are the recurring points coming up?

- IBA talks with IBA villager's representatives. IBA tells then the representatives what is to be done. For example, if a beekeepers is working for himself, they tell him to join IBA (wearing short/t-shirt of IBA). But as we have not enough money, we should recover the money invested, which is not the case.

C. What actions have been taken to solve the arise issue?
D. **(24b)** Monitoring and evaluation are set around 5 objectives

- I know the objectives

E. To you, what are the key points of the framework, what it is it's mean?

- All are important, patrols are important.

F. Do you think these indicators of success are relevant?
G. Which one is the most relevant for you?
H. Which shall be removed/modified/added?

- Yes. Among of them, the VGS are important and IBA should get them fix employment and insurances (conditions of work). Increasing they salary (100'000 per month is not enough). Reducing the number of VGS could help getting them a fix contract and improving their condition. A correct number of VGS could be 14, plus the driver (list is available). Getting them a fix salary and reducing their number would lead to a charge reduce for IBA. A correct salary would be TZS 200'000 per month.

A 25. IBA might probably face a reduction of the existing financial support from ADAP

A. Do you consider this exiting support as essential for the future of IBA?

B

- Yes.

B. How sustainable is IBA on your opinion (at the time of this survey)

- IBA is now getting a good sustainability, but herited from many old problems.

C. How sustainable can be IBA on your opinion?
   - Within next year, if the harvest is good. We could make a collecting point to increase the honey collected by IBA.

D. On your opinion, which amount shall be collected on a yearly basis to allow IBA to be sustainable?
   - 200'000'000 TZS per year, this order to pay for patrols, the maintenance of the car (detailed list provided after this interview).

E. Do you have pathways to improve IBA sustainability?
   - Yes. Permit issuing is not sufficient. Marketing of honey should be improved and new market to be find (supermarket/hotels/external market outside the country). Now we have no special market, quantity sold now is not enough, direct selling at ADAP office is not sustainable.

F. What activities shall be reinforced, which shall be removed from IBA scope?
   - We have a 3mio budget per year for Batik production over 12 villages (I think). This is way too little money, we had then to choose a reduced number of villages, this year 5, to support them (semkua, kaolo, Ipuaga, Inyonga, Kamsisi). The budget was insufficient for other villages.

G. What could be your role in that process?
   - I ask time to improve this situation, as I can go by myself to villages and tell them to join IBA.

H. In what timeframe do you consider this possible?

A

B

26. Since the beginning of IBA and furthermore ADAP, how do you think has evolved villagers' consciousness about the exceptional biodiversity that takes place in the MBKZ?

    A. How would you estimate the % of villagers that are aware of this biodiversity?
       - My opinion, number of illegal activities has reduced (compared to other places), that is positive. For example, timber activities has completely disappeared in MBKZ.

    B. Do they have regrets of any kind?

    C. Do they have expectations?

27. Extra : What if we were giving beekeepers for free modern beehives?
    - If we give modern beehives to beekeepers, that means getting other products as glue, beewax, royal gelly, we need to find new markets in the meantime, as currently we would not have the money to buy big quantities of honey products, even if the beekeepers come at the office. But if we asked 20% of production in exchange of modern beehives, IBA would become sustainable.

All these questions are driven by the accrual Management Plan (2016-2010) and they all addressed subject that are listed in this document.

This MP is theoretical…

1. TFS aims to develops and manage forests and bee resources. How do you consider their role within the MBKZ?

A

B

   A. Are they providing technical support to IBA?
      - Never
   B. Are they monitoring the beekeeping activities conducted by IBA?
      - Yes
   C. If yes, by which means?
      - Their business is limited for the time being to count the number of arrestations made by IBA (poaching, tree cutting, etc…)
   D. Are they struggling to prevent illegal harvesting of forest product?
      - They are friend with the timber business guy. Because the law stipulates that : for a guy to be given a license to harvest timber, TFS must ensure that they are stamped TFS. But they don't do that actually. If someone go to the forest without a license, cut thousand of trees, they can request service of TFS, pay them a little bit, then TFS comes with the stamp and stamped them. Their mission is to close monitoring the forest, but actually it does not happend like it should. All employee were friends, from the same school.
   E. Are they of any help to maintain communication with all involved stakeholders?
   F. As an example, during the past years?

A

2. Does the switch of management responsibilities from FDB to TFS in 2014 has led to complications, improvement or led to no changes?
      - We can call this an issue of understanding that TFS of Mlele decided to create. As IBA has signed the MoU with FBD (forest beekeeping division), one amongst many dpt in the Natural Ressources Minister, they should have taken over the already signed agreement (MoU), but they didn't, saying that the contract was signed with FBD, not TFS. Wih mean that we are now working (IBA) illegally in the MBKZ. This change brought many unexpected challenges.

B

   B. Is there a new MoU signed by TFS or does the previous was taken over?
      - No. DMCO and I went to the National Tree planting days and we noticed that other TFS managers are very humble, you can speack and share opinion, which is not the case with TFS of Mlele.
   C. Does the MoU still carry the same objectives, i.e. a mutual desire of sustainable use of the forest plants?
   D. Is the mandate of 10 years attributed in 2010 to IBA to manage the MBKZ still respected?
      - It is not respected anymore since TFS took over the FDB responsibilities.
      - Are there any new issues arising since TFS direct participation?
      - What kind of conflict can you identify?
      - What could be the solutions or action to be taken?
        - Last December 2017, due to this clashes (wich are normally a non-event at a Ministry level), Yves manages to see the executive director of TFS.

After his departure (Yves), some month later, the guys from TFS formed a committee in Mlele (amongst other mission) and we had a meeting we them of almost five days, which was a very strong meeting. Finally, we set some resolutions, which if could be well implemented, there would be no problem anymore. We agreed then all on the solutions, but no implementation occurred. The new MoU is still to be signed by TFS, the new MoU will be signed in 2020 between IBA and TFS. Which means that no MoU will be signed in-between. During this meeting, we proposed that the current MoU should continue until its maturity (2020). After that, the Ministry will assess the performances of IBA, then we will see if the possibility exists to grant IBA with a new contract.

- At which level?

3. Recently, the prime minister has operated a cleaning within the governmental institutions, which led to fire employee, such as within TFS.

A

B

   A. How do you consider this cleaning?
      - An artificial way of solving problems. Its like a shift only. If someone was really making mistakes, how could you reallocate him to a new job? They just have been suspended for a period of time, waiting to be reallocated. The same situation occuerred at the Rukwa Game Reserve where only the top 5 managers remains, which is to be qualified as a fake cleanness.
   B. Is this leading to issue for IBA or will that make future collaboration easier?
      - Currently it is a fifty-fifty situation. The problem with these reallocations is that new employee taking their responsibility will automatically refer to the former person in charge, this to know all the ABC from the current pending files. Again, they are mainly friends from the same school of Agriculture, there no really hope for the situation to change. For example, the District Commissionner of Mlele was very hash with us, it reached to a point where the TFS manager was sharing a lunch with the DC at his home. Finally, thee DC realised that it was IBA that was doing its job properly. The DC went, herself, to TFS, and recommend them to hand-over the problem of Timber business.
   C. What could be done to IBA taking advantage of this situation?
      - The situation between IBA and TFS cannot be solved at the moment. This should be solved at a Ministry level. Tha area managed by IBA is only a small part of the forests they manage, and most of them are almost empty (from wildlife). TFS fells that IBA is overthrowing them a lot. IBA is a threat, demonstrating that they are doing the job better than them. We don't do many effforts to advocate the nice job that IBA (through ADAP support) is doing. IBA could be given many areas to manage, as at the very top-le vel of decision makers, they really want the forest to be preserved. A the bottom level, they treat tress as a source of income.
   D. What could be your role in that process?
   E. At which timescale?

4. Land use plans established for all villages are becoming soon obsolete (if not already)

A

B

   A. Is the de-gazetting of portion of forest into village land threatening the MBKZ?

- It was done all through villages of Mlele, the problems which arises, is the misuse of funds. The plan conducted for more than ten years is like useless. The second problem is once the plan is set-up, there should be some supervision, which is not happening, this is the biggest failure.

B. What kind of solution do you recon to curb this land-expand inflation?
    - MBKZ is not easy to be given to villagers as it partially belonging to the Central Governement of Forests (Mulele hills). I think there is no such threat in MBKZ.
- Law enforcement
- VGS patrols increment
- Other

C. Who/which stakeholders/actors should be involved to act finding a solution?
D. What could be your role in that process?

5. Awareness of the population or some government staff of what is really the MBKZ

A

- Yes. Everybody knows what we are doing. Natrual resources is the source of income for some guys. The ones who are exploiting the resources illegally will hate IBA. So, some of the villagers will hate you because you prevent them to exploit the wealth illegally.

B. Is the communication and the dialogue between IBA, District officers, local communities and the government established?

B

C. How would you qualify this dialogue?
D. Do you consider as important villagers to be informed on the tasks conducted by IBA into the MBKZ?
    - The information to villager has already been made for many years now. Most of them are aware of what IBA/ADAP is doing.
E. Is it occurring on a regular basis?
F. At which timescale?
G. Which risk do you forecast in case this awareness cannot be improved?
H. How soon these risks will increase?
I. On your opinion, how can this awareness be improved?
J. By whom?
K. What could be your role in that process?

6. Do you think the income redistribution and sharing of benefits for local population has a clear scheme?

A

- Never. The sustainability of IBA has not been reached, therefore redistribution is not implemented. Previously, fines collected by IBA were huge and brought a lot of money to IBA. Now it has been cut straight. As TFS doen't consider the MoU available anymore, we don't have permission to collect fines anymore. IBA has not the authority to collect fines. IBA has no stamp to stamp timber products and should inform TFS to do this. A spoon of sugar in the ocean is given back to IBA. From 1.5 mio fined for illegal cattles, only 200'000 has been given back to IBA. TFS requested the VGS to count the cattles, they didn't bother going by themselves.

B. Which amount (%) has been redistributed to villages, for ex. In 2017?

B

C. What could be improved?

D. How can these improvements be executed?
E. Within which time-table?
F. Which risk do you foreseen in case this sharing cannot be improved?
G. How soon these risks will increase?
H. Does the Village Council made report available to villagers to see?

A B 7. How do you consider important staff stability?

A. Is the turnover recorded past years an issue or a necessary chore/evil?
   - Normally it is not encouraged in any institution. Somehow it is necessary to permit goals of projects to be achieved. Kambura was fired because of the non-execution of his job.

B. On your opinion, how can this turn-over be reduced?

A B 8. What is the effective number of VGS under contract with IBA?
   - Initially, 30. We agreed then with Yves to make it 25. As many of the guys were not active, not trained anymore. But within the 25 group, there are some guys who are still unactive. Actives ones are around 16 or 17, up to 18.

B. Do you consider this number as too little, correct or too big?
   - I would prefer this number to be reduced. We could then consider to convert budget for a salary, as a permanent job for some of them. Then, the only expenses for patrols would be food. Few people, equipped with nice material (boots for example, are not enough for camera setting).

C. Do you think it would be sustainable to reduce the number of VGS meanwhile increasing their training and providing them with a fix contract?
   - Yes, that would be an efficient way to reduce expenses.

V D. At which occurrence are they engaged into patrols?
E. How long do they last?
F. In your opinion, which way of transects is the most efficient in terms protection, walk transects, car transects or a mix of both means?
   - Walking is the most efficient. Car shall just take them to the start point. If possible, a idea that rised is to cook food before departure, the driven bring them in different areas, and they walk freely until their reach the meeting point, where Yahaya will wait for them. So, no more groups.

G. Are the patrols randomised of any kind?
   - Earlier, the fuel was unsifficient to explore various areas. But now, (after 37 days without patrols), some areas are known for illegals activities, and VGS are instructed to explore freely these areas. So we can say that patrols are randomised in some way, except for the next patrol.

H. Dixon is the team leader, who is the assistant leader?
   - This issue has just emerged last year, around April, we had no plan. So we don't have official assistant.

I. Considering the possibility of absence, illness or even death, is there any VGS now capable to handle the team leader's responsibilities as good as he is now handling them?
   - No. Dixon is a bit of an exception as he is managing everything. Other guys are very dependent. It is very tough for IBA to find a replacement.

J. Is this a risk of loss of knowledge if such event occurs (severe sickness, death)?
K. Do you consider English language a necessary mean to communicate with stakeholders?

- Somehow yes, somehow not. Muzungu come only in July, so once a year. 3 VGS speaking English would be sufficient.

L. Are VGS having lessons or training of any kind?
   - Yes. But trained for simple technics only, basic ones.

M. As an example, during year 2017?

N. Has ever an external expert mandated to conduct the process of evaluations on VGS' capacities?
   - Since I arrived here (2 years), we have never seen that.

O. Have they insurances of any kind?
   - Never.

P. How many VGS have the right to carry weapons?
   - All, everybody was trained. The process to get a second gun has passed the District level, RCO (regional Criminal Officer) has been paid for the gun permit. When the permit will be issued, Richard Andrea will collect it. Maye this will be solved at the end of August, or inbetween (not sure, as external issue).

Q. Is this sufficient in your opinion?

R. To whom patrols report is presented to?
   - Primary target is Geneva. The report is first presented to DMCO for translation.

S. At which frequency?

T. Are actions taken after the report's publications?
   - It depends. If there are important events, yes. If I could be trained on GPS, I could by myself take actions directly, or suggest VGS to increase the walking sessions. I could request it for my follow up as well, before waiting for Geneva to respond, as sometimes they are busy and sometimes there is no answer before months. Actions are to be taken just after the patrols, no months after. Retain part of their salary could be an encouragement to walk more for example. Being more reactfull. I take the GPS points and send them to Geneva for their analysis.

U. By whom?

V. Of which kind?

W. As an example, in past year?

9. The Central Committee meeting is held on a quarterly basis

A

B

A. Is it receiving any income from the fines paid by offenders?
   - Never.

B. As an example, for year 2017?

C. Are these incomes issuing profits to the villages?

D. As an example, for year 2017?

E. Has CC already mandated external parties to undertake projects related to management or conservation of the MBKZ?

F. In which cases?

G. Has the CC provided advices on environmental issues at village level?

H. As an example, in the recent years?

I. How has it been perceived by villagers?

10. MBKZ committee is holding monthly meetings

B

A. Is it organising a meeting as well with Village Government to exchange about MBKZ management?

B. What are the outputs of these meetings?
C. Are there any points coming repetitively?
D. What could be improved in term of arise issues?
E. What could be your role in that process?

