



Maintenance of mammal diversity in the biodiversity conservation area of the Ity gold mine (Western Côte d'Ivoire)

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Abstract

Mining expansion in western Côte d'Ivoire alters habitats and threatens mammals, which are sensitive bioindicators of habitat disturbance. The Ity Mining Company (SMI) has set aside a 10-ha conservation area, "Camp Forest", within its concession in the Zouan-Hounien Department (Tonkpi Region). This study assessed the effectiveness of this parcel as a relict habitat for mammals in a highly anthropised landscape. Ten camera traps were deployed following a standardised protocol from July to September 2022. The sampling effort totalled 870 trap-nights, yielding 1,714 independent events (1.97 events per camera-day). Eight mammal species from three orders (Artiodactyla, Carnivora and Rodentia) were recorded: *Tragelaphus scriptus*, *Philantomba maxwellii*, *Civettictis civetta*, *Genetta genetta*, *Galerella sanguinea*, *Atherurus africanus*, *Cricetomys gambianus* and *Funisciurus pyrropus*. The Shannon index ($H' = 1.64$) indicated moderate diversity, and Pielou's evenness index ($J' = 0.84$) a relatively even distribution of individuals among species. Relative abundance indices showed a predominance of *T. scriptus* and *P. maxwellii*, while the other species were rarely detected. "Camp Forest" thus supports a structured and relatively balanced mammal assemblage, confirming its role in maintaining local biodiversity in a mining landscape. Continued monitoring is needed to guide the sustainable management of conservation areas within industrial concessions.

Keywords: Biodiversity; Camera trapping; Conservation area; Mammal diversity; Mining activities; West Africa

1. Introduction

Like many West African countries, Côte d'Ivoire has experienced a marked expansion of mining activities, particularly gold mining, since the 1990s, with both industrial and artisanal operations intensifying in its western forest zone (Kouamé et al., 2020). However, this growth has been accompanied by major environmental changes, including deforestation, habitat fragmentation, chemical pollution and increasing anthropogenic pressure, which profoundly alter ecosystem structure and functioning (Hilson, 2002). Mammals are among the biological groups most sensitive to these disturbances and are widely recognised as excellent bioindicators because of their trophic position, ecological requirements and vulnerability to habitat change (Wuwer and Attuquayefio, 2006; Bitty et al., 2015). In heavily anthropised mining landscapes, their species diversity and relative abundance are therefore likely to decline significantly. In response to these challenges, some mining companies are progressively adopting environmental management measures aimed at reducing their ecological footprint. These include voluntary conservation areas within mining concessions, designed as potential refuges or ecological corridors for residual biodiversity (Laurance et al., 2015). Nevertheless, in West Africa, and in Côte d'Ivoire in particular, scientific data assessing the actual effectiveness of such areas in maintaining mammal communities remain scarce and fragmentary (Kablan et al., 2017; Diarrassouba et al., 2019).

The present study was conducted within the concession of the Ity Mining Company (Société des Mines d'Ity, SMI), located in the Zouan-Hounien Department. As part of its corporate social and environmental responsibility policy, the company has established a 10-ha conservation area known as "Camp Forest", intended to preserve the residual floral and faunal components of the mining site (ITIE, 2023). This initiative offers a unique opportunity to assess the potential role of such a preserved area for mammal conservation in a mining context. The

general objective of this study was therefore to assess the effectiveness of the "Camp Forest" parcel as a relict habitat for mammals in a landscape heavily transformed by mining. Specifically, it aimed to (i) inventory the mammal species occurring in this conserved area, (ii) analyse their diversity and relative abundance, and (iii) assess the extent to which this area can contribute to maintaining local mammal populations, thereby providing a scientific basis for sustainable biodiversity management strategies in industrial settings.

2. Materials and Methods

2.1. Study area

The "Camp Forest" parcel lies within the operating area of the Ity Mine, in the Zouan-Hounien Department, Tonkpi Region, western Côte d'Ivoire. Ity village is located at 6°52'11" N and 8°06'38" W, approximately 13 km south-east of the town of Zouan-Hounien, the departmental capital (Figure 1). Hydrographically, the area is influenced by the Cavally River, the main watercourse of the region (Ettien, 2005; Doffou, 2020), whose gallery forests are one of the structuring elements of the landscape (Fadika, 2013). Topographically, the Ity area is a gently undulating peneplain dotted with isolated hills, notably Mounts Ziatouo (316 m), Ity (301 m), Tontouo (309 m), Flotouo (304 m), Zouatouo (306 m) and Guématouo (375 m) (Bakayoko et al., 2013), several of which have a recognised gold potential (Kouadio, 1996). The study area has a mountain climate characterised by high rainfall, with two main seasons: a rainy season and a dry season (Ouedraogo, 2001). The "Camp Forest" parcel lies within a mosaic of vegetation types, including gallery forests along the Cavally River, secondary forests and old cocoa and coffee plantations. The main socio-economic activities of local communities are agriculture, fishing, hunting and, nowadays, illegal artisanal gold mining (Brou, 2019).

