Original Article

Insights into the status and distribution of pangolins in Togo (West Africa)

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SHORT TITLE: Pangolins in Togo

Abstract

Pangolins are considered among the most threatened mammal species, both globally and also in Africa. However almost nothing is known on their status and distribution across wide areas of their range, including Togo (West Africa). We assessed the status and distribution of pangolin species in Togo. Fieldwork was undertaken in five localities around the Fazao Malfakassa National Park, five sites around Togodo Protected Areas Complex (Togodo North and Togodo South National Parks), "Les Deux Béna" and Missahohe Forest Reserves, Yikpa-Dzigbe, Evou and Afagnan Community Forests. In all of these protected areas and forest islands, only one pangolin species was recorded: the white-bellied pangolin (*Phataginus tricuspis*), with no records of the giant ground pangolin (*Smutsia gigantea*), a species that now appears unlikely for Togo. Due to the pangolin's nocturnal behavior spotlighting was carried out as an index of relative abundance and calculated as the Kilometric Index of Abundance (KIA). Our results indicate that *P. tricuspis* is relatively abundant in suitable habitats in Fazao-Malfakassa National Park, in Togodo North National Park and in the Assoukoko Forest Reserve. These habitats mainly reflect dense remnant forest patches where numerous termite mounds and ant nests occur. The present study provides significant scientific information on the status of pangolins in Togo that can help inform the development of a conservation programme for this species in Togo.

KEYWORDS

KIA estimates; Ecology; Distribution; Conservation; Pangolins; Togo; West Africa

1 | INTRODUCTION

Pangolins are considered among the most threatened mammals worldwide, and declines in populations of all eight species have been predominantly caused by a relentless and continuous detrimental harvest and trade for traditional medicines for Asian cultures (e.g., Ingram et al., 2018; Baker 2014). However, pangolin species are also culturally used as traditional medicines and in the bushmeat trade in western and central Africa (e.g., Soewu & Ayodele 2009; Boakye et al., 2015), including Togo (see D'Cruze et al., 2020). In addition, pangolins do not benefit anymore from strong traditional protective status, e.g. they were important divinity in some places (Akpona et al., 2008; Segniagbeto et al., unpublished) Thus, all eight species of pangolins are increasingly

threatened throughout Asia (e.g., Coggins, 2003; Newton et al., 2008; Thapa, 2013; Zhang et al., 2015) and Africa (Akpona et al., 2008; Soewu & Sodeinde, 2015; Heinrich et al., 2016; Ingram et al., 2018). Three species are native to western Africa, i.e., the black-bellied pangolin (*Phataginus tetradactyla*), that has been assessed Vulnerable (Ingram et al. 2019), the giant ground pangolin (*Smutsia gigantea*), that has been assessed Endangered (Nixon et al. 2019), and the white-bellied pangolin (*Phataginus tricuspis*), that also has been assessed Endangered (Pietersen et al. 2019). Distribution pattern of former two species is disrupted by the Dahomey gap (Salzmann & Hoelzmann 2005).

A main factor working against the development of an effective conservation strategy is the lack of data on the distribution and abundance of these mammals. In the case of Africa, information on pangolin numbers and ranges is limited (Luiselli et al., 2015; Soewu & Sodeinde, 2015), and often drawn from carcass counts in bushmeat markets (e.g. Ingram et al., 2019). For Togo, West Africa, virtually nothing is known on the conservation status of pangolins (see Amori et al., 2016). According to the national report on biodiversity for Togo (PNAE-Togo, 2002), two pangolin species have been reputedly recorded in the country, *Phataginus tricuspis* and *Smutsia gigantea*). However, based on museum specimens and historical and peer-reviewed literature, *S. gigantea* may not be present in Togo (see Wilson & Reeder 2005; Amori et al. 2016). It is however remarkable that despite these sparse data regarding the occurrence of pangolins in Togo, the country documents exports during the recent years, a strangely vexing fact, also on the occurrence of which species in the country itself. According to the CITES trade database (https://trade.cites.org/en/cites_trade - accessed 10th February 2020) 72 specimens of *S. gigantea* and 1,492 specimens of *P. tricuspis* were exported from Togo between 1984 – 2017.