11. IBA Management team

B
V

A. Is the management team planning by itself the patrols of VGS?
B. Who oversees the choose of the VGS to operate such patrols?
C. Is the management team in charge of permit deliverance?
D. Is it collecting fines from offences?
E. Is conducting monitoring of beekeepers' practices?
F. How are they conducting this monitoring?
G. Who is conducting the survey?
H. With which means?
I. What is the estimated overall amount collected past years through fines for offences?
J. Are VGS receiving part of these fine paid by every person they arrested?
K. As an example, in year 2017?
L. Do you consider this process of retrocession as an encouragement for VGS to pursue their duty?

12. Mlele District Council

A
B

A. Are they providing IBA with technical advices on implementation issues concerning conservation and natural resources' management?
    - In normal circumstances, they should. But they are not doing that. Although they are receiving salaries to protect areas, but if you request their help, they will ask for diesel, food, allowances. Not possible with the tight budget IBA has.
B. As an example, what was their last support?

V

C. Have they joined VGS patrols at any time?
    - No. Normally every three month we have a Full Council, where all councillors meet and discuss. The Natural Ressoucres dpt wants to go to the forest, shoot a buffalo and then discuss around meat.
D. At which frequency are they sending an officer to these patrols?
E. How are they reallocating funds (if any) derived from the management to villages?
F. As an example?

13. Inter sector linkage and cooperation

A

A. Do you consider inter sector linkage and cooperation as an essential part of the success in the conservation of the MBKZ?
    - Absolute! Stakeholders should link together.
B. How are set-up /maintain links between all the above-mentioned institutions?
    - We are facing now a big dis-link between these organs. As an example, few days ago, we were quarrelling with Beekeeping Officers. Normally, when Beekeepers are going to harvest, they shall pay some 10'000's to IBA. But the District is telling that, permit IBA is illegal.
C. Which tools are used to do so?
D. Who is involved in that process?
E. What could be your role in that process?

- It is possible to improve this linkage. It is a matter of resources, what they want is allowances. If you offer them these allowances, we will be friend. But ADAP, with its fix budget, we cannot do that. That is why they hate us. They assume that we have a lot of money, but actually it is not. They want help from ADAP, for example diesel, and if we could do so, then we become friends. As we know that Yves doesn't like these process, we don't dare to tell him. If you want to become a good friend with an African, he should eat you. If your hands are very short, no friendship.

F. In your opinion, what should be improved?
G. How and by which means?
H. In which timescale?

14. Who is taking part on planning the management activities for MBKZ protection?

A

- VGS who are patrolling. Dixon and IBA manager can propose names for VGS to be fare, and after my recommendation, we assign guys to the task.

B. On which basis (quarterly, monthly)?

15. Beekeepers training to shift from traditional to modern beehives and techniques

A
B
V

A. What kind of training is provided?
B. At which frequency?
C. Is this a success or not?

- Yes, it is a success as the honey from Inyonga is well known by its quality. The only challenge is to be able to buy the harvest produced by beekeepers, modern harvesting gears. Most of the beekeepers are still using fire to chase the bees away from their hive. The honey is still good as they don't mix it or boil it.

D. What is the cost of a training session? (IBA/beekeepers)
E. At your opinion, is it worth the amount? (return in investment)

- Nowadays, funds for projects supported by Europeans has drastically reduced. We know that they are targeting on specific issues. For instance, 4mio to train women for batik fabrication, but in eleven villages, we cannot do that, this is not enough. So you have to select three or four villages, still the amount is too little. This is not a straight benefit for IBA, but for some beekeepers or women.

F. What would you recon to improve this situation?

- We wrote some report to Yves, that is where the accounter failed to produce some financial statements, normally we have balances in every activities and request some additional funds for activities that might have been conducted partially.

G. Are VGS assessing the number of harvested beehives compared to declared ones?
H. What is the magnitude of this number?
I. How are they proceeding to do so?
J. Which number of regular camps is located within the MBKZ?

- Game officer reported to us that even legal beekeeper's camps were doing illegal business. Some of them did very long beehives in order to hide traditional guns and went poaching with it during the night. Some of other camps are inviting illegal timbers' businessmen, and some camps nearby Msima river invited illegal fishers to they camps. When we asked some the illegals guys to move, they went to complain to the District Commissioner, we would be on TV's. The situation is

very complicated. If you catch an illegal guy, you bring him to the court, and legally they are just allowed to fine him. So if I have much money, you pay the fine and will go back again doing my illegal activities (playing with those fines).

K. Are VGS recording non-registered camps?
L. Which number of illegal camps is located? (approximate)
M. Are they fining non-registered camps owner of any kind?
N. As an example, for 2017?
O. Is Msima training centre supported by IBA? (House rent, staff…)
P. Is there any return on investment done so far?

16. Fire management

A
V

A. No dry area shall be burnt and a turn-over is to be done: is this respected/feasible in your opinion?
    - Most of the forest is early-burnt in order to new grass to grow.
B. How are trained VGS?
    - They are just repeating a natural phenomenon. No proper skills to do that.
C. Have been the District Natural Resources Officer and the District Beekeeping Officer of any help on that matter in the recent years?
D. As an example?

17. Are roads and tracks repaired when damages are observed?

A

    - Yes. It is done regulary.

B. When have been processed these controls lately?

V

    - This rain season 2017 was very high, this lead to cut ADAP camp to the rest of the MBKZ. We have to propose a special budget to repair the road, which costs 2 mio approximately
C. What are the means engaged to do so?
    - Annually we have a budget of 4mio to do that. 4Mio is far not enough to maintain the roads in good shape. A lot of roads are in bad conditions, some of them a cut. Previously, ADAP was providing 40mio for roads maintenance.
D. Who is executing the work?
    - VGS
E. Support to income generating activities
F. What are the means in term of support IBA provides to local population to engage in conservation actions?
G. Are meetings or trainings provided/held by IBA to engage surrounding MBKZ villages to participate to these conservations actions?
H. In your opinion, are these means sufficient?
I. What could be enhanced?
J. By which means?
K. Is benefit sharing possible?
L. How would you organise this sharing?

18. Training of human resources

A
B
V

A. Do you consider HR training a key to improve performances capacities?
    - Sure
B. Have you personally been involved in such training?
    - Yes.

C. As an example, what was the last training you received?
   - last September, we had a 21 days training session with Yves regarding monitoring evolution in the reporting. We had to distinguish our work as we were reporting almost the same things.

D. At which recurrence you consider these training shall be conducted?

E. Have you personally expectations for your next training?
   - Yes. I need more skills on project evaluation, even on project cycle. Yves gave me a lot of support, he is very stable on management.

F. Who should you refer to in case you need a training?

G. Has a request been already refused?
   - If you have a genuine reason to ask for a training, Yves never refuses.

H. What was the reason of this refusal?
   - If you addend the company for less than a year. Trainings are given, but with a % of your salary. It is contractual.

19. Are you aware of any yearly time table for the overall activities?

A
B
V

	Tagreted period											
Field Activites	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Patrols												
Beekeeping facilitation and camp assesement												
Fire management												
Boarder maintenance												
Roads maintenance												
Flora assesement and monitoring												
Wildlife assessement and monitoirng (camera traps)												
Support to income generating activites												
Strengthing of village institution												
Training of management staff												
Training of Village scouts												
Evaluation of human resources performance												

   - Yes.

B. Did you make personally recommendations for its improvement?
   - Sometimes changes is difficult, it is better to discuss with Yves, as changes are difficult to operate. Nothing has been changed. It is difficult to explain to somebody who is thousands of km away through phone the reason for changing the timetable.

C. What could have been the reasons for not following the schedule planned on this time table?

20. Modern beehives – traditional beehives

A
B
V

A. Do you consider new beehives as an essential part of the future success for IBA sustainability?
    - Yes, modern beehives are an essential part of futur IBA sustainability. They offer huge production, they prevent the deforestation, they increase income for beekeepers and for the institution.
B. Only sitting of new modern beehives should be tolerated. Considering that it has been years since it is not permitted to site traditional beehives, and the short durability of them (i.e. 2 years) would you consider any traditional beehive as a new one?
    - Yes. Even after 3 or 4 months they are old and cannot be used anymore.
C. What is the action to be taken when traditional beehives are sited?
    - National beekeeping Act provided a time to beekeepers to shift from traditional to modern beehives. Time is over. For Mlele, most of the responsible in Law supervision are blaming the ancient Prime Minister of Tanzania (resident to this area), he encouraged Beekeepers to continue with traditional beehives. For the Game Reserve, we can only allow beehives that are two years or more, but for the new ones, we will shoot it. In Mlele, the law allow you bring the offender to the court. So if you destroy them (and if you are very close to the Distrcit Commissionner, who is kind of the president of the area), she can assist us a lot. She can even order that every traditional beehives to be considered as illegal.
D. Are you allowed/encouraged/prompted to take any action?
    - No. Under unlawful situation you can do it. But the one we call bush-layers will bring you problems, as the will report it. Brought to the court, traditionnals beekeepers will just be fined, the fine is not big. Sometimes, the police is even playing their game and take the money and release them.
E. Taxation of honey/non-timber products
F. Is there any income gathered from the taxation of beekeeping activities (except for IBA permit)?
G. How is managed this 10% tax on beekeeping activities and products?
H. By which means do you collect it?
I. Is there a risk of fraud from the beekeepers trying to diminish the value of their harvest?

21. Hunting

A
B

A. Does the Wildlife division communicate in advance the hunting quotas/locations to IBA central committee?
    - Hunting is allowed, but they don't communicate to us the quotas in advance.
B. On which basis are they establishing such quotas?
C. Considering the costs at the expense of IBA (patrols), and the money for the benefits of the Wildlife Division (hunting's permits), would you consider normal a retrocession of the hunting benefits to IBA?
    - It is not shared. For the Rungwa project, Yves wrote to the Managing director of this company, Raoul Ramon, an American guy, to see the possibility of collaborationin the new project. There was no response on that. IBA has not place to speak loudly.
D. What shall be this retrocession (in %/fix rate)?
E. Which amount would that grant IBA if so occurs?
F. What actions are to be taken to gather an agreement with WD?

G. Do you consider as pressing to initiate this process with the WD?
H. What could you do to improve this situation?
I. At which timescale?

22. Poaching activities and other illegal gathering of forest products

A

V

A. Do you consider patrols as an efficient way to counter poaching and illegal activities?
   - Yes, that is. IBA patrols were conducting with sticks against AK47. Even in areas were VGS were patrolling with SMG machine guns, rhino were killed, elephants were killed, lions… there were not protecting, but collaborating with the poachers.

B. Are they randomised?
C. Shall they be reinforced of decreased?
D. Have you ever heard of Intelligence-led Law Enforcement for Wildlife protection?
   - Yes. It is a very good technic.

E. Do you consider this feasible?
   - Yes, this is a very good idea, possible, we speak with Yves sometimes that about. The challenge is, it depends on the guy who is giving you information. If this guy feels concerned by the deforestation, it could work.

F. By which means?
   - We cannot offer more than 10'000-20'000 TZS.

G. At which timescale?
   - It never happened before. The risk is that with so little money, it can be offered 10 times more by the offenders to keep silence. Money is the point to implement such manners.

23. Manager, member of MBKZ Committee and District Officer are responsible to hear offender.

A

   - We are not allowed to do that (because of TFS not recognising the MoU)

B. IBA Manager shall record the amount of fine paid, is it so?

B

C. Has it already occurred that an offender was not able to pay for the fine and be condemned to conduct manual work/community work for a duration corresponding to the debt amount?
D. If not, what are the difficulties encountered?

24. MBKZ committee and IBA manager are to conduct monthly meetings in villages to inform villagers on activities' implementation, and to discuss about management difficulties and success.

A

B

A. Generally, can these meetings be effectively held?
B. What are the recurring points coming up?
C. What actions have been taken to solve the arise issue?
D. Monitoring and evaluation are set around 5 objectives
E. To you, what are the key points of the framework, what it is it's mean?
F. Do you think these indicators of success are relevant?
G. Which one is the most relevant for you?
H. Which shall be removed/modified/added?

25. IBA might probably face a reduction of the existing financial support from ADAP

A

B

A. Do you consider this exiting support as essential for the future of IBA?
   - It is really essential for the existing IBA.

B. How sustainable is IBA on your opinion (at the time of this survey)

- Not sustainable without support.

C. How sustainable can be IBA on your opinion?
   - Going on with financial support, and within 3 years it could be sustainable. If the current management team works the way they are working now.

D. On your opinion, which amount shall be collected on a yearly basis to allow IBA to be sustainable?

E. Do you have pathways to improve IBA sustainability?
   - Yes. As no fines and no taxes are collected, money gathered from permit is little money, the only source of income is honey, though as many as possible modern beehives. We have here two scenarios : 1) IBA is like a father, it need its own source of income (beehives belonging to IBA directly), so IBA should have more financial capabilities to invest more on beehives, up to 500. IBA would become more attractive for beekeepers. Currently, and due to bad experience, beekeepers would never give their honey to IBA for credit. 2) To be able to buy honey from beekeepers, we need funds. Therefor we managed to contact the beekeepers representative of each village and propose them to give them harvesting materials against a % of their production of honey, but what failed, is the non-harvest of this season. A problem is chasing another problem. We expected 5 or 6 drums back (10 buckets per drum, a bucket is around 20-25 litres). Without harvesting (no honey in Mlele this time, even a country problem because of the rain dropping down the flowers), we missed our target.

F. What activities shall be reinforced, which shall be removed from IBA scope?

G. What could be your role in that process?

H. In what timeframe do you consider this possible?

A

26. Since the beginning of IBA and furthermore ADAP, how do you think has evolved villagers' consciousness about the exceptional biodiversity that takes place in the MBKZ?
   - They are aware, but not all are liking the job we are doing as they still consider immediate income instead of preserving long-term incomes.

