Developing a threat Risk Register based on the IUCN threat hierarchy for five Tropical Important Plant Areas in Guinea (#90504)

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Developing a threat Risk Register based on the IUCN threat hierarchy for five Tropical Important Plant Areas in Guinea

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Guinea lost 92% of its total original forest before the end of the 20th Century. In addition, in the Guinee-Forestiere region alone, a further 25% of the remaining forest has been lost between 2000 and 2018, primarily driven by agriculture. One of the obstacles to effective protected area management in Guinea is the lack of quantitative measurements of the characteristics and location of the threats. A pilot study to develop a threat risk register for Tropical Important Plant Areas in Guinea using the IUCN threat hierarchy is outlined. Data was collected from five areas in Guinee-Forestiere to create individual risk registers for mapping and monitoring threats. The results show that the biggest threat is from agriculture, followed by biological resource use and intrusions and human disturbance. The level of threat of agriculture varies between sites but is the greatest threat at Mt Bero and Southern Simandou Mountains, though results could be skewed by sampling density. Further training on identification and classification of threats is needed to ensure consistency of recording across areas. This is a novel technique for recording threats to plants in protected areas in Africa as no equivalent has been found during the course of this research. This tool has potential uses, both nationally and internationally, to improve monitoring of threats to rare plants and the forest landscape and can feed into IUCN Red List species and ecosystem assessments, as well as Protected Area Management Effectiveness systems.

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Abstract

Guinea lost 92% of its total original forest before the end of the 20th Century. In addition, in the Guinée-Forestière region alone, a further 25% of the remaining forest has been lost between 2000 and 2018, primarily driven by agriculture. One of the obstacles to effective protected area management in Guinea is the lack of quantitative measurements of the characteristics and location of the threats. A pilot study to develop a threat risk register for Tropical Important Plant Areas in Guinea using the IUCN threat hierarchy is outlined. Data was collected from five areas in Guinée-Forestière to create individual risk registers for mapping and monitoring threats. The results show that the biggest threat is from agriculture, followed by biological resource use and intrusions and human disturbance. The level of threat of agriculture varies between sites but is the greatest threat at Mt Bero and Southern Simandou Mountains, though results could be skewed by sampling density. Further training on identification and classification of threats is needed to ensure consistency of recording across areas. This is a novel technique for recording threats to plants in protected areas in Africa as no equivalent has been found during the course of this research. This tool has potential uses, both nationally and internationally, to improve monitoring of threats to rare plants and the forest landscape and can feed into IUCN Red List species and ecosystem assessments, as well as Protected Area Management Effectiveness systems.

Introduction

Guinea lost 92% of its total original forest before the end of the 20th Century (Sayer et al, 1996). In addition, in the Forestière region alone, a further 25% of the remaining area has been lost between 2000 and 2018 (Fitzgerald et al. 2022). Furthermore, Guinea saw strong growth in the average rate of agricultural expansion from 1.3% per year between 1975-2000 to 4.7% per year between 2000-2013, but this was not distributed equally between regions (CILSS, 2016).

In Guinea, there are general known risks to the forests and flora, as already outlined in management and development plans (MEDD, 2021), but on-the-ground implementation of mapping and monitoring of these risks is still lagging. Conservators and ecoguards patrol the forests for signs of poaching and illegal tree cutting or clearing using the SMART (Spatial Monitoring and Reporting Tool) system (https://smartconservationtools.org/), but other smaller scale threats go unrecorded. Moreover, interpreting what is a threat can also be difficult for people on the ground when no definitions are provided to those in the field or if there is a lack of knowledge around the species concerned. Using a unified classification of threats, such as the lexicon developed by Salafsky et al (2008) and now under the management of the IUCN Classification Schemes Working Group, enables threats to be analysed across sites and between countries (BGCI, 2021). Logically, the IUCN threat hierarchy is the best available classification scheme, providing a standard framework that can be applied.

Risk or threat registers are used to identify threats in project or organisational management (RBG Kew, 2021; stakeholdermap.com; UNDP, 2023); however, a risk register framework can provide a useful way to identify, record and manage threats in a wide range of scenarios. In 2015, Mace et al looked at using this concept to create a risk register for Natural Capital. Although not perfect, the process of gathering the information needed for the register helped to indicate areas which could, with more data collection and research, produce a robust and relevant policy level tool. In this work, we explore the creation of a risk register for Tropical Important Plant Areas (TIPAs) identified in Guinea in 2019 by Couch et al as a means to provide an efficient way of gathering data for monitoring, mitigation and forward policy planning. A pilot study was undertaken to create preliminary risk registers for five TIPAs which correspond to the Key Biodiversity Areas (KBAs) of Guinée-Forestière as defined by the Critical Ecosystem Partnership Fund Biodiversity Hotspots of the Guinean Forests of West Africa (CEPF, 2015) who funded the work.