The occurrence of pangolins in Togo is likely to be detrimentally affected by habitat loss and degradation; even protected areas of Togo that still include suitable forest habitats are heavily cleared and increasingly converted to agricultural land (e.g., Fousseni et al., 2012; Atsri et al., 2020). For instance, the Togodo Protected Areas Complex (Togodo North and Togodo South National Parks), Fazao-Malfakassa National Park, Missahohe and Assoukoko Forest Reserves have been continuously penetrated and affected by the surrounding local communities (Atsri et al., 2018). The status of pangolins in Togo is only partially protected by law, i.e., the permit to capture, hunt and/or kill an individual may be obtained via the Wildlife Protection and Hunting Ordinance

(1968) with updated Decree (1980) and are not likely based on scientific quota as there are no available surveys data from the wild.

In this study, we aim at (i) updating distribution data on pangolins and providing an initial assessment of the species' conservation status in Togo based on field surveys and interview campaigns; (ii) providing preliminary data on the relative population density using the Kilometric Index of Abundance (KIA) in some selected protected areas within the country; (iii) identifying threats that detrimentally impact pangolin populations and their habitat; and (iv) providing recommendations for a sound conservation strategy within any future Pangolin Action Plan for Togo.

2 | STUDY AREA

Togo is a West African country located in Gulf of Guinea. The country lies in the Dahomey gap, bordered by the Upper Guinea forest zone to the west and the Guineo-Congoloian forest region to the east (https://eros.usgs.gov/westafrica/ecoregions). It is made up of a long strip of land located between 6° - 11° North latitude, and 0° - 2° East longitude and stretches over 660 km from North to South. It is only 50 km wide along the coast, East-West; maximum width is 120 km around 7 - 8°N. The landscape is largely a gently undulating plain, with the exception of the Atakora mountain chain that crosses the country in a northeast-southwest direction. From North to South, the country is successively made up of Ecological Region I or the Sudanese savannahs zone where leguminous plants of the family Mimosoideae (*Acacia* spp.) or Combretaceae (*Terminalia* spp., *Combretum* spp.) dominate, as well as dry forests consisting mainly of *Anogeissus* sp., gallery forests and grasslands around temporary or permanent ponds. The next ecological region (Region II) is made up of hills covered in part with dense dry forests and open forests. Region III is the area of the Guinean savannahs, characterized by a relatively rich flora in which the families Combretaceae and Andropogoneae are dominant. Region IV corresponds to the southern part of the country. The latter region is typified by a wet tropical climate, and was originally largely covered with tropical moist or semi-deciduous forests. Region V is limited to the littoral area. It is a strongly disturbed landscape of littoral bushes, halophilous or marshy grasslands and mangroves. We will mention these zones as ER (Ecological Regions) throughout the text below. We surveyed the following protected areas (PAs): (i) Togodo Protected Areas Complex (Togodo North and Togodo South

National Parks), (ii) Fazao-Malfakassa National Park (FMNP), and (iii) Assoukoko Forest Reserve; (iv) "Les Deux Béna" Forest Reserve; (v) Missahohe Forest Reserve, (vi) Yikpa-Dzigbe and Evou Community Forests (Fig. 1).

3 | METHODS

3.1 | Protocol

Field surveys were conducted from January 2019 to March 2020 (Online Supplemental Table S2 and S3). Duration of fieldwork depended on the size of the Protected Area (PA) or the forest reserve. In each PA and forest ecosystem, data on abundance and distribution of pangolins was accumulated by (1) conducting interviews with local hunters, park managers and ecoguards (i.e. persons patrolling actively the protected territories); and (2) carrying out line transects, performed during the night and day, within forest areas that were considered suitable pangolin habitats by experienced ecoguards or local hunters.