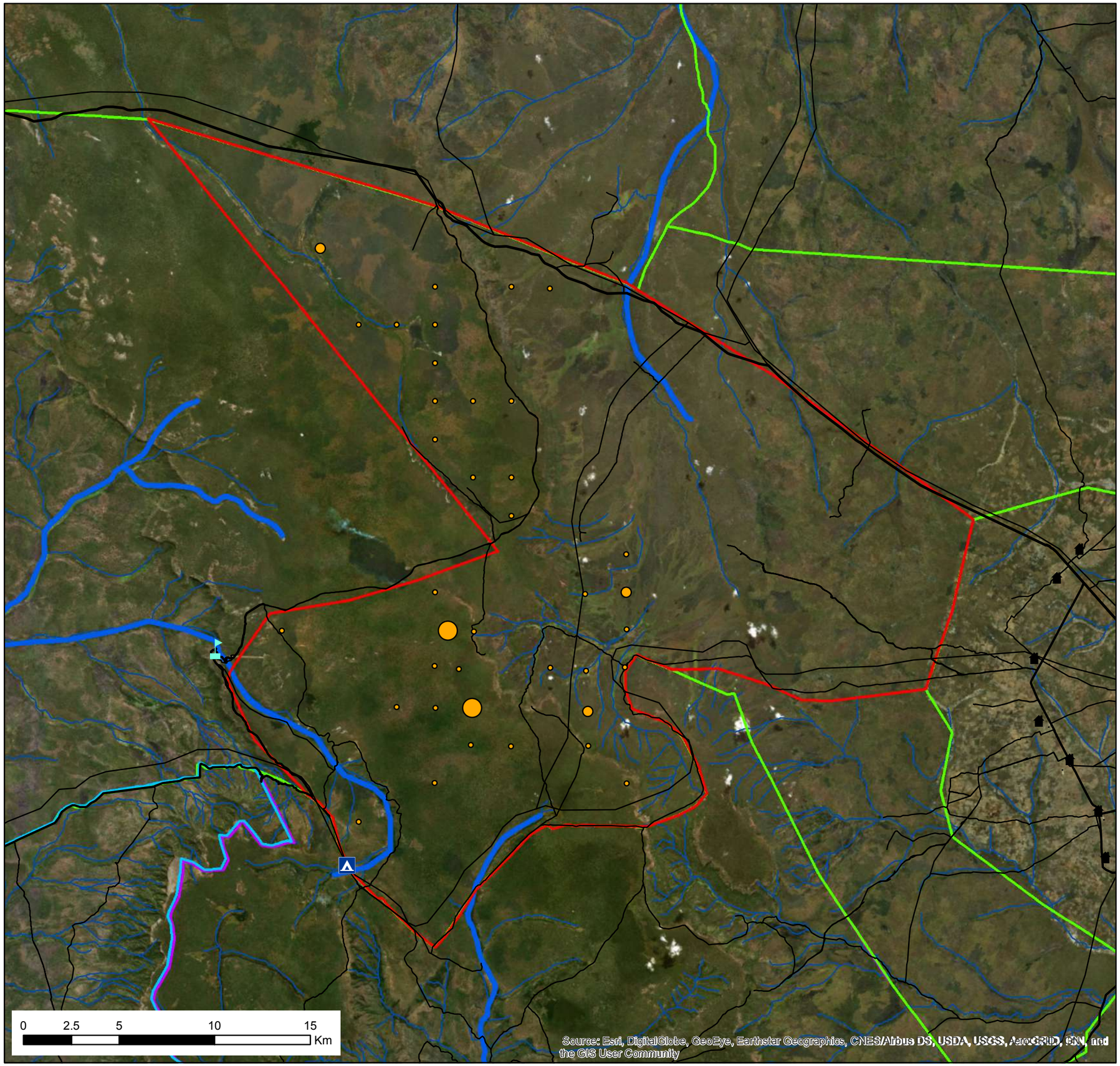
B

A. How would you estimate the % of villagers that are aware of this biodiversity?

B. Do they have regrets of any kind?

C. Do they have expectations?

Appendix 7: Distribution maps of mammals



Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Alcelaphus buselaphus lichtensteinii

- 1.000000 - 2.000000
- 2.000001 - 4.000000
- 4.000001 - 7.000000
- 7.000001 - 10.000000
- 10.000001 - 13.000000

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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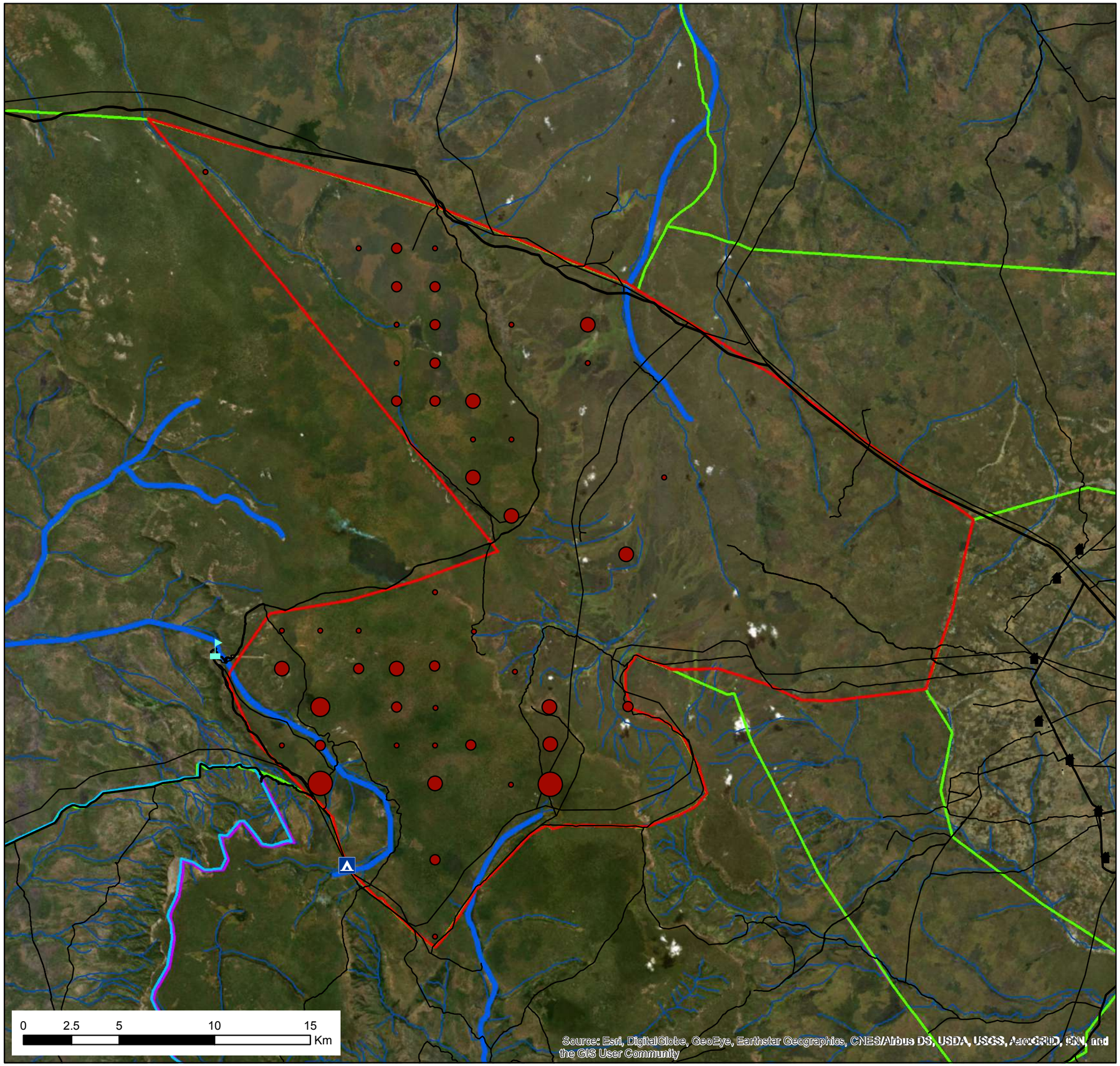

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Bdeogale crassicauda

- 1.000000
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 9.000000
- 9.000001 - 20.000000

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Appendix 7: Distribution map

Legend

Cercopithecus mitis moloneyi

1.000000

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Chlorocebus pygerythrus

1.000000

1.000001 - 6.000000

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Civettictis civetta

- 1.000000
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- Mlele BKZ

Source : SITG

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Appendix 7: Distribution map

Legend

Cricetomys gambianus

1.000000

1.000001 - 4.000000

Mlele BKZ

Source : SITG

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Crocuta crocuta

- 1.000000
- 1.000001 - 2.000000
- 2.000001 - 4.000000

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Damaliscus lunatus

- 1.000000
- 1.000001 - 3.000000
- 3.000001 - 4.000000

Mlele BKZ

Source : SITG

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0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Equus quagga bohemi

- 1.000000
- 1.000001 - 2.000000
- 2.000001 - 4.000000
- 4.000001 - 6.000000

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Galago senegalensis

1.000000

1.000001 - 2.000000

Mlele BKZ

Source : SITG

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Genetta angolensis

- 1.000000 - 2.000000
- 2.000001 - 4.000000
- 4.000001 - 6.000000
- 6.000001 - 8.000000
- 8.000001 - 12.000000
- Mlele BKZ

Source : SITG

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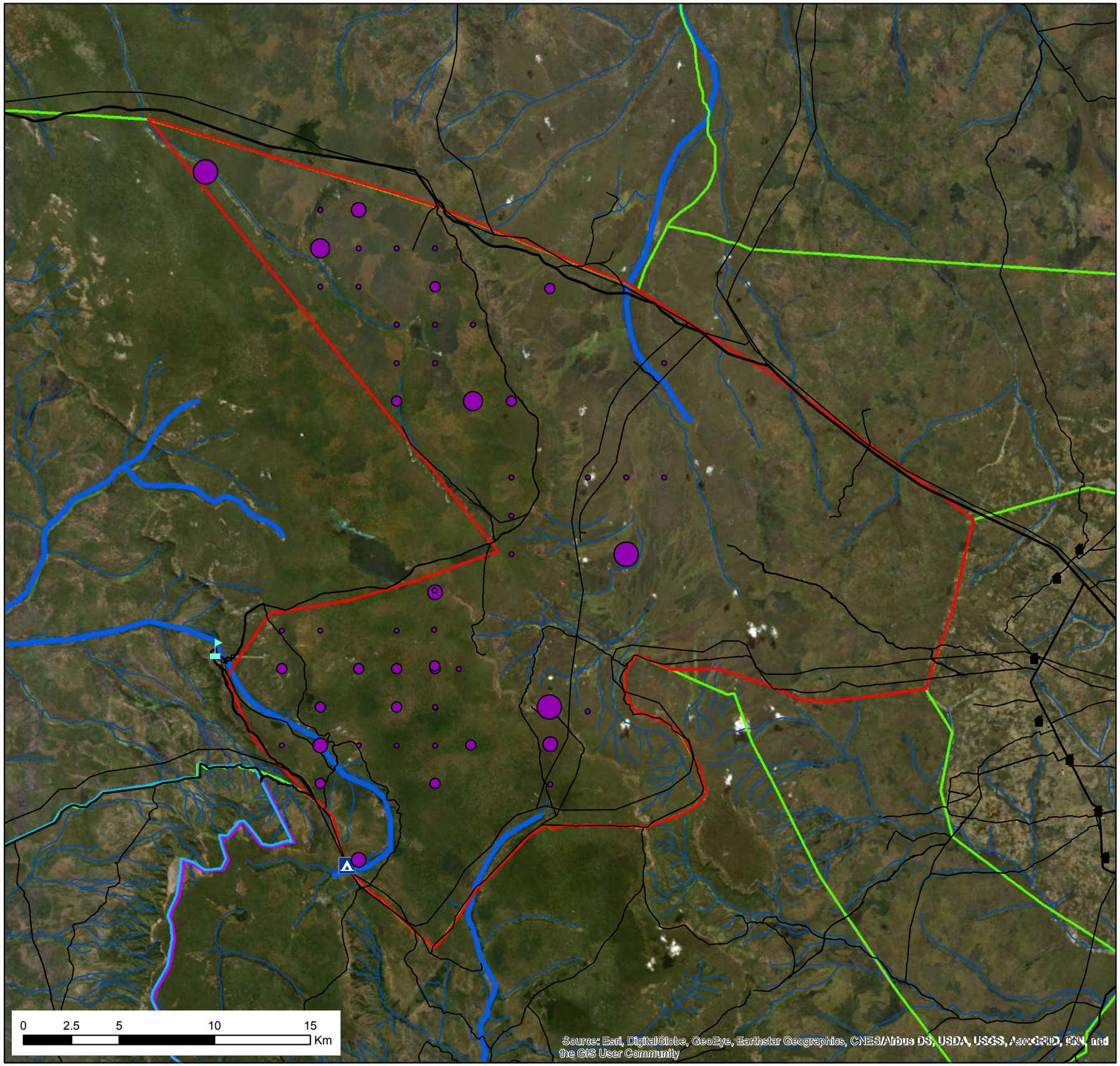

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Genetta maculata

1.000000

1.000001 - 2.000000

Mlele BKZ

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0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Giraffa camelopardalis tipelskirshi