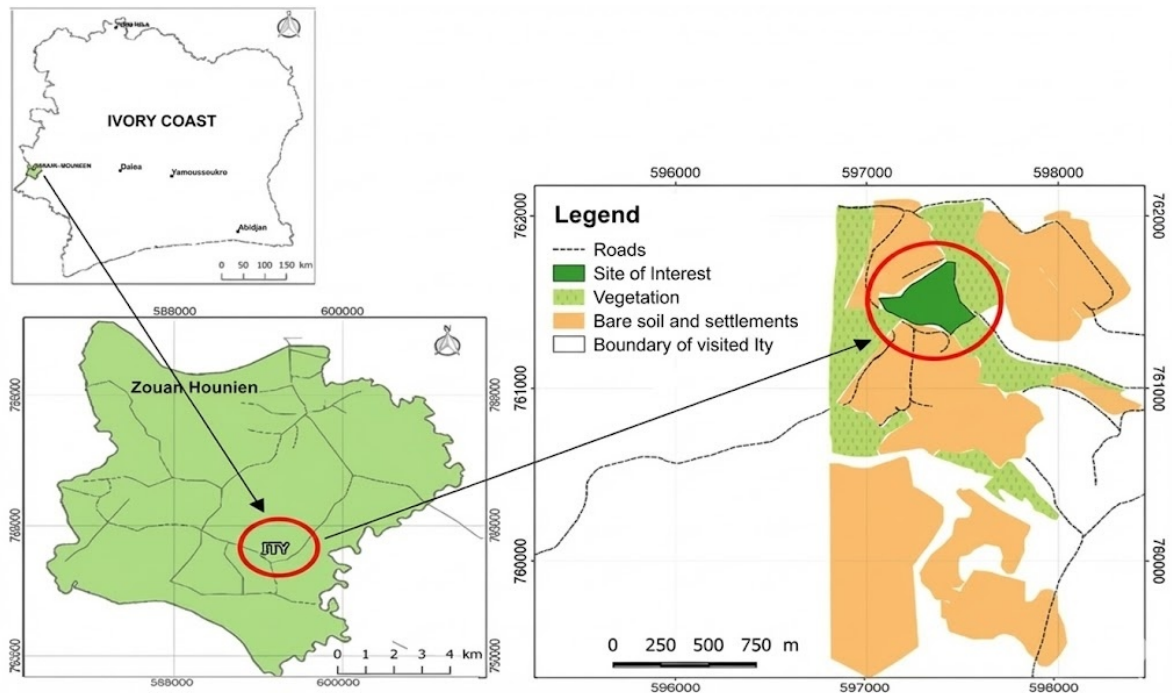


Figure 1: Geographical location of the "Camp Forest" parcel of the SMI

2.2. Equipment

A Garmin Global Positioning System (GPS) receiver was used to record the geographical coordinates of mammal presence signs and of camera-trap locations. In addition, ten Blazervideo camera traps were deployed to collect photographic and video data on the mammals of the SMI conservation area.

2.3. Data collection

Camera trapping was used to collect data on mammals within the biodiversity conservation area of the SMI (Varma et al., 2006; O'Connell et al., 2011). Camera-trap sites were identified during a reconnaissance survey on foot, and the locations showing the most significant signs of mammal presence were selected for deployment. On this basis, ten sites were selected within the "Camp Forest" parcel. Their geographical coordinates were recorded with a GPS and numbered from 1 to 10. Each camera trap was individually calibrated and configured on site. Cameras were set to hybrid mode (photo/video), allowing both still images and video sequences to be recorded. Image resolution was set to 16 megapixels to ensure satisfactory image quality. Video length was set to 60 seconds, with a 2-second interval between successive detections.