Interviews and market surveys

We obtained data on human-pangolin relationships and on the perceived population status of pangolins, through the application of semi-structured interviews in villages surrounding the studied PAs. All interview procedures followed the guidelines of the British Sociological Association, and no minors (< 18 years old) were included. Interviews were based on a questionnaire developed to allow the survey team record all information gathered as well as potential threats to pangolins. Further, information on hunting, as well as the number of pangolin individuals hunted two weeks prior to the survey were queried. In 22 villages, a total of 98 hunters and farmers were interviewed. In each village, interviewees were asked (i) to list the pangolin species they have seen in their area (about radius of 1 km in general) within the last year, and (ii) to describe their colouration, size, diet, habitat and behavioural characteristics. After allowing the interviewees to describe the eventual species mentioned, in which photographs of some species were withheld from them; only afterwards we showed the interviewees photographs of the different species and asked them to choose the species they had seen. We also interviewed 24 park

managers and ecoguards in FMNP and four (04) at Togodo Protected Areas Complex; these interviews, jointly with those applied to the local hunters allowed us to identify the appropriate habitats in which to carry out the field surveys. Besides, we also visited five (05) local markets and interviewed 12 local hunters who used to supply pangolins for bushmeat markets. The numbers of pangolins hunted at each site or in the surrounding forests, within two weeks prior the survey, were also recorded based only on direct evidence such as photos, meat, scales, live or dead animals.

Field surveys

We conducted field surveys within previously identified pangolin habitats in the studied PAs and forests. We selected suitable habitats for pangolins based on our preliminary random walks in each study area, and from information provided by the varying interview groups. As is generally known, pangolins are more abundant in habitats with a relatively high density of ant and termite nests since pangolins feed exclusively on surface-active ants and termites (Jacobsen et al., 1991; Swart, 1996; Pietersen et al., 2014).

Due to the pangolins predominantly nocturnal behavior, the field survey team (one scientist, two Master's students and two local hunters or local guide from a village near the survey location) carried out a total of 162 hours of night-time searches, between 07:00 to 10:00 pm, Lomé time (Online Supplemental Table S1). At each selected site, line transects (varying from 1.46 to 8.26 km) were walked slowly and silently. Acoustic signals were also taken into consideration; a moving pangolin will drag its tail and rustle the dead leaves on the forest floor. If this specific noise was heard and localized, we used flashlights to search for the animal. When located, the animal would defensively roll itself into a ball making it easy to examine. In some cases, we observed pangolins during the day; particularly while the team survey was prospecting and searching for suitable sites for the nighttime surveys. When an individual was encountered, we took photos, recorded GPS coordinates of the site, and made a brief description of the habitat features before releasing the animal. Habitat data collected would include the vegetation type (e.g., type of woodlands within the ecoregions, cf. Segniagbeto et al. 2011) at the site of observation, including the dominant tree species. The GPS coordinates data allowed us to identify these habitats at a larger scale. In addition to describing the habitat type, we noted its degree of modification and degradation using four-point scale (none, slight, average and high

179 alteration). In order to avoid pseudoreplication, we did not repeat single transects in different
180 days, to minimize the probability of re-encountering an individual pangolin.
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182 **3.2 | Statistical analyses**

183 To assess the density of the species, we used the Kilometric Index of Abundance (KIA):

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185 $$\mathrm{KIA} = \frac{number\ of\ individuals\ observed}{Distance\ surveyed\ (km)}$$

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187 This method is a fast and convenient way to determine the spatial and temporal distribution of
188 wildlife when the number of observations is low. Due to the small sample sizes, age classes and
189 sex ratios were not considered in our analyses (Vincent et al., 1991).
190 The correlation between latitude/longitude of the surveyed sites and the KIA index was assessed
191 by Spearman's rank correlation coefficient (r_s). The correlations between the surface area (in ha)
192 of the PAs, (i) the number of observed individuals in the wild, (ii) the KIA index in each PA and
193 forest, and (iii) the number of individuals observed taken by hunters, were analyzed by using the
194 Pearson's product moment correlation coefficient. We herein present means as ± 1 Standard
195 Deviation, and Alpha was set at 5%.