- 1.000000
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 7.000000

Mlele BKZ

0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Source : SITG

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Hippotragus equinus

- 1.000000
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000

Mlele BKZ

Source : SITG

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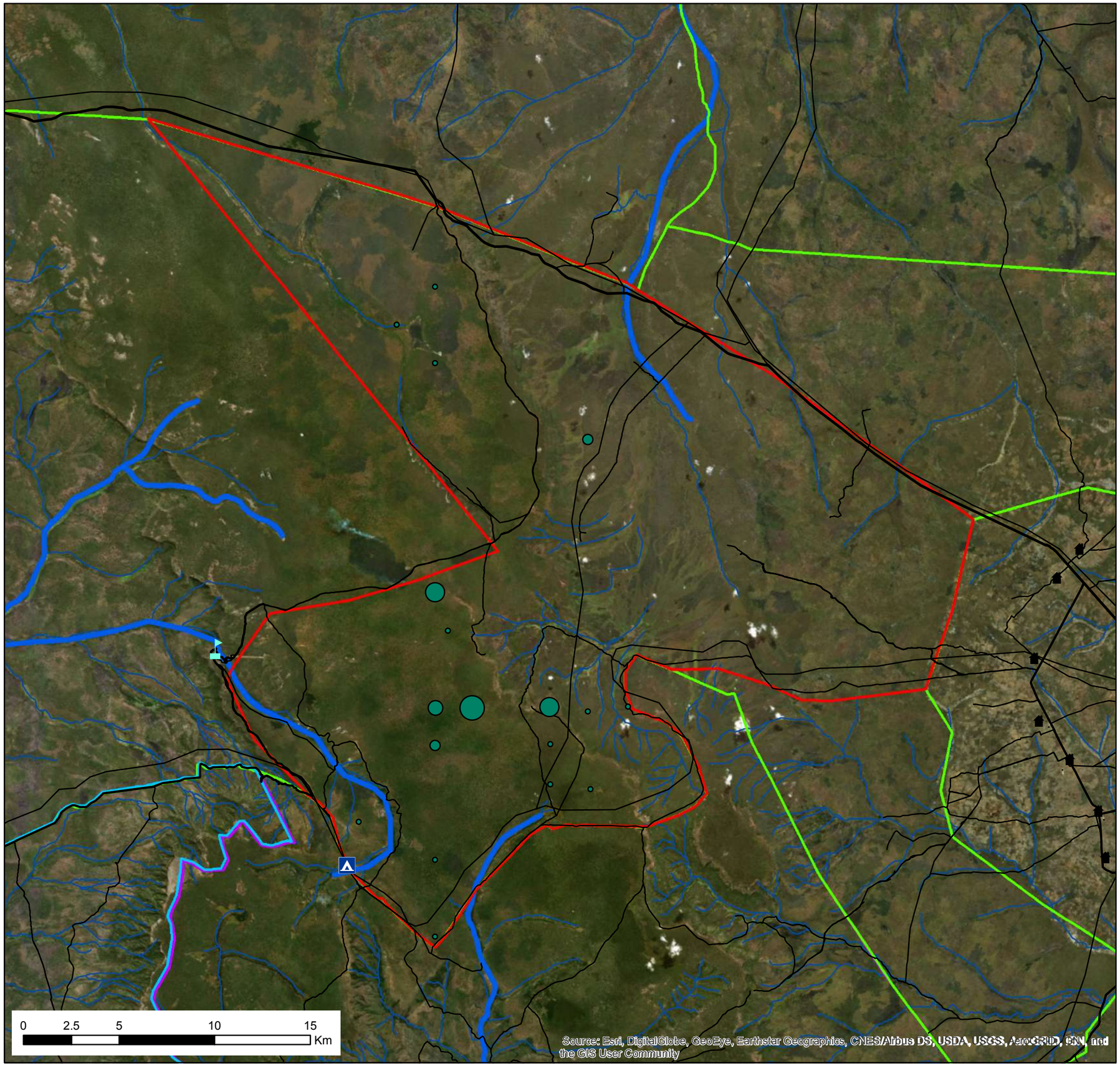

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Hippotragus niger

- 1.000000
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 7.000000
- 7.000001 - 13.000000
- Mlele BKZ

Source : SITG

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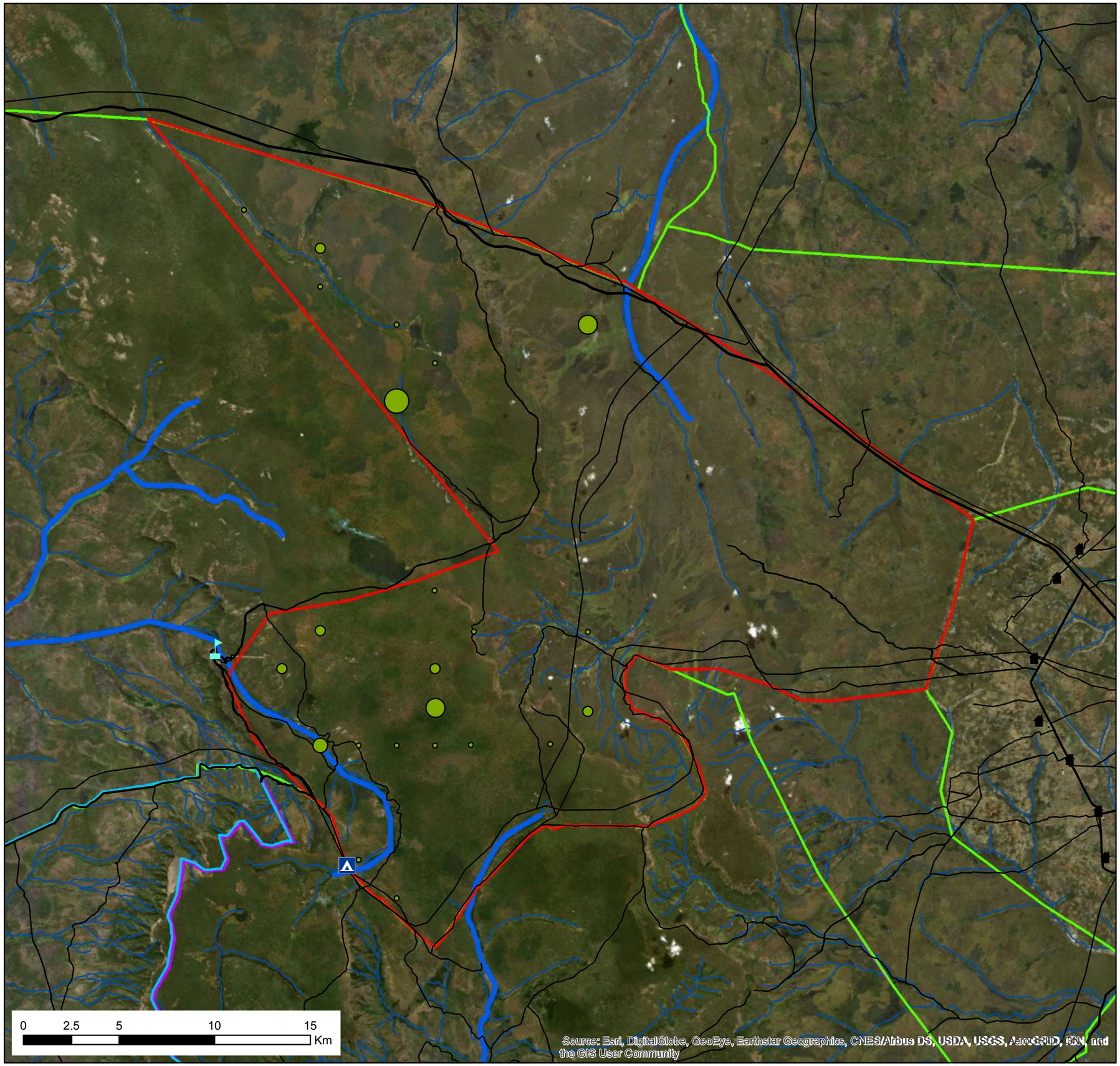

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Hystrix africaeaustralis

- 1.000000
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 4.000000
- 4.000001 - 7.000000
- Mlele BKZ

Source : SITG

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Ichneumia albicauda

1.000000

Mlele BKZ

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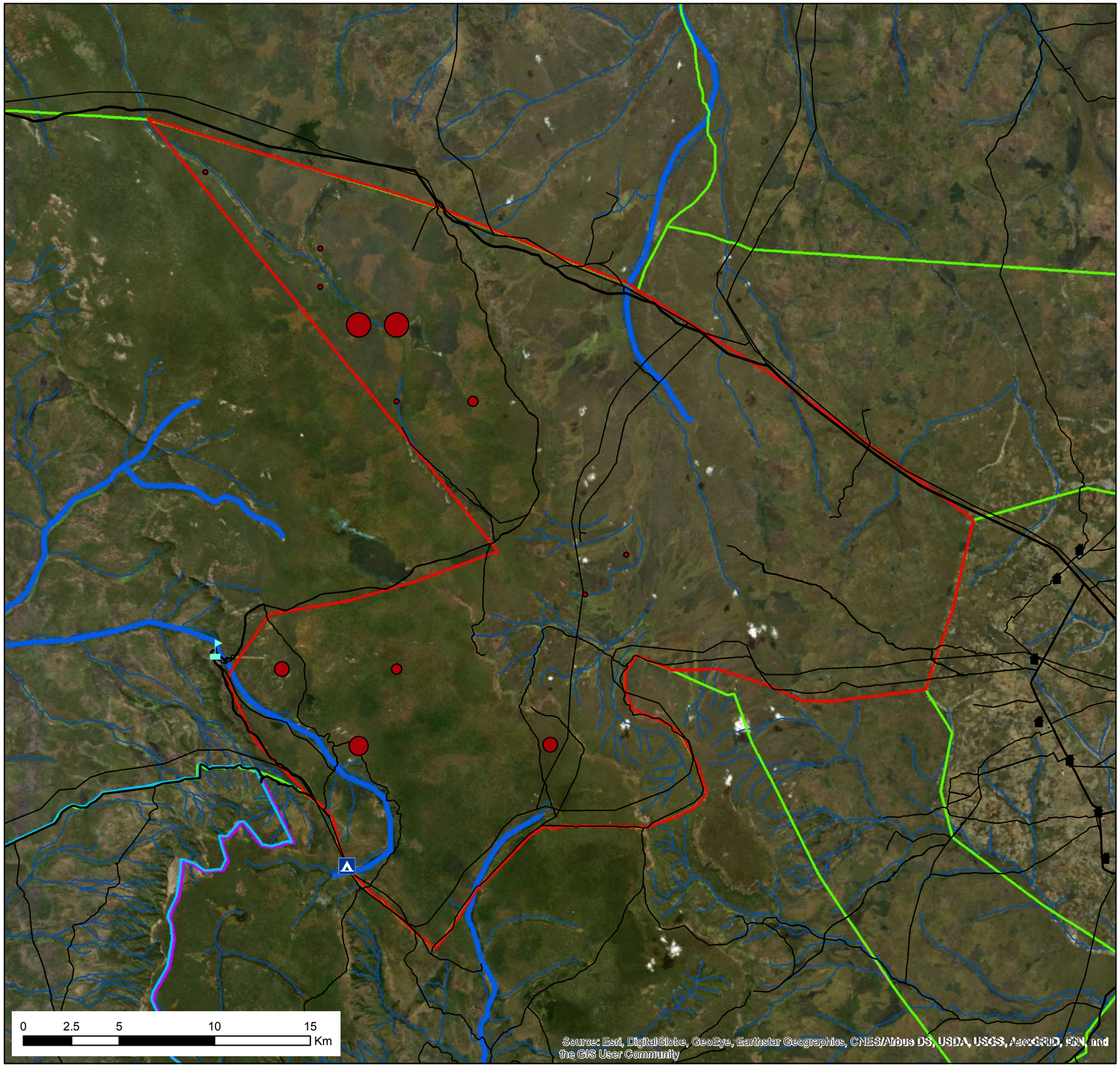
0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Lepus sp.

- 1.000000
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 4.000000
- 4.000001 - 5.000000

Mlele BKZ

Source : SITG

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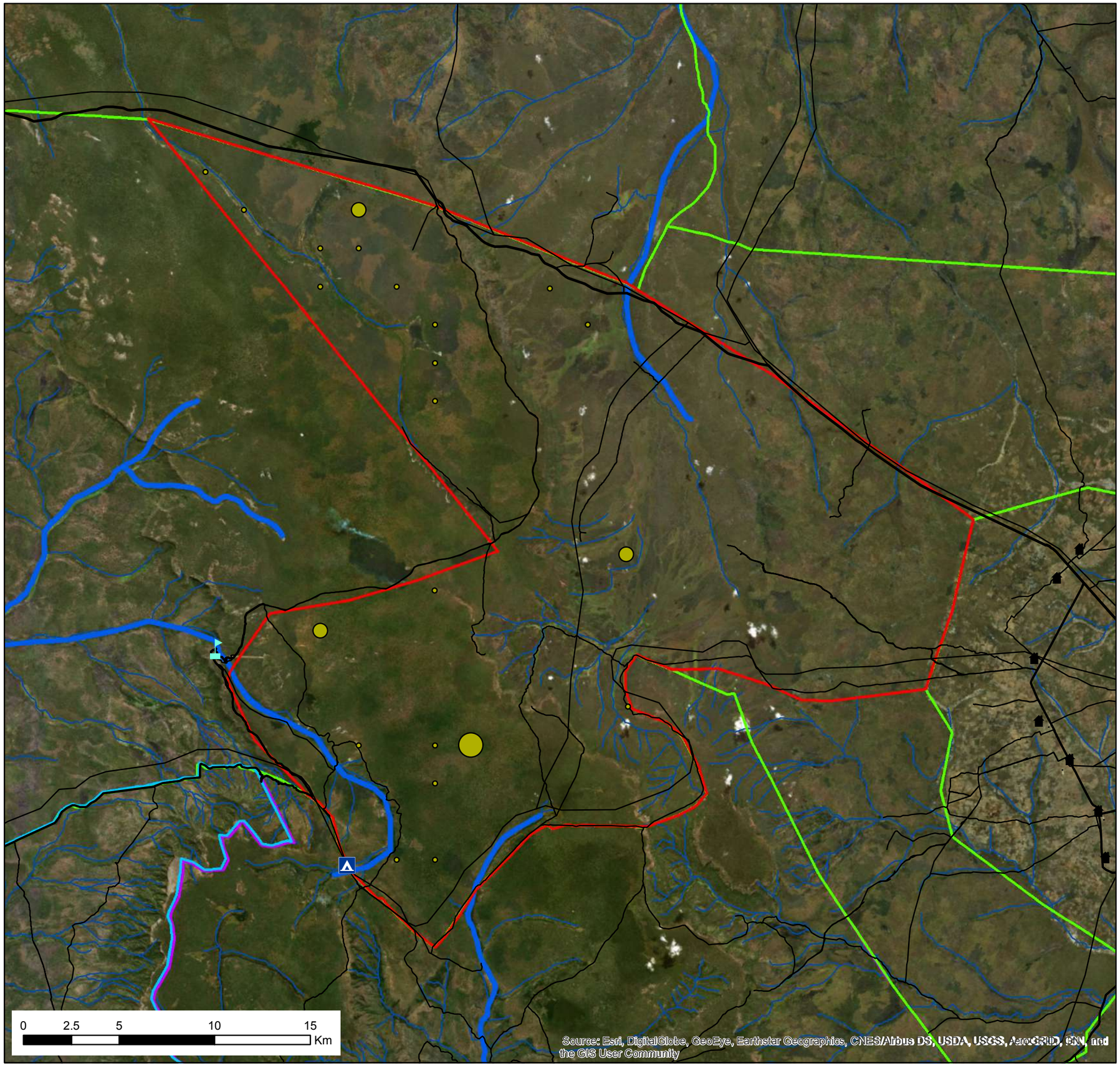