These settings were intended to optimally record information on one or more individuals moving within the detection zone of the device (Trolliet et al., 2014; Hedwig et al., 2018; Monket et al., 2022). Installation points were reached by GPS navigation using the previously recorded coordinates. At each theoretical installation point, a search was conducted within a 10-m radius to identify a suitable supporting tree (Ancrenaz et al., 2012; Kely, 2020; N'Goran et al., 2020; Monket et al., 2022). The camera trap was then attached to the selected tree at a height of 0.5 m above the ground and oriented along a north-south axis to limit direct sunlight on the lens during automatic triggering. Before final installation, test photographs and recordings were taken to check that each device was functioning properly (Vimercati, 2009; N'Goran et al., 2020). The mammal survey was conducted from July to September 2022.

2.4. Data analysis

Data retrieved from the camera traps were transferred to a computer for analysis. Species richness of the conservation area was defined according to Grall and Coïc (2006). The Shannon diversity index (H') and Pielou's evenness index (J') were calculated to assess species diversity and

the distribution of individuals among species, respectively. The overall camera-trap yield according to the operating period and the capture frequency were also determined. Camera-trap capture success was estimated using the relative abundance index (RAI), defined as the number of observations of each mammal species relative to the sampling effort (camera-trap operating days) (Colwell and Coddington, 1994; Zausa et al., 2024). Based on this index, species were classified as follows: $RAI > 15$, frequently detected species; $10 < RAI \leq 15$, common species; $5 < RAI \leq 10$, uncommon species; $0 < RAI \leq 5$, rare species in the study area. Species were identified from images and video sequences on the basis of the authors' field experience and confirmed using *Mammals of Africa* (Kingdon and Hoffmann, 2013).

3. Results

3.1. Sampling effort

The ten camera traps operated from 6 July to 30 September 2022, i.e. 87 days. The total sampling effort was therefore 870 trap-nights. These trap-nights produced 1,714 independent events, comprising 986 photographs and 728 videos of identifiable mammals, giving a capture rate of 1.97 events per camera-day.

3.2. Species richness

Analysis of the camera-trap photographs and videos revealed eight mammal species belonging to six families and three orders, namely Artiodactyla, Carnivora and Rodentia (Table 1). These were the bushbuck (*Tragelaphus scriptus*),

Maxwell's duiker (*Philantomba maxwellii*), African civet (*Civettictis civetta*), common genet (*Genetta genetta*), slender mongoose (*Galerella sanguinea*), African brush-tailed porcupine (*Atherurus africanus*), Gambian pouched rat (*Cricetomys gambianus*) and fire-footed rope squirrel (*Funisciurus pyrropus*) (Figure 2). The Shannon and evenness indices recorded in the "Camp Forest" parcel were $H' = 1.64$ and $J' = 0.84$, respectively. The Shannon value indicates moderate mammal species diversity in the biodiversity conservation area of the SMI, suggesting that the area is moderately rich in mammal species. The evenness value, close to 1, indicates that individuals are fairly evenly distributed among the species of the assemblage; in other words, all species are represented in relatively similar proportions and no single species dominates the assemblage of this conservation area.

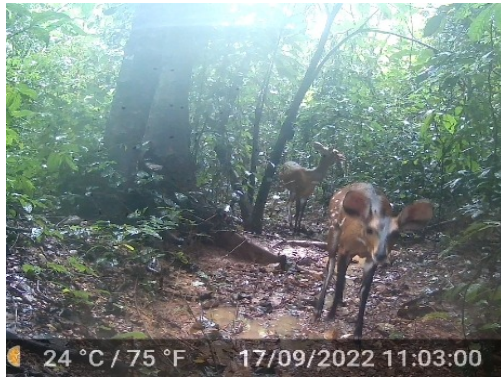
3.3. Relative abundance

The highest relative abundance indices (RAI) in the "Camp Forest" parcel were recorded for *Tragelaphus scriptus* and *Philantomba maxwellii*, with 18.42 and 16.83 observations per 100 days, respectively, indicating that these two species were the most frequently detected. One common species, *Atherurus africanus*, was also recorded, with an RAI of 12.16 observations per 100 days. The other five species, *Civettictis civetta*, *Genetta genetta*, *Cricetomys gambianus*, *Galerella sanguinea* and *Funisciurus pyrropus*, were rarely detected during the study (Table 1).