196

197 **4 | RESULTS**

198 Data collected on pangolins during our field surveys is summarized in the Online Supplemental
199 Table S2 and S3. In all PAs and forests surveyed, only *Phataginus tricuspis* was recorded (Fig. 2).
200 Interestingly, the presence of *P. tricuspis* individuals in the Afagnan forest island probably
201 indicates the southernmost limit of the species' distribution in Togo.

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204 **4.1 | Fazao-Malfakassa National Park (FMNP)**

Five (05) different sites were surveyed (Table 1). *P. tricuspis* appeared relatively common in this PA, with 17 individuals directly recorded during field surveys and an average KIA of 0.732 ± 0.501 individual per km. The highest number of sightings were obtained at the Elavagnon and Koui sites (with respectively 1.62 and 0.63 of KIA; Table 1), which are dry dense forest islands in valleys where termite mounds and ant nets are abundant. During our field work, we encountered illegal hunters smoking pangolin meat inside the FMNP (Fig. S1).

4.2 | Assoukoko, "Les Deux Béna", Yikpa-Dzigbe and Missahohe forest areas

As shown in Table 1, pangolins were also relatively frequent in Assoukoko forest (KIA = 0.66 at Diguengue and KIA = 0.58 at Assoukoko). Interviews with local hunters allowed us to locate and record nine (09) more individuals that were kept in two villages (05 and 04 individuals at Djiguengue and Assoukoko respectively). According to local hunters, pangolins are especially active during the early phase of the rainy season (March and April), when they search actively for termites and ants (which are becoming very abundant). At this time, pangolins are easily catched mainly for food or to be sold in the local markets as bushmeat.

In the other three forest areas, no wild pangolins were observed during field transects but we were able to record 03, 02 and 03 individuals from local hunter interviews in Klabè-Efoukpa, Yikpa-Dzigbe and Agome-Tomegbe (around Missahohe Forest Reserve), respectively.

4.3 | Togodo Protected Areas Complex (Togodo North and Togodo South National Parks)

The mean KIA value among the five (05) surveyed sites was 0.392 ± 0.343, thus indicating a relatively high abundance of the species in this complex of protected areas. Pangolin populations were more abundant in Togodo North than Togodo South (Tomety-Kondji and Gboto-Zouvi, see Table 1). This difference in pangolin abundance could be related to the fact that Togodo North is comparatively more forested than Togodo South. In Togodo South, the frequency of encounters with pangolins was comparatively low (KIA = 0.25 and 0.28 in the areas Tomety-Kondji and Gboto-Zouvi, respectively). Interviews performed with the local hunters around this protected area allowed us to additionally record 10 individuals kept by the local hunters two weeks prior the field survey in the surrounding villages of the PA.

4.4 | Community forests

Pangolins were observed in several community forests, especially as bushmeat mostly between Amakpapé, Kpele to Notsé and between Blita, Sotouboua to Sokodé. We also found a small number of individuals in the wild in the two community forests we surveyed (Table 1).

4.5 | Comparative analyses

During our field surveys we encountered a total of 34 individual pangolins, average KIA of 0.484 ± 0.383 individuals per km (range = 0 – 1.62, median = 0.52 individuals). Another 56 pangolins that had been caught by hunters within 14 days prior to our surveys (for these latter we could not be sure of their exact locality of capture) were recorded. We found no effect of latitude ($r_s = 0.197$, $n = 19$, $P = 0.419$) or longitude ($r_s = 0.067$, $n = 19$, $P = 0.787$) on the KIA. Instead, the surface area (ha) of the protected areas or forests was positively correlated with the number of observed wild pangolins ($r = 0.921$, $P = 0.0011$) as well as with the number of individuals observed in the hunters' hands ($r = 0.957$, $P = 0.00019$). However, KIA was not influenced by the surface (ha) of the protected areas or forest ($r = 0.452$, $P = 0.261$).

KIAs varied significantly among the different study areas (one-way ANOVA: $F_{3,15} = 3.546$, $P < 0.05$), with Tukey HSD post-hoc test showing that the highest densities were found in the FMNP and in Togodo Protected Areas Complex (Fig. S2).