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Mellivora capensis

- 1.000000
- 1.000001 - 2.000000
- 2.000001 - 12.000000
- Mlele BKZ

Source : SITG

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Mungos mungo

- 1.000000
- 1.000001 - 2.000000
- 2.000001 - 7.000000

Mlele BKZ

Source : SITG

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Orycteropus afer

- 1.000000
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 4.000000

Mlele BKZ

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0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Otolemur crassicaudatus

- 1.000000
- 1.000001 - 2.000000
- 2.000001 - 3.000000

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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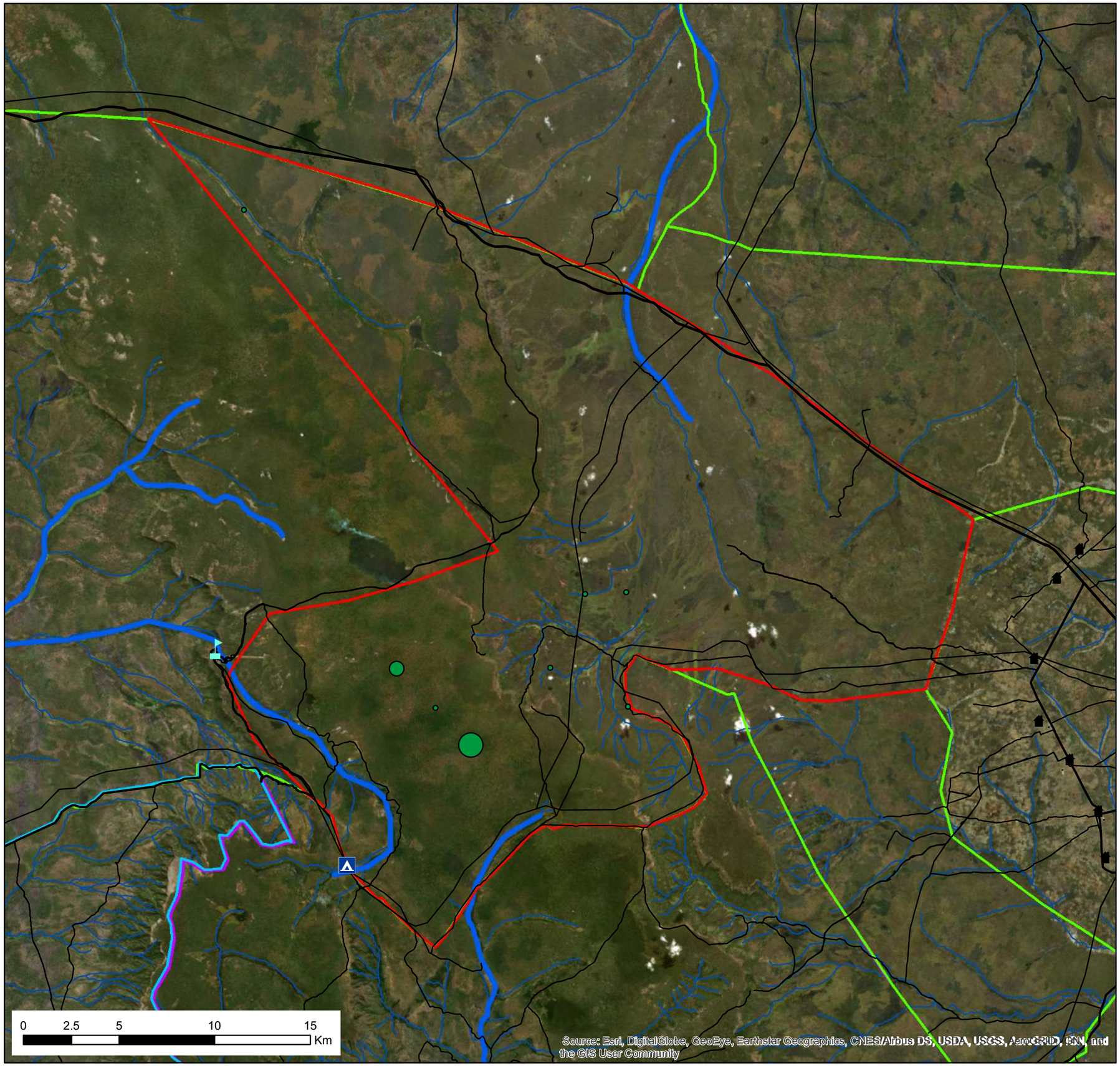

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Panthera pardus

- 1.000000
- 1.000001 - 6.000000
- 6.000001 - 8.000000
- Mlele BKZ

Source : SITG

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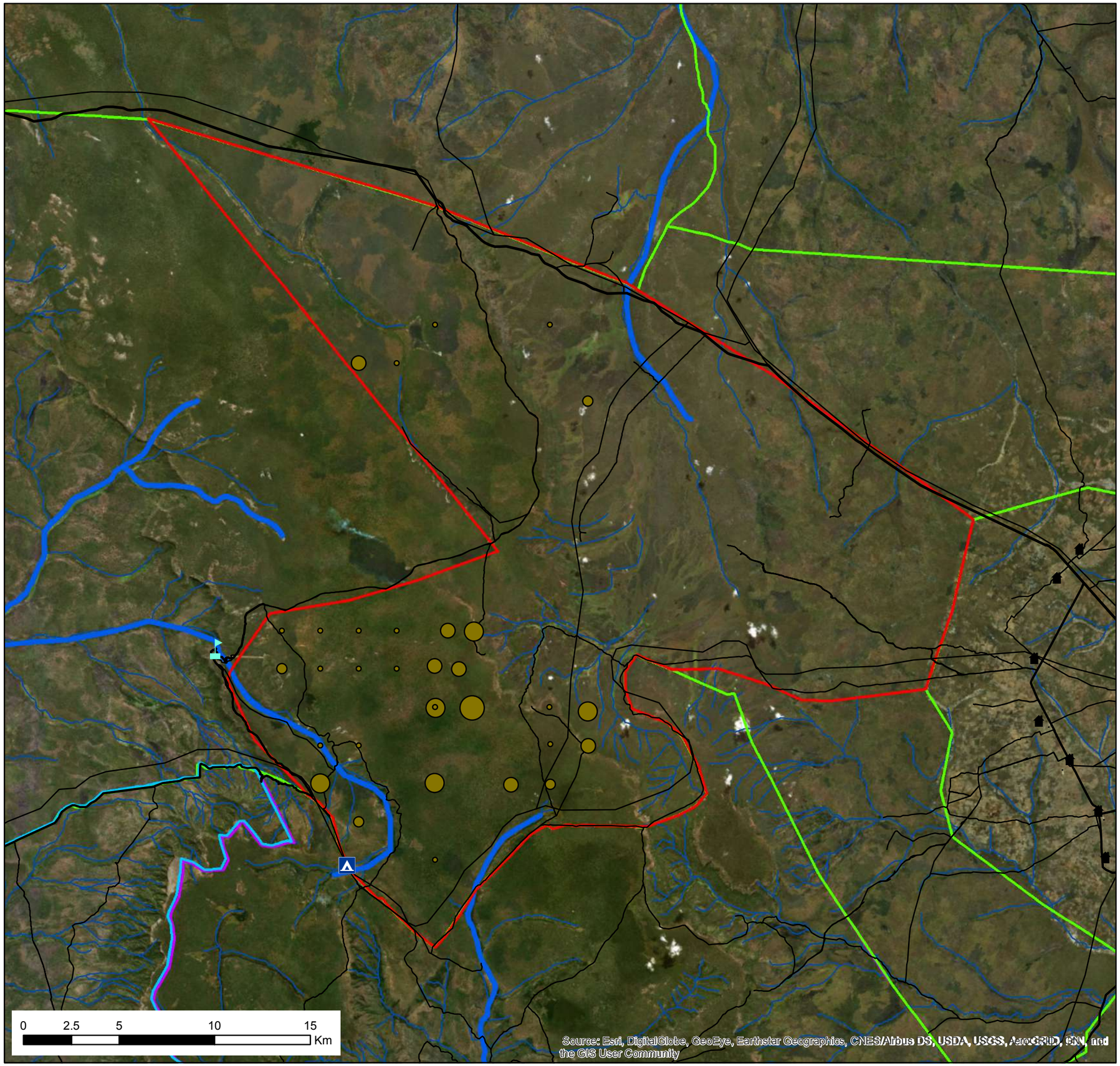

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Papio cynocephalus

- 1.000000
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 8.000000

Mlele BKZ

Source : SITG

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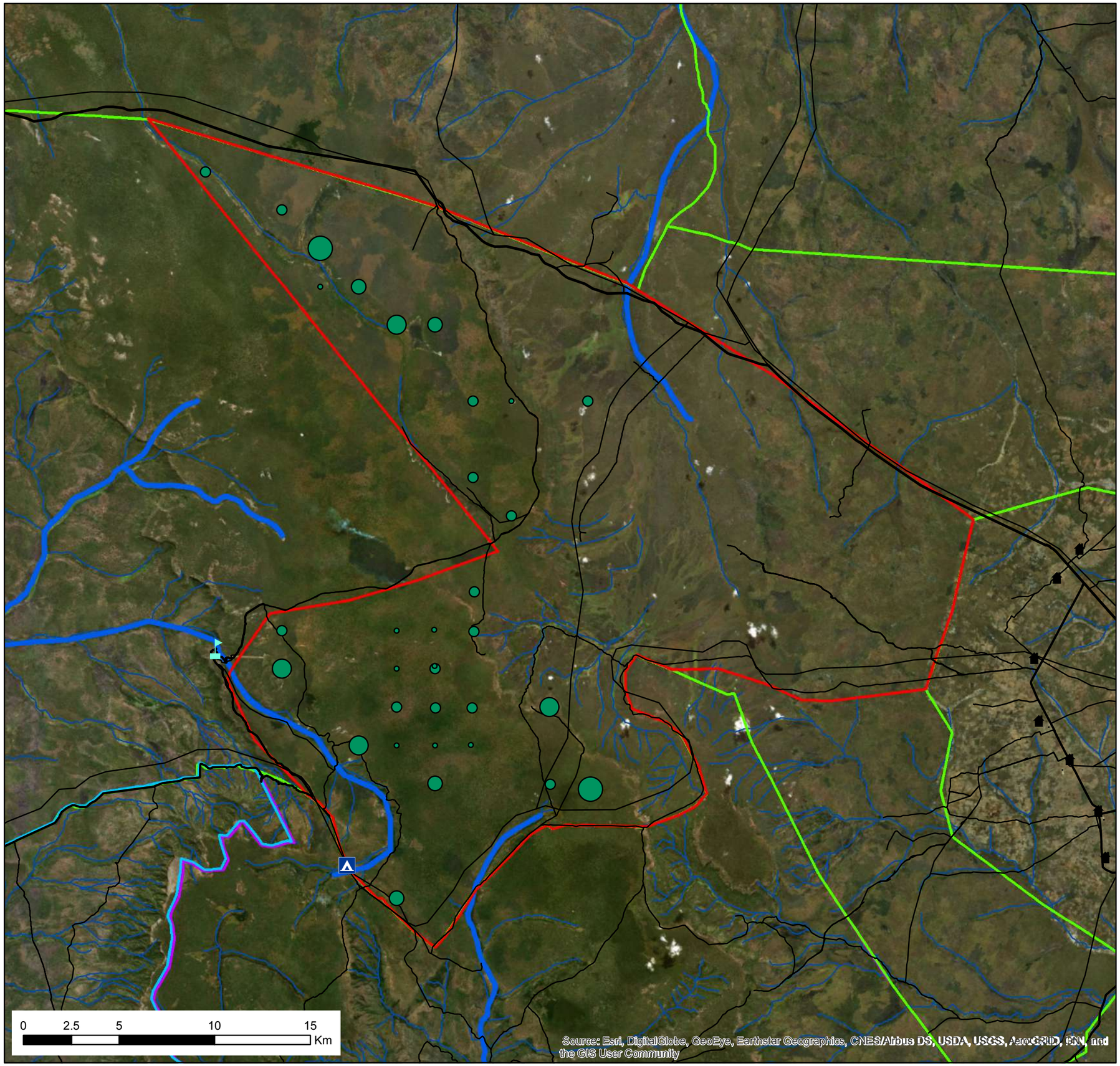

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Pedetes surdaster

- 1.000000
- 1.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 7.000000
- 7.000001 - 11.000000
- Mlele BKZ