The study area includes the KBA/Tropical Important Plant Areas (TIPAs) of Mont Béro, Diécké Classified Forests, the Southern Simandou mountains which includes the Pic de Fon Classified Forest, the UNESCO World Heritage Area of Mts Nimba and the “Man and Biosphere Reserve” of the Massif de Ziama, in the south-east forest region of Guinea (Fig. 1). These sites contain the largest remnants of lowland and submontane forest in Guinea and are highly important for the conservation of many threatened and endemic plant species (Couch et al, 2019); however, this is not always reflected in the management and development plans (PAG) (MEDD, 2020; MEDD, 2022a,b). Recently written PAGs for Mt Bero and Diécké consider the general site-based threats

but do not consider the diversity of, or threats to the flora, prompting two Conservation Action Plans for plants of Mt Bero and Diécké to be written (Diaby et al, 2021, Couch and Simbiano, 2021). and the need for a method to record and quantify these threats.

Many of these forests are surrounded by villages which depend on the forests for medicines, food and materials. However, they are also responsible for damaging of those forests through clearing for agriculture, unsustainable harvesting of plant parts and trees for fuelwood and construction (MEDD 2022b). Guinea has an estimated 63% rural population, increasing annually by 2.1% (World Bank, 2021). The increasing population in regional centres also puts increased pressure on natural resources. A local study of socioeconomic species, in the five large markets of the Forest region, cited reduced availability of certain species for medicines and food products (Simbiano et al, in ed).

The threat register proposed here is based on the IUCN threat classification scheme Version 3.2 (IUCN, 2012) which provides a hierarchical structure of threat types for use in IUCN Red List assessments. This classification scheme was chosen as it is standardised and internationally recognised, allowing comparisons with future datasets, and enables data to be easily incorporated into future Red List assessments.

Materials & Methods

Study area

All five areas studies are Key Biodiversity Areas identified by CEPF (2015) and were also identified as protected areas by Brugière et al. (2009). Mount Béro is a Classified Forest of around 80 km^2 (Protected Planet, 2021) [central coordinates 08^o 12’ N, 08^o 38’ W], located to the south-east of the Simandou range, mainly in the prefecture of Nzérékoré, , with an elevation starts at 600 m with the highest peak at 1,182m. Threatened habitats of submontane forest are present on the flanks of the mountain, and submontane grassland, of the type described as ‘high altitude lateritic bowé’, at the summit (Couch et al, 2019). Wooded and grassy savannah, natural and derived, are also present on the flanks, with gallery forests along permanent watercourses. The area was classified in 1952, and especially since 2009 significant damage has been done to the area; currently, the whole area is subject to development (MEDD, 2022). Mount Béro’s classified forest is home to 14 threatened plant species, including the world’s largest population of two endangered species of massive flowering Acanthaceae (Couch et al, 2019).

Diécké’s Classified Forest is the largest remaining area of lowland forest in Guinea [central coordinates: 07° 12’ 36’’ N, 08° 56’ 43’’ W], with an altitude span of 300 m to 550 m. It is located at the southwestern tip of Guinée-Forestière in Yomou prefecture, on the border of Côte d’Ivoire and Liberia. It consists mainly of moist lowland forests with closed canopy, and dense evergreen rainforests. A total of 29 threatened plant species are found here, including many threatened trees. The forest has experienced logging in the past, but most of the forest has remained intact with a closed canopy and open or shrubby undergrowth (Couch et al, 2019).

Ziama Massif Man and Biosphere Reserve, approx.111,000 ha, is located in the prefecture of Macenta. It has an elevation span of 950m to 1,400m, with a highest point at 1,387 meters. It was classified in 1942 and declared as a biosphere reserve in 1987. This reserve ranks 4th out of the 12 major sites designated in West Africa for the conservation of biodiversity (MEDD, 2021). It contains various ecosystems from dense submontane forest, lowland rainforest, swamp forest, gallery forest and secondary forest. These different ecosystems each have a unique flora and fauna richness important for conservation. The Ziama Massif contains 33 plant species with a restricted distribution and two endemic plant species (Couch et al, 2019).

The southern Simandou mountains are situated in the south-east of Guinea. They are part of the Loma-Man range that extends into Sierra Leone. The highest peak, Pic de Fon, reaches 1,658m. It has species associations with the Fouta Djallon Highlands and the Nimba Mountains. The ridges and flanks have a mosaic of submontane forest and high altitude lateritic bowé grassland with high species diversity, recognised threatened habitats of Guinea. The area has the second highest diversity of plant species in Guinea after the Nimba Mountains, with over 1,400 documented plant species, including more than 40 threatened species, and at least one species globally endemic to Pic de Fon. A mining concession occupies part of the site, which will have a significant impact on the vegetation of the area when operational (Couch et al, 2019).