5 | DISCUSSION

Our surveys throughout Togo indicate that only *P. tricupsis* is present in the country, supporting Wilson & Reeder (2005) and Amori et al. (2016) suggestions. The presence of *S. gigantea*, as indicated by PNAE-Togo (2002), remains doubtful, as there is no single voucher individual that clearly and verifiably originated from Togo. It is likely that the data on the WCMC / UNEP CITES Trade Database (accessed on 10th February 2020: https://trade.cites.org/en/cites_trade), indicating that 72 specimens of the *S. gigantea* were exported from Togo between 2011 and 2014, was a case of misidentification/misreporting. Alternatively, these individuals could have come from the

neighbouring countries (for instance Ghana, as reported by vendors at traditional medicine markets; D'Cruze et al. 2020), as Togo also exports many non-native species including reptiles (D'Cruze et al. in press) and is involved in some illegal cross border trade including ivory (Segniagbeto et al., 2020). During our interviews we did not obtain any accurate description or a photographic identification of *S. gigantea*.

We only found wild pangolin populations in three of the six protected sites that we surveyed in Togo: the FMNP, Togodo Protected Areas Complex and the Assoukoko Forest Reserve. These PAs contain dense forest islands heavily populated by high densities of termite mounds (our unpublished observations). Within the FMNP, KIAs were higher in two specific sites, Elavagnon and Koui, which are both close to the Assoukoko Forest Reserve; the same forest ecosystem that appears to provide suitable habitat for pangolin (see below). Given this, any pangolin conservation programme in Togo would likely benefit from maintaining the connectedness of these two PAs.

The habitats in which pangolins were recorded in this study are similar to those described by other authors (Happold, 1987; Kingdon, 1971, 1997; Luiselli et al., 2015; Jansen et al., 2020), indicating that *P. tricuspis* is predominantly linked to moist tropical lowland and secondary forests, but can only be found in savannah-forest mosaics, dense woodland and riparian forests. These vegetation types are also distributed in different ecological regions in the country but mainly in the ecological regions II, III, IV and V (Ern, 1979), and these ecoregions are also included in the distribution range of the species (Pietersen et al., 2019). In this context, we also indicate that the West African forest-savannah mosaic is constantly under change, due to the expansion of agricultural land, extraction of commercial timber and bush fires; these factors were weighted differently in the period 1987-2015, and these changes also affect the FMNP (Atsri et al. 2018).

We acknowledge that there were some limitations with regards to the methods and approaches used in this study that should be considered when evaluating the results. Specifically, our data should be considered as preliminary and relatively opportunistic, whereas further studies would be better to include other methodologies (for instance, camera traps surveys; see Khwaja et al., 2019) in order to better standardize the field effort across the various protected areas and forests, and to better compare the data from Togo with those from other countries in the species' range. That being said, the insights provided by our fieldwork represent useful data on the status and exploitation of a threatened species of conservation concern.

Throughout its range in West and Central Africa, the population decline of *P. tricuspis* has been caused by a combination of forest loss, in particular in West Africa where the annual forest loss was 0.9% between 1990 and 2000 and 0.3% between 2000 and 2010 (Mayaux et al. 2013), increasing exploitation rates of tropical African pangolins for local use and consumption as bushmeat and traditional medicine (Ingram et al. 2018), as well as the advent of intercontinental trafficking of African pangolin scales since around 2008 (Challender & Hywood 2012). The latter primarily involves this species, mostly for the illicit export of their scales (i.e. as opposed to as a by-product of bushmeat trade) (Krishnasamy & Shepherd, 2017).

In Togo, from a conservation perspective, it is encouraging to report that pangolin populations can be observed across multiple protected areas and forest ecosystems. Our preliminary findings suggest that the relative abundance of *P. tricuspis* is higher than that previously reported for some populations in other range states (e.g., Gudehus et al., 2020). Nevertheless, there are on-going pressures on the pangolin populations in Togo that are of potential conservation concern.