Source : SITG

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Petrodromus tetradactylus

- 1.000000
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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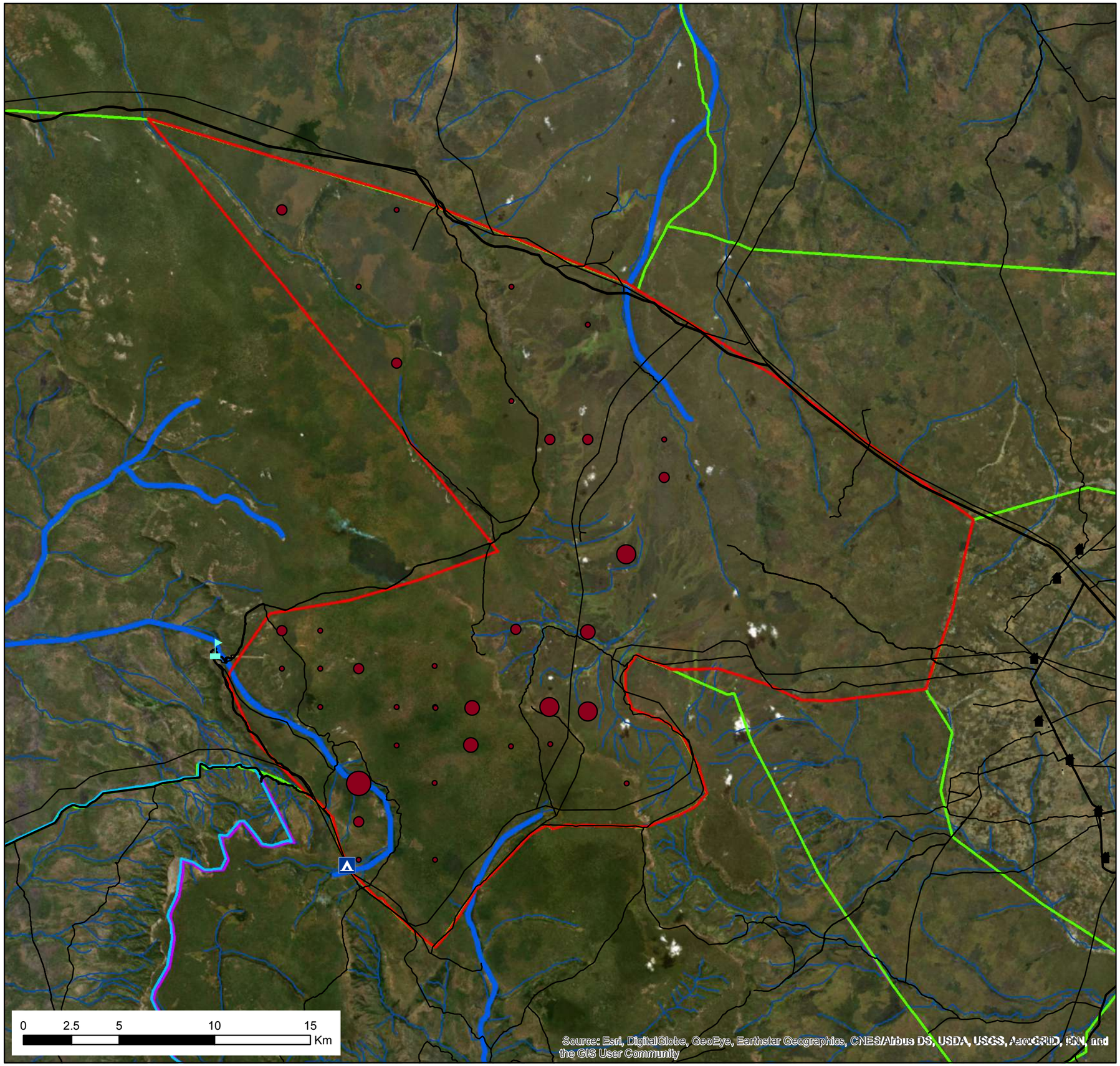

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Phacochoerus africanus

- 1.000000
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 7.000000

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Philantomba monticola

1.000000

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Potamochoerus larvatus

- 1.000000
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Raphicerus sharpei

- 1.000000
- 1.000001 - 2.000000
- 2.000001 - 3.000000

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

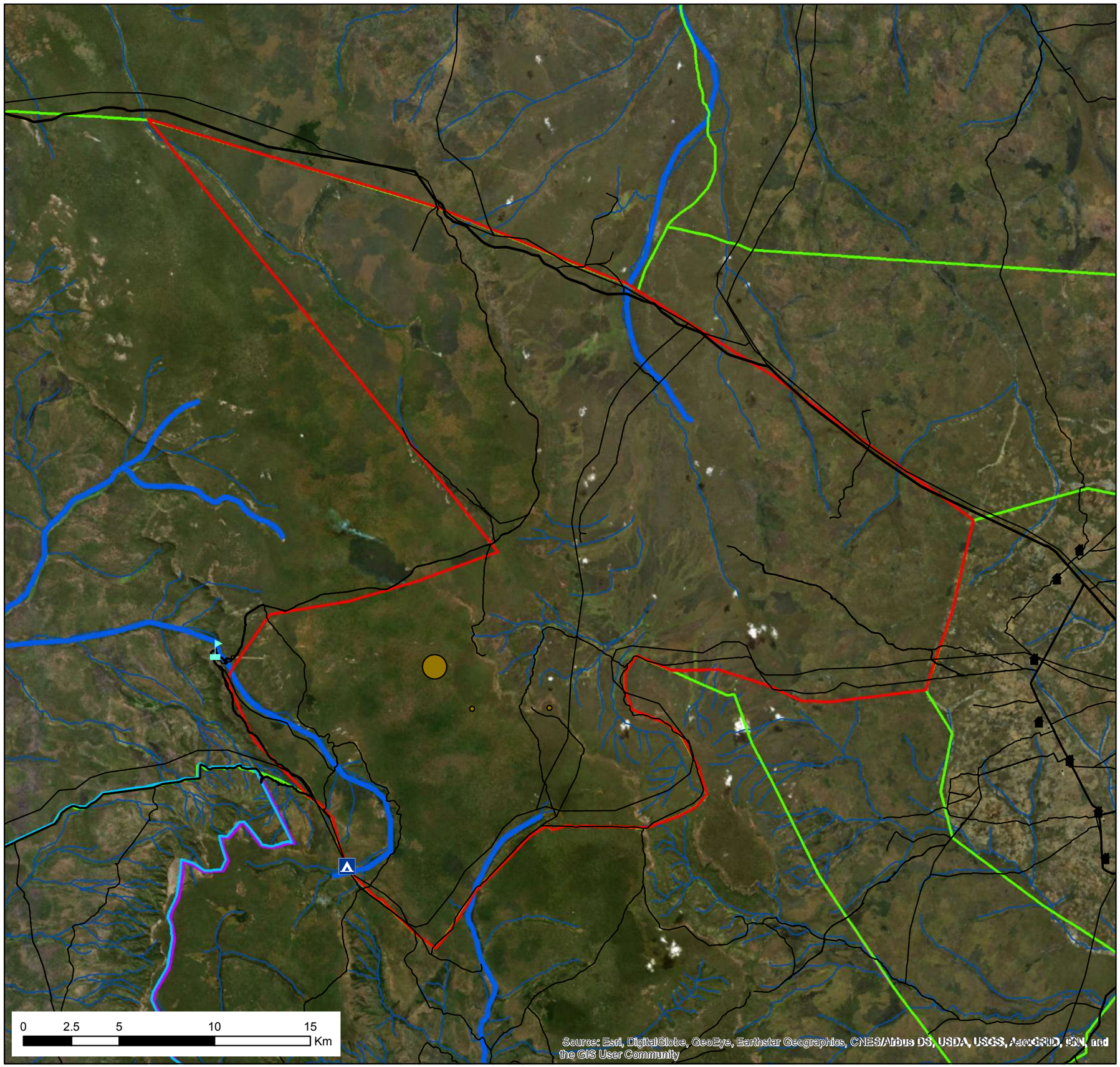
Legend

Rhynchogale melleri

1.000000

1.000001 - 8.000000

Mlele BKZ



Source : SITG

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Smutsia temminckii

1.000000

Mlele BKZ

Source : SITG

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Sylvicapra grimmia

- 1.000000 - 2.000000
- 2.000001 - 4.000000
- 4.000001 - 6.000000
- 6.000001 - 10.000000
- 10.000001 - 14.000000
- 14.000001 - 18.000000
- 18.000001 - 23.000000
- 23.000001 - 54.000000

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Syncerus caffer

1.000000

1.000001 - 2.000000

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

Hes·so Haute Ecole Spécialisée de Suisse occidentale

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0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Taurotragus oryx

1.000000

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Tragelaphus scriptus

- 1.000000
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 5.000000
- 5.000001 - 12.000000

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 7: Distribution map

Legend

Tragelaphus strepsiceros

1.000000

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Appendix 8: RAI maps of mammals

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Alcelaphus buselaphus lichtensteinii

- 0.002800
- 0.002801 - 0.005700
- 0.005701 - 0.008500
- 0.008501 - 0.025500

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Bdeogale crassicauda

- 0.003400
- 0.003401 - 0.010200
- 0.010201 - 0.017100
- 0.017101 - 0.030700
- 0.030701 - 0.068300

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Cercopithecus mitis moloneyi

0.500000

Mlele BKZ

0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Chlorocebus pygerythrus

- 0.024400
- 0.024401 - 0.146300
- Mlele BKZ

0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Source : SITG

Author : Buffard Fabrice. Août 2018

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Appendix 8: RAI map

Legend

Civettictis civetta

- 0.011500
- 0.011501 - 0.023000
- 0.023001 - 0.034500

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Cricetomys gambianus

0.030300

0.030301 - 0.121200

Mlele BKZ

0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Source : SITG

Author : Buffard Fabrice. Août 2018

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Appendix 8: RAI map

Legend

Crocuta crocuta

- 0.009500
- 0.009501 - 0.019000
- 0.019001 - 0.038100
- Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Damaliscus lunatus

- 0.024400
- 0.024401 - 0.073200
- 0.073201 - 0.097600

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Appendix 8: RAI map

Legend

Equus quagga bohemi

- 0.007000
- 0.007001 - 0.014000
- 0.014001 - 0.028000
- 0.028001 - 0.042000
- Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Galago senegalensis

0.047600

0.047601 - 0.095200

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Genetta angolensis

- 0.003000 - 0.006100
- 0.006101 - 0.012200
- 0.012201 - 0.018300
- 0.018301 - 0.024400
- 0.024401 - 0.036600

Mlele BKZ

0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, GN, and the GIS User Community

Source : SITG

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Appendix 8: RAI map

Legend

Genetta maculata

- 0.017900
- 0.017901 - 0.035700
- Mlele BKZ

Source : SITG

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Giraffa camelopardalis tipelskirshi

- 0.005300
- 0.005301 - 0.010500
- 0.010501 - 0.015800
- 0.015801 - 0.036800

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Hippotragus equinus

- 0.012700
- 0.012701 - 0.025300
- 0.025301 - 0.038000
- 0.038001 - 0.063300

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Hippotragus niger

- 0.001000
- 0.001001 - 0.002400
- 0.002401 - 0.003400
- 0.003401 - 0.008400
- 0.008401 - 0.013200

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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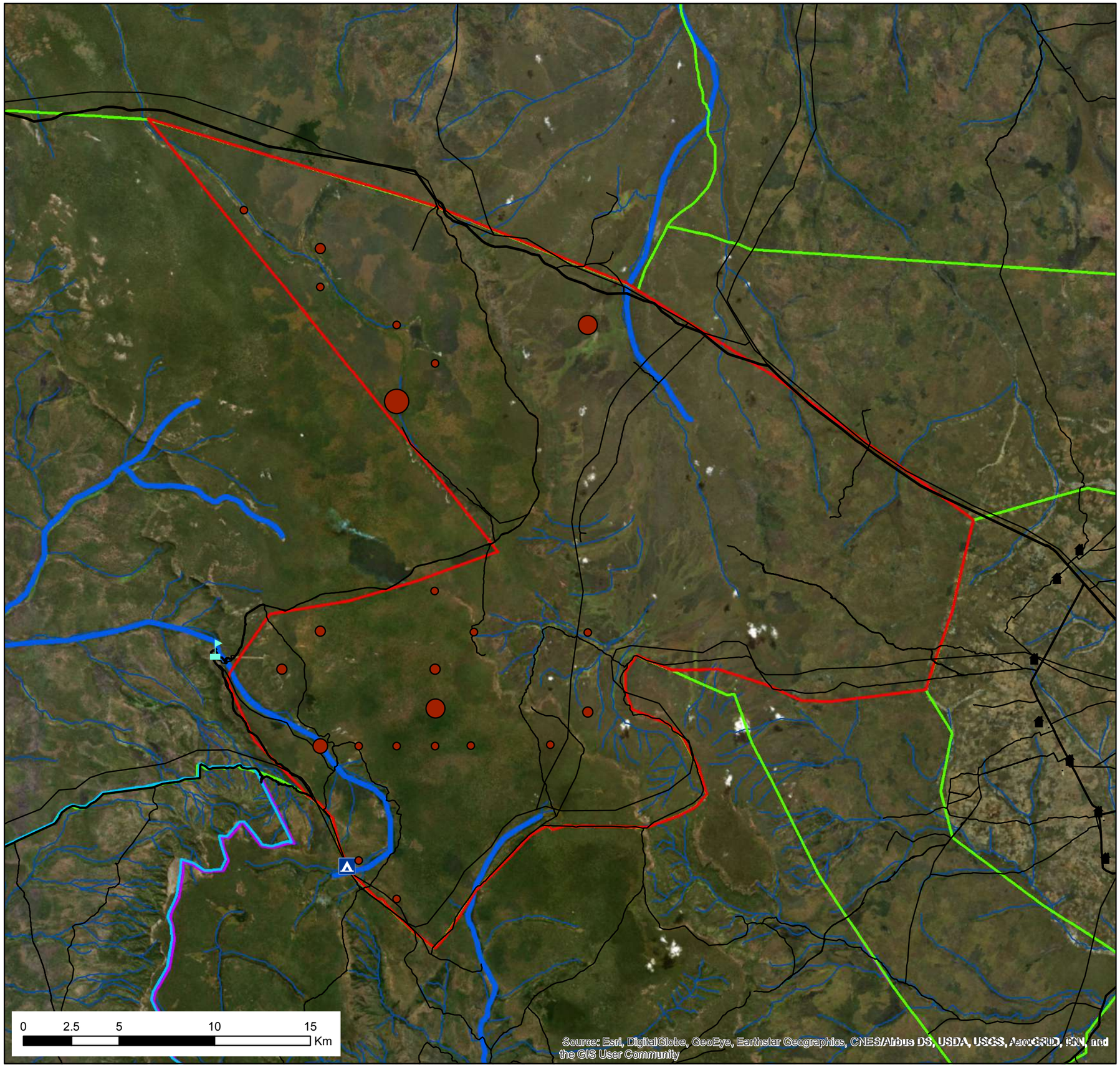
0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Hystrix africaeaustralis

- 0.008000
- 0.008001 - 0.016000
- 0.016001 - 0.024000
- 0.024001 - 0.032000
- 0.032001 - 0.056000

Mlele BKZ

Source : SITG

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Ichneumia albicauda

0.050000

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Lepus sp.