Table 1: Species richness and relative abundance of mammal species in the "Camp Forest" parcel

Order	Family	Common name	Scientific name	RAI
Artiodactyla	Bovidae	Maxwell's duiker	<i>Philantomba maxwellii</i>	16.83
		Bushbuck	<i>Tragelaphus scriptus</i>	18.42
Carnivora	Viverridae	African civet	<i>Civettictis civetta</i>	3.55
		Common genet	<i>Genetta genetta</i>	1.89
		Slender mongoose	<i>Galerella sanguinea</i>	0.76
Rodentia	Hystriidae	African brush-tailed porcupine	<i>Atherurus africanus</i>	12.16
		Gambian pouched rat	<i>Cricetomys gambianus</i>	0.87
		Fire-footed rope squirrel	<i>Funisciurus pyrropus</i>	0.54

RAI: relative abundance index (number of observations per 100 camera-trap days)



(a) *Tragelaphus scriptus*



(b) *Philantomba maxwellii*



(c) *Civettictis civetta*



(d) *Genetta genetta*



(e) *Galerella sanguinea*



(f) *Atherurus africanus*



(g) *Cricetomys gambianus*



(h) *Funisciurus pyrropus*

Figure 2: Camera-trap photographs of the eight mammal species recorded in the "Camp Forest" parcel

4. Discussion

The survey conducted in the biodiversity conservation area of the SMI recorded eight mammal species belonging to six families and three orders. Although this species richness is lower than that reported by Kouakou et al. (2021) in Mont Sangbé National Park (27 species), the difference can be explained by the size and protection status of that area compared with our parcel. As a protected area, Mont Sangbé National Park benefits from strict surveillance and active protection against hunting and disturbance, whereas the "Camp Forest" parcel has no official protection status (OIPR, 2024). The smaller size and limited availability of diverse habitats in the study area also restrict ecological niches and food resources, which may limit mammal diversity (Kadmon, 1993; Tews et al., 2004; Assui et al., 2024). Nevertheless, the diversity observed in the SMI parcel is not negligible. Studies conducted in other unprotected forest fragments have shown that such areas can serve as important refuges for wildlife, particularly mammals, and play a key role in conservation at the local scale (Kouakou, 2014; Bamba et al., 2017; Kouakou et al., 2017). Similarly, Valé et al. (2024) emphasised that well-preserved forest fragments, even without official protection status, are essential and should be integrated into wildlife management strategies. In the "Camp Forest" parcel, the Shannon index ($H' = 1.64$) indicates moderate species diversity, while the high evenness ($J' = 0.84$) shows that individuals are relatively evenly distributed among species.

Relative abundance analysis showed that *Tragelaphus scriptus* and *Philantomba maxwellii* were the most frequently detected species (RAI = 18.42 and 16.83, respectively), reflecting their ability to adapt to a variety of habitats, including those heavily disturbed by human activities (Happold, 2013; Kingdon and Hoffmann, 2013; Bohoussou et al., 2022; Kouakou et al., 2024). Conversely, several species, notably *Civettictis civetta*, *Genetta genetta*, *Cricetomys gambianus*, *Galerella sanguinea* and *Funisciurus pyrropus*, were rarely recorded. This low detection rate may

result from their greater sensitivity to habitat disturbance such as deforestation, fragmentation and hunting pressure (Djagoun et al., 2018). These anthropogenic pressures, which persist in the region, continue to negatively affect the populations of certain species, highlighting the need for proactive and targeted habitat management (Béné et al., 2012; Bitty et al., 2013). Nevertheless, the presence of these less frequent species demonstrates that even a small parcel, when relatively well preserved, can support a diverse faunal assemblage. These results highlight the role of the SMI conservation area as a refuge for mammals in a mining landscape and underline the need for regular wildlife monitoring in order to assess the effectiveness of conservation measures and to plan appropriate management actions.

5. Conclusion

The camera-trap survey conducted in the "Camp Forest" parcel of the Ity Mining Company documented eight mammal species belonging to the orders Artiodactyla, Carnivora and Rodentia. The substantial sampling effort and high capture rate attest to the effectiveness of the survey design. Observed species diversity was moderate ($H' = 1.64$), while the high evenness ($J' = 0.84$) indicates a relatively homogeneous distribution of individuals among species. The most frequently detected species were *Tragelaphus scriptus* and *Philantomba maxwellii*, whereas the other taxa were recorded only occasionally. Overall, these results show that the study area supports a structured and relatively balanced mammal assemblage, confirming the ecological value of this conservation area and the need for its regular monitoring.

Acknowledgments

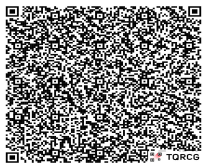
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