For example, although some cited its increased rarity, "Pangolin" was identified as the most commercially viable wild animal derivative by vendors at the "Marché des Fétiches" in Lomé (D'Cruze et al. 2020) (thought to be the largest market for traditional medicine in West Africa; (Segniagbeto et al. 2013). Our survey work also indicates that pangolin hunting is actively practiced by local communities in the villages surrounding protected areas (e.g., 26 and 09 individuals reported pangolin hunting close to the FMNP and the Assoukoko Forest Reserve in the two weeks prior to our field work respectively) and at sites within them (with pangolins in the Assoukoko Forest and other ecological units such as the "Les Deux Béna", Yikpa-Dzigbe, Missahohe being particularly targeted for bushmeat and the international pet trade).

Hunting activity is reported to be higher during the dry season (when forests are burnt to facilitate the capture of individuals) and the beginning of the rainy season (when termites and ants are more active).

Based on our survey findings, to help ensure the future survival of the remaining *P. tricuspis* populations in Togo, we recommend that future conservation programs should look to:

- Assess the impact of hunting on the pangolin populations and to identify supply chains and revenues (with Togo and internationally) associated with the exploitation of pangolins as bushmeat trade and traditional medicine;

- Initiate outreach projects that can empower local communities to effectively manage the existing network of protected areas and community forests. This work should reduce the impact of pangolins and other species illegal hunting in and around the protected areas;
- Maintain the connectivity between FMNP and the Assoukoko Forest Reserve. These two forests ecosystems appear to represent an important potential unit for the pangolin populations in Togo.
- Increase enforcement effort and capacity in protected areas in Togo, and seek to increase cooperation with other enforcement bodies (in other pangolin ranges states and consumer countries) to prevent illegal hunting of pangolins in and from Togo. .
- Conduct additional in-depth pangolin focused field surveys and population monitoring in key national parks and extend such efforts to other forest ecosystems in Togo, notably the Abdoulaye and Alédjo Wildlife Reserves; and the Amou-Mono Forest.

AUTHOR CONTRIBUTIONS

Study design and fieldwork: GHS, DA, EKGA, HKA; data analysis and writing the article: LL, JEF; reviewing the various drafts: MA, NDC; final review: all authors.

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CONFLICTS OF INTEREST

None.

DATA AVAILABILITY STATEMENT

The data that supports the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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466 TABLE 1. Synopsis of the data collected on pangolins during field surveys conducted at various protected areas in Togo. FMNP =

467 Fazao-Malfakassa National Park.

Site	Long	Lat	No. individuals	Distance surveyed per site (km)	KIA	No. individuals recorded by interviews
Point de vue (FMNP)	0.81661	882.465	3	8.26	0.36	6
Kalare (FMNP)	0.95549	886.896	2	3.97	0.50	3
Bounako (FMNP)	0.87454	913.578	3	5.41	0.55	5
Elavagnon (FMNP)	0.7678	840.079	7	4.31	1.62	10
Koui (FMNP)	0.74036	840.826	2	3.14	0.63	2
Assoukoko forest (Diguengue)	0.63197	800.834	1	1.5	0.66	5
Assoukoko forest (Assoukoko)	0.62196	801.929	2	3.4	0.58	4
Klabè-Efoukpa	0.74578	760.267	0	2.0	0.00	3
Yikpa-Dzigbe	0.60724	710.537	0	5.0	0.00	2
Missahohe (Agome-Tomegbe)	0.57287	693.725	0	5.0	0.00	3
Togodo Protected Areas Complex						
Veli Kope / Adjamagbo Kope	143.047	687.589	2	3.86	0.52	2
Atchankeli	143.918	692.541	0	5.63	0.00	1
Asramatou	154.563	690.199	3	3.29	0.91	3
Tomety-Kondji	156.411	683.932	2	7.89	0.25	2
Gboto-Zouvi	146.575	679.857	2	6.99	0.28	2
Community forests						
Evou community forest (Evou-Kodegbe)	104.138	753.097	1	1.46	0.68	2
Evou community forest (Teme-Azafi)	107.955	749.865	1	1.93	0.52	0
Afagnan (Agome-Seva)	174.101	647.139	2	3.61	0.55	1
Afagnan (Batonou)	175.174	644.192	1	1.72	0.58	0