- 0.005700
- 0.005701 - 0.011400
- 0.011401 - 0.017100
- 0.017101 - 0.022900
- 0.022901 - 0.028600

Mlele BKZ

0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, GN, and the GIS User Community

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Mellivora capensis

- 0.017200
- 0.017201 - 0.034500
- 0.034501 - 0.206900

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Mungos mungo

- 0.029400
- 0.029401 - 0.058800
- 0.058801 - 0.205900

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Orycteropus afer

- 0.011800
- 0.011801 - 0.023500
- 0.023501 - 0.035300
- 0.035301 - 0.047100

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Otolemur crassicaudatus

- 0.022200
- 0.022201 - 0.044400
- 0.044401 - 0.066700

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Panthera pardus

- 0.014500
- 0.014501 - 0.087000
- 0.087001 - 0.115900
- Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

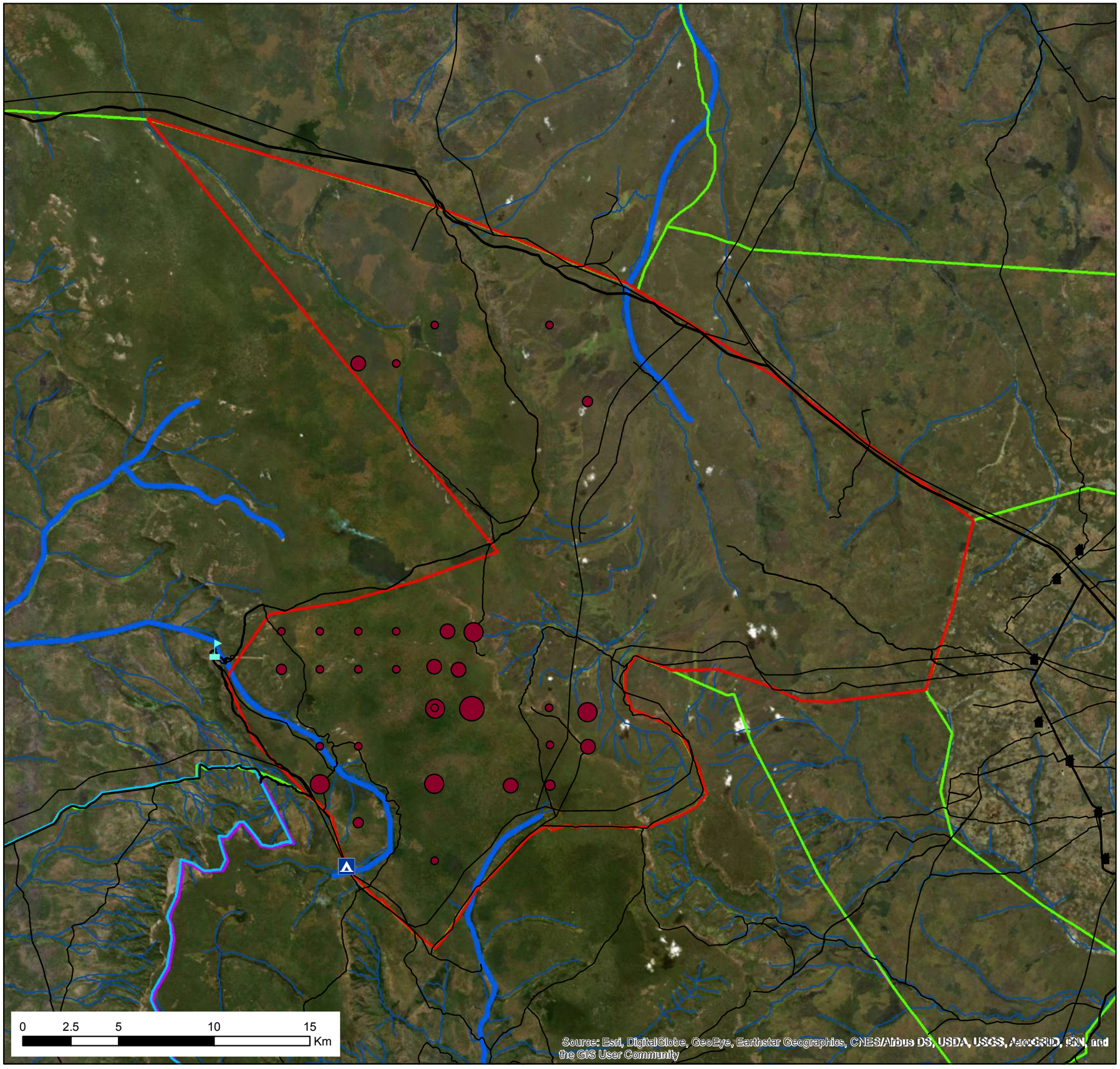
Appendix 8: RAI map

Legend

Papio cynocephalus

- 0.004400
- 0.004401 - 0.008700
- 0.008701 - 0.013100
- 0.013101 - 0.021800
- 0.021801 - 0.034900

Mlele BKZ



Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Pedetes surdaster

- 0.003500
- 0.003501 - 0.010500
- 0.010501 - 0.017500
- 0.017501 - 0.024600
- 0.024601 - 0.038600

Mlele BKZ

0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, GN, and the GIS User Community

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Petrodromus tetradactylus

- 0.047600
- 0.047601 - 0.095200
- 0.095201 - 0.142900

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Phacochoerus africanus

- 0.003000
- 0.003001 - 0.006000
- 0.006001 - 0.009000
- 0.009001 - 0.015100
- 0.015101 - 0.021100

Mlele BKZ

0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, GN, and the GIS User Community

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Philantomba monticola

0.024400

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Rhynchogale melleri

0.076900

0.076901 - 0.615400

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Potamochoerus larvatus

- 0.004400
- 0.004401 - 0.008800
- 0.008801 - 0.013300

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Raphicerus sharpei

- 0.010100
- 0.010101 - 0.020200
- 0.020201 - 0.030300

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Smutsia temminckii

0.500000

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Sylvicapra grimmia

- 0.000500 - 0.001600
- 0.001601 - 0.004200
- 0.004201 - 0.007300
- 0.007301 - 0.011900
- 0.011901 - 0.028100

Mlele BKZ

0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, GN, and the GIS User Community

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Syncerus caffer

0.014300

0.014301 - 0.028600

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

Hes·so Haute Ecole Spécialisée de Suisse occidentale

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0 2.5 5 10 15 Km

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Taurotragus oryx

0.333300

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Tragelaphus strepsiceros

0.034500

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 8: RAI map

Legend

Tragelaphus scriptus

- 0.004100
- 0.004101 - 0.008200
- 0.008201 - 0.012300
- 0.012301 - 0.020500
- 0.020501 - 0.049200

Mlele BKZ

Source : SITG

Author : Buffard Fabrice. Août 2018

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Appendix 9: Map of Tanzanians' Game Controlled Areas (GCA) exploited by the Tanzania Big Game Safari

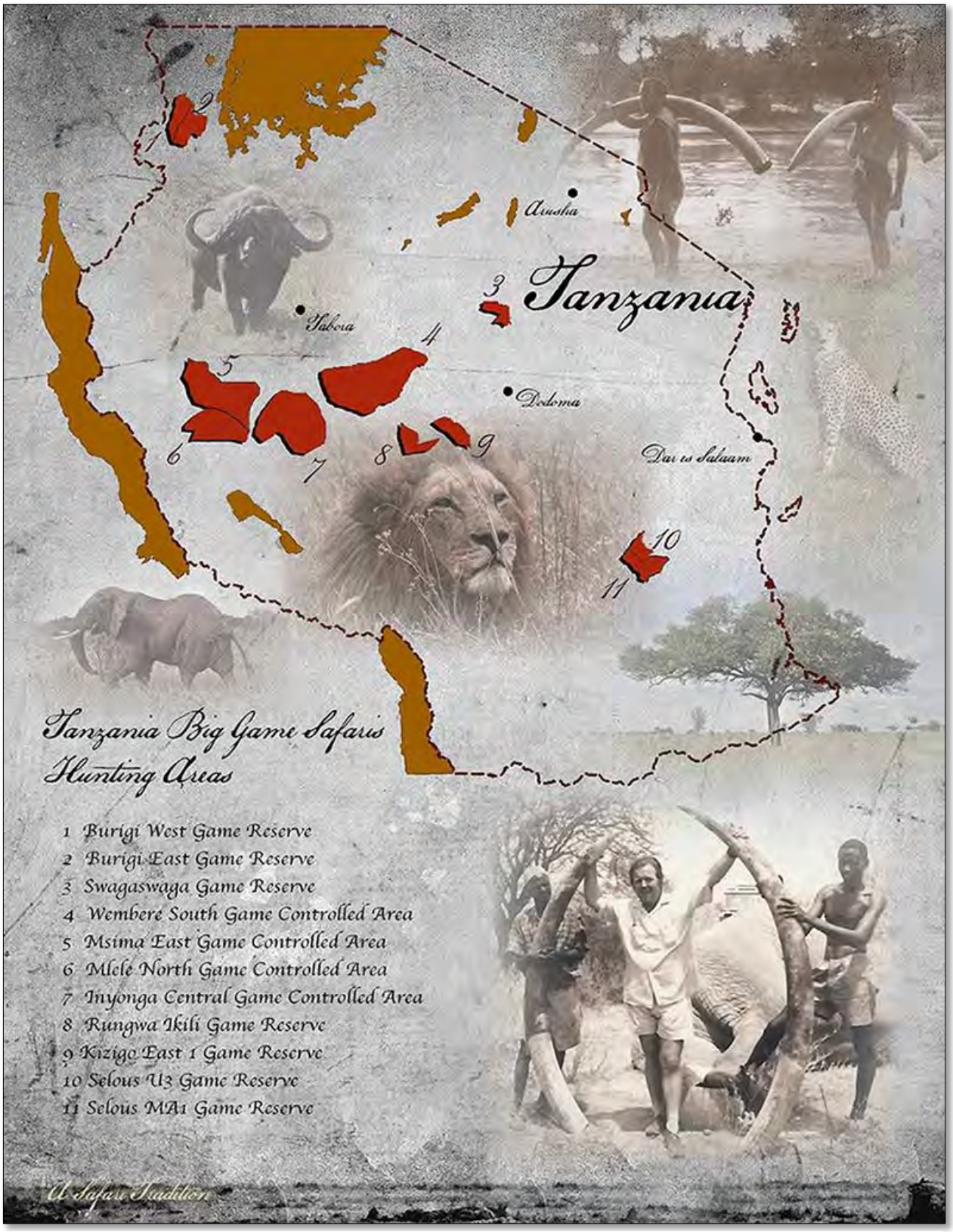
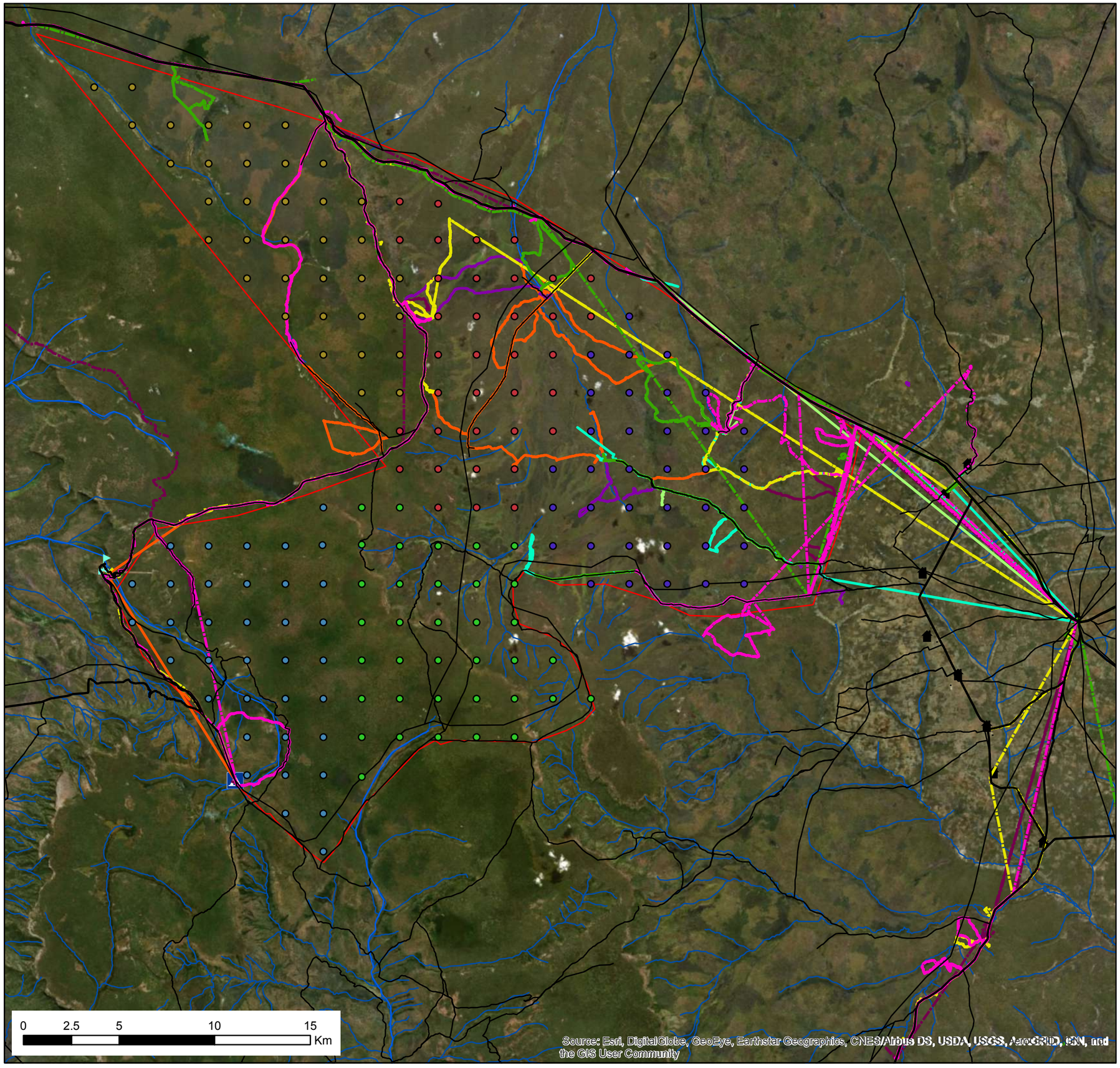


Figure 15: Map of Tanzanians' Game Controlled Areas (GCA) exploited by the Tanzania Big Game Safari. Source: http://tanzaniabiggame.com/web-content/map.htm. Downloaded on August 14th, 2018.