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FIGURE 1. Map of Togo showing the surveyed protected areas and forest ecosystems

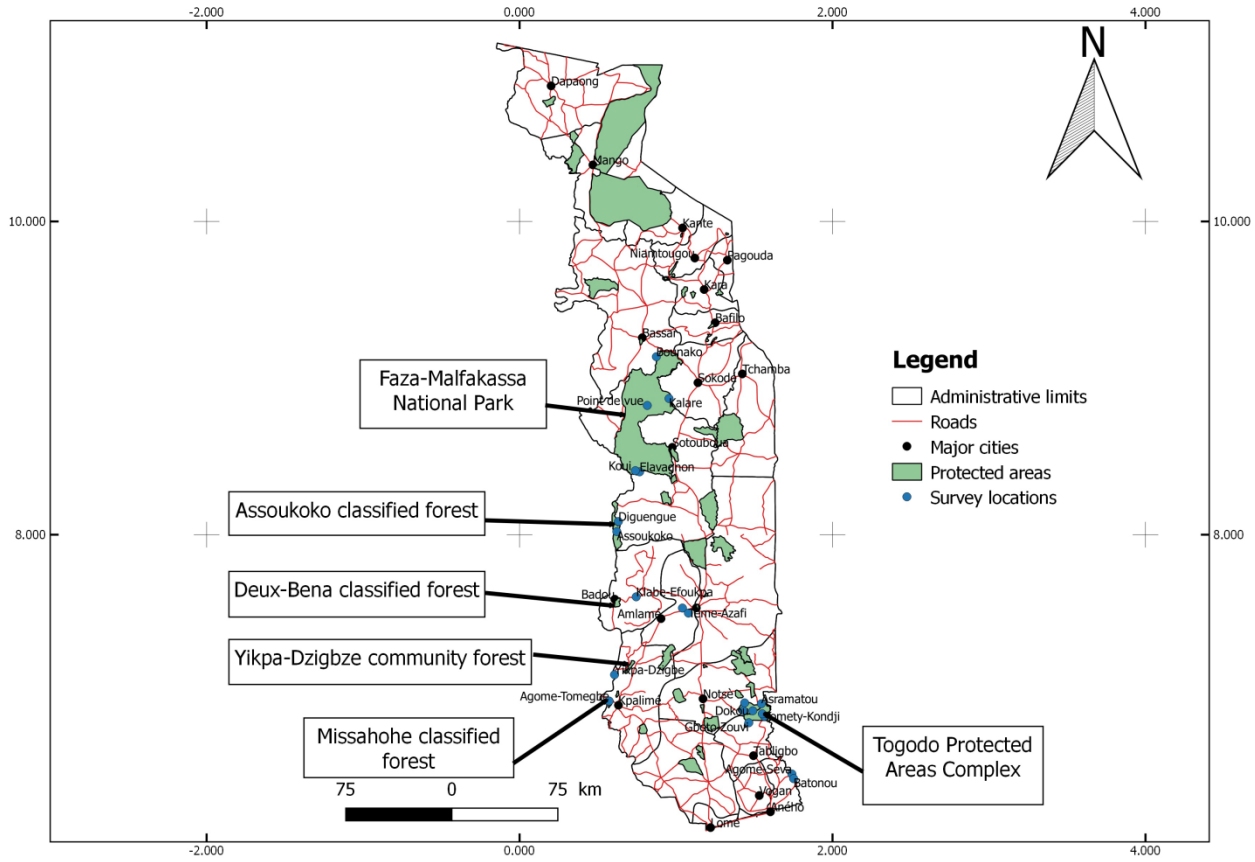

FIGURE 2. White-bellied pangolin (*Phataginus tricuspis*) observed in the wild at Kalare, Fazao-Malfakassa National Park. (Photo: Patrice Delagnon Assou)

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