Appendix 10: Patrols map from August 2017 to March 2018

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 10: Patrols map



Legend

- TZA_roads
- Main rivers
- March 2018
- 22-28 Feb 2018
- 9-14 Feb 2018
- 20-30 Jan 2018
- 21-27 Nov 2017
- 9-10 Nov 2017
- 5-8 Oct 2017
- 8-15 Aug 2017
- Mlele BKZ

Quadrat

- M1
- M2
- M3
- M4
- M5

Source : SITG

Author : Buffard Fabrice. Août 2018

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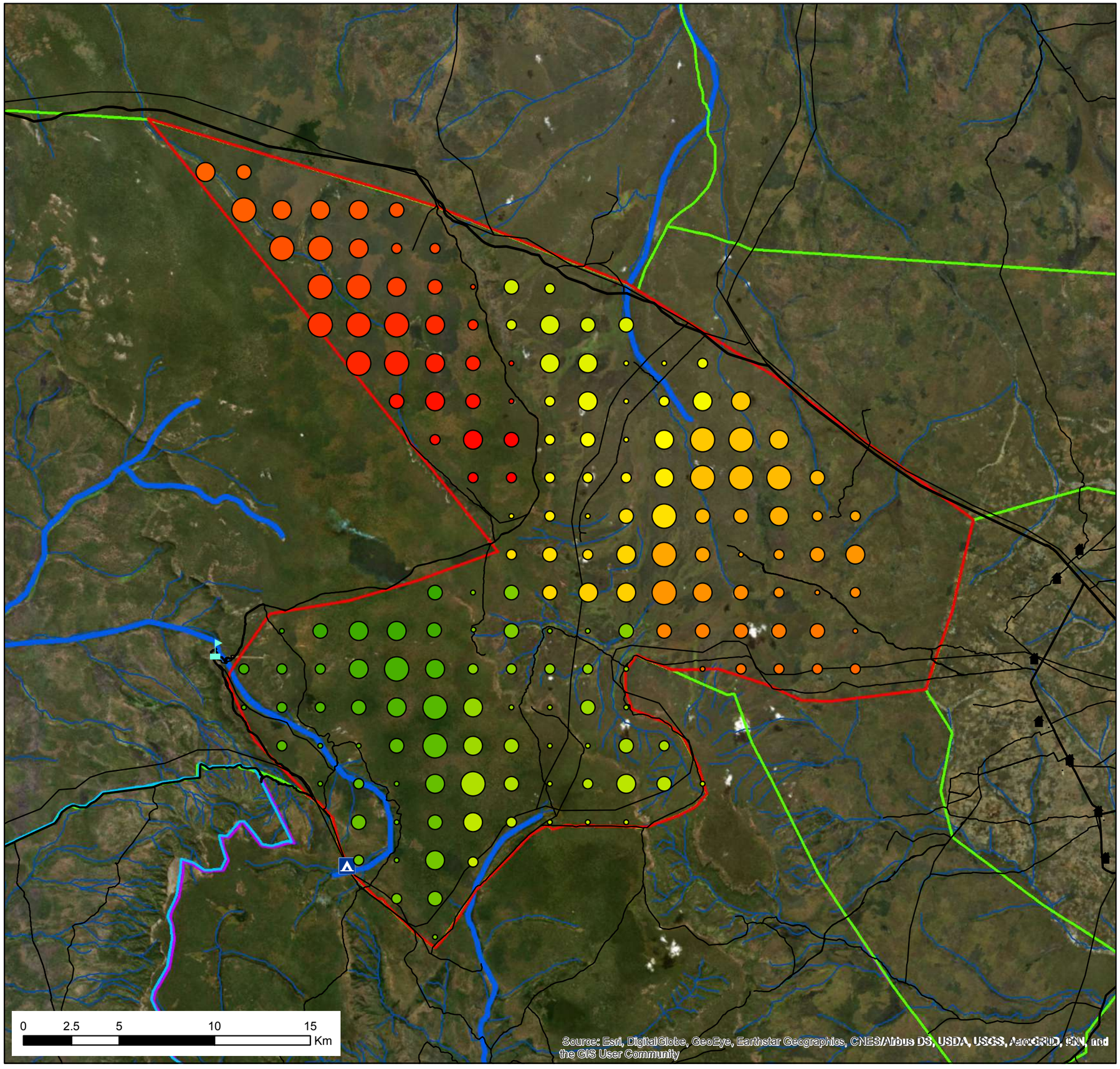
Appendix 11: Threat of poaching



Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 11: Threat of poaching

This map is encompassing the distance to roads and the distance to poaching.

The closer to the road, the smaller the symbol. The risk of poaching is symbolised with colors.
Green = low threat
Red = high threat

Source : SITG

Author : Buffard Fabrice. Août 2018

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Appendix 12: Species Richness map of mammals

Key determinant of the species richness, distribution and abundancy of medium and large mammals in a dry forest ecosystem: environmental or anthropogenic factors?

Appendix 12: Species Richness

Legend

Species Richness

- 0 - 2
- 3 - 5
- 6 - 8
- 9 - 12
- 13 - 19

Source : SITG

Author : Buffard Fabrice. Août 2018

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Appendix 13: Predictive list of mammals

Table 1: List of predictive mammals for the Mlele Beekeeping Zone (part 1). Source: Present survey.

N°	Order	Familly	Name[1]				Author and date	Status[2]
			Scientific	French	English	Swahili		
1	Carnivora	Canidae	*Canis adustus*	Chacal à flancs rayés	Side-striped jackal	Bweha miraba	(Sundevall, 1857)	LC
2	Carnivora	Canidae	*Canis mesomelas*	Chacal à Chabraque	Black backed jackal	Bweha nyukundu	(Schreber, 1775)	LC
3	Carnivora	Canidae	*Lycaon pictus*	Lycaon	Wild dog	Mbwa-mwitu	(Temminck, 1820)	EN
4	Carnivora	Felidae	*Leptailurus serval*	Chat tigre	Serval	Mondo	(Schreber, 1776)	LC
5	Carnivora	Felidae	*Panthera pardus*	Léopard	Leopard	Chui	(Linnaeus, 1758)	VU
6	Carnivora	Felidae	*Panthera leo*	Lion	Lion	Simba	(Linnaeus, 1758)	VU
7	Carnivora	Herpestidae	*Atilax paludinosus*	Mangouste des marais	Marsh mongoose	Nguchiro / Maji	(G.[Baron] Cuvier, 1829)	LC
8	Carnivora	Herpestidae	*Bdeogale crassicauda*	Mangouste à queue touffue	Bushy tailed mongoose	Kitu	(Peters, 1852)	LC
9	Carnivora	Herpestidae	*Mungos mungo*	Mangue rayée	Banded mongoose	Nguchiro miraba	(Gmelin, 1788)	LC
10	Carnivora	Herpestidae	*Helogale parvula*	Mangouste naine	Dwarf mongoose	Nguchiro mfupi / Kitafe	(Sundevall, 1847)	LC
11	Carnivora	Herpestidae	*Herpestes ichneumon*	Mangouste ichneumon	Egyptian mongoose	Nguchiro kijivu	(Linnaeus, 1758)	LC
12	Carnivora	Herpestidae	*Herpestes sanguineus*	Mangouste rouge	Slender mongoose	Nguchiro mwembamba	(Rüppel, 1835)	LC
13	Carnivora	Herpestidae	*Ichneumia albicauda*	Mangouste à queue blanche	White-tailed mongoose	Nguchiro mkia mweupe	(G.[Baron] Cuvier, 1829)	LC
14	Carnivora	Herpestidae	*Rhynchogale melleri*	Mangouste de Meller	Meller's mongoose	-	(Gray, 1865)	LC
15	Carnivora	Hyaenidae	*Crocuta crocuta*	Hyène tachetée	Spotted Hyaena	Fisi madoa	(Erxleben, 1777)	LC
16	Carnivora	Mustelidae	*Mellivora capensis*	Ratel	Honey badger	Nyegere	(Schreber, 1776)	LC
17	Carnivora	Viverridae	*Civettictis civetta*	Civette d'Afrique	African Civet	Fungo	(Schreber, 1776)	LC
18	Carnivora	Viverridae	*Genetta angolensis*	Genette d'Angola	Miombo Genet	Kamsimba mkia meusi na madoa meupe	(Bocage, 1882)	LC
19	Carnivora	Viverridae	*Genetta maculata*	Genette panthère	Large-spotted Genet	Kamsimba	(Gray, 1830)	LC
20	Cetartiodactyla	Bovidae	*Aepyceros melampus ssp. melampus*	Impala	Impala	Swalapala	(Liechtenstein, 1812)	LC
21	Cetartiodactyla	Bovidae	*Alcelaphus buselaphus ssp. lichtensteinii*	Bubale de Lichtenstein	Liechtenstein's Hartbeest	Kongoni	(Peers, 1849)	LC
22	Cetartiodactyla	Bovidae	*Damaliscus lunatus ssp. jimela*	Damalisque	Topi	Nyamera	(Matschie, 1892)	VU
23	Cetartiodactyla	Bovidae	*Hippotragus equinus*	Antilope rouanne	Roan Antelope	Korongo	(É. Geoffroy Saint-Hilaire, 1803)	LC
24	Cetartiodactyla	Bovidae	*Hippotragus niger*	Hippotrague noir	Sable Antelope	Palahala	(Harris, 1838)	LC
25	Cetartiodactyla	Bovidae	*Kobus ellipsiprymnus ssp. defassa*	Cobe defassa	Defassa waterbuck	Kuro-ndogoo	(Ogilby, 1833)	NT
26	Cetartiodactyla	Bovidae	*Oreotragus oreotragus*	Oréotrague	Klipspringer	Ngurunguru / Mbuzi mawe	(Zimmermann, 1783)	LC
27	Cetartiodactyla	Bovidae	*Raphicerus sharpei*	Grysbok de Sharpe	Sharpe's grysbok	-	(Thomas, 1897)	LC
28	Cetartiodactyla	Bovidae	*Redunca arundinum*	Grand Cobe des roseaux	Souther Reedbuck	Tohe-Kusi	(Boddaert, 1785)	LC
29	Cetartiodactyla	Bovidae	*Syncerus caffer ssp. caffer*	Buffle d'Afrique	African Buffalo	Nyati	(Sparrman, 1779)	LC
30	Cetartiodactyla	Bovidae	*Sylvicapra grimmia*	Céphalophe de Grimm	Common Duiker	Nsha / Nsya	(Linnaeus, 1758)	LC
31	Cetartiodactyla	Bovidae	*Taurotragus oryx*	Eland du Cap	Common Eland	Pofu	(Pallas, 1766)	LC
32	Cetartiodactyla	Bovidae	*Tragelaphus scriptus*	Guib harnaché	Bushbuck	Pongo / Mbawala	(Pallas, 1766)	LC
33	Cetartiodactyla	Bovidae	*Tragelaphus strepsiceros*	Grand Koudou	Greater kudu	Tandala mkubwa	(Pallas, 1766)	LC
34	Cetartiodactyla	Giraffidae	*Giraffa camelopardalis ssp. tippelskirchi*	Girafe Masaï	Masai Giraffe	Twiga	(Matschie, 1898)	VU
35	Cetartiodactyla	Suidae	*Phacochoerus africanus*	Phacochère commun	Warthog	Ngiri	(Gmelin, 1788)	LC
36	Cetartiodactyla	Suidae	*Potamochoerus larvatus*	Potamochère	Bushpig	Nguruwe mwitu	(F.Curvier, 1822)	LC
37	Lagomorpha	Leporidae	*Lepus sp.*	Lièvre	Hare	Sungura	(Linnaeus, 1758)	LC

[1] Upon The Kingdon Field Guide to African Mammals. Second Edition, Bloomsbury Publishing, 2015.

[2] The IUCN Red List of Threatened Species. Version 2017-3. <www.iucnredlist.org>. Downloaded on 26 June 2018.

Table 2: List of predictive mammals for the Mlele Beekeeping Zone (part 2). Source: Present survey.

N°	Order	Familly	*Name*[1]				Author and date	Status[2]
			Scientific	French	English	Swahili		
38	Macroscelidea	Macroscelididae	*Petrodromus tetradactylus*	Pétrodrome	Four toed Elephant shrew	Sengi	(Peters, 1846)	LC
39	Perissodactyla	Equidae	*Equus quagga ssp. boehmi*	Zèbre de Steppes	Plains Zebra	Punda milia	(P.Matschie, 1892)	NT
40	Pholidota	Manidae	*Smutsia temminckii*	Pangolin terrestre	Ground pangolin	Kakakuona		VU
41	Primates	Cercopithecidae	*Cercopithecus nictitans mitis ssp. moloneyi*	Cercopithèque à diadème	Moloney's white-collared Monkey	Tumbili kahawia na mweusi	(scalter, 1893)	LC
42	Primates	Cercopithecidae	*Chlorocebus pygerythrus*	Vervet bleu	Vervet Monkey	Tumbili / Ngedere	(F.Curvier, 1821)	LC
43	Primates	Cercopithecidae	*Papio cynocephalus*	Babouin cynocéphale	Common Baboon	Nyani nfano	(Linnaeus, 1758)	LC
44	Primates	Galagidae	*Galago senegalensis*	Galago du Sénégal	Northern Lesser Galago	Komba ya Senegal	(E. Geoffroy, 1796)	LC
45	Primates	Galagidae	*Otolemur crassicaudatus ssp. monteiri*	Otolemur monteiri	Silvery greater Galago	Komba kubwa	(Bartlett in Gray, 1863)	LC
46	Proboscidea	Elephantidae	*Loxodonta africana*	Elephant d'Afrique	African Elephant	Tembo	(Blumenbach, 1797)	VU
47	Rodentia	Hystricidae	*Hystrix africaeaustralis*	Porc-épic de l'Afrique du Sud	South African Porcupine	Nnungu	(Peters, 1852)	LC
48	Rodentia	Pedetidae	*Pedetes surdaster*	Lièvre sauteur	East african Spring Hare	Kamendegere	(Thomas, 1902)	LC
49	Tubulidentata	Orycteropodidae	*Orycteropus afer*	Oryctérope	Aardwark	Muhanga / Mhanga	(Pallas, 1766)	LC

[1] Upon The Kingdon Field Guide to African Mammals. Second Edition, Bloomsbury Publishing, 2015.

[2] The IUCN Red List of Threatened Species. Version 2017-3. <www.iucnredlist.org>. Downloaded on 26 June 2018.