The Nimba Mountains are situated in the south-east of Guinea, in the Lola Prefecture, extending into Liberia and Ivory Coast. It is the highest peak in Guinea, reaching 1,752m above sea-level. The Guinea part of the Nimba mountains covers 149.2km² and was protected in 1944. The majority (134.1km²) is recognised as a World Heritage Site and is a core area of the Nimba Mountains Biosphere Reserve, designated in 1980. It has over 2,400 plant species, making it the richest documented botanical site in West Africa. At least six plant species are globally endemic to the Nimba Mountains, and more than 40 are threatened. Although recognised as a Biosphere Reserve and World Heritage Site, the rare plant species and habitats of the range are still threatened. In 1944, an area of 15.16km² was excised from the colonial Strict Nature Reserve of 1944 for mineral exploration. There is currently an iron-ore mining concession of 6.25km² in this area (Couch et al, 2019).

Methodology

Initially, a paper questionnaire was formulated in Microsoft Word for data collection in the field, using 14 of the tier 2 IUCN threat categories (IUCN, 2012). A disturbance score of ‘low’, ‘medium’, ‘high’ or ‘very high’ was recorded for each threat with coordinates and a description of the threat. The timeframe was recorded according to if the threat was in the past, ongoing or with potential to be a future threat.

However, this initial questionnaire did not gather precise enough data as the categories were too broad and the descriptions from the field team were not detailed enough, consequently, a different approach was developed.

A detailed Excel spreadsheet was prepared using the three-tier IUCN threat classification v.3.2 (IUCN, 2012). In the spreadsheet (Supplementary materials II) the tiers have been grouped and can be collapsed to reduce the number of lines where specific threats are not triggered, to simplify the data presentation. There are three classification columns, followed by columns for Location, Coordinates, Habitat and Description of activities. The next two columns have the scores for Disturbance (1 = low to 4 = very high) and Timeframe (1 = past, 2 = future, 3 = ongoing) and a third column automatically calculates an overall Disturbance score by multiplying the disturbance and timeframe scores. A fourth, and last, column is dedicated to mitigation measures, either suggestions or actions already in place.

The scores are ranked 'low' to 'very high' in increments of 3 and colour coded according to RAG status (citation? or Table/Appendix of this manuscript?) , i.e. a disturbance score of 1-3 is 'low', and therefore green, whereas a disturbance score between 10-12 would be 'very high', and therefore dark red.

We suggested that activities with a "low" score will require monitoring; activities with "medium" scores require monitoring and some mitigation; and activities with "high" and "very high" scores require management interventions. For example, overcollection of non-timber forest products (NTFPs) such as collection of bark for medicinal purposes, recorded as a medium risk, local communities could be encouraged to put a harvesting quota in place, with supervision of a local committee. If forest clearance for poacher camps is recorded as a high risk, ecoguards would be required to patrol areas more frequently to apprehend or deter poachers.

The risk register format was transcribed into KoboToolbox (www.kobotoolbox.org) to create a user-friendly format to record threats, using the KoboCollect smartphone application. KoboCollect automatically registers a geolocation for the threat and photos can be taken and associated with that datapoint.

Training sessions with ten Ecoguards from the five areas were held to introduce the form on KoboCollect and how to identify threats according to the IUCN threat categories. An initial "before- and-after session" was held to refine the data collection and discuss which categories best describe activities, to improve data quality. The Ecoguards subsequently went into the field in all five of the TIPAs to collect data on threats for five days. Data from all sites was collated through KoboToolbox into a spreadsheet and the datapoints mapped using QGIS 3.16 LTR. Quality control of the results was done by the first author, who translated the data into the risk register format in Excel. These registers were then shared with Centre Forestière Nzérékoré. Risk registers for all five sites can be found on the website of the National Herbarium of Guinea(www.herbierguinee.org).

Results

Of the main threats identified, during the survey missions, according to tier 1 of the IUCN threat hierarchy are: 2. Agriculture and Aquaculture is by far the greatest threat (45.45%), followed by

5. Biological resource use (16.50%), 6. Human intrusions and disturbance (11.45%), 1. Residence and commercial (8.42%), and 7. Natural systems modification (5.05%) (Fig 2).

A breakdown per site (Fig 3) shows that Mont Béro and Southern Simandou Mountains (Pic de Fon) have the highest total number of threats, 105 and 77 respectively. Agriculture and Aquaculture class are the most important threat in all areas except in Ziama, where it is Biological Resources Use (Table 1).

The distribution of threats recorded across the five sites can be seen in Fig.4. The density of sampling varied across sites with Ziama, Nimba and Diécké being less well covered during the pilot survey than Mt Bero and Pic de Fon where there is better access.

Breaking this down further into the sub-categories, using Mont Béro as an example, the risk register (Supplementary Material I) shows that 65/68 threats recorded under 2. Agriculture & Aquaculture fall under sub-class 2.1 Agriculture & Perennial Non-Timber crops. The third sub-class shows that, at Mont Béro, these are a combination of 2.2.2 Small-scale agriculture (22), 2.2.3 Agro-industrial farming (37) and 2.2.1 Shifting agriculture (6) and three records of grazing at various levels (Table 2). The majority of the agro-industrial farming at Mt Bero is plantations of coffee, oil palm or banana. The RAG status in the risk register shows that only 5 out of 65 agriculture threats were recorded as low risk, 41 as medium risk, 16 as high risk and 3 qualify as very high risk (Fig.5). The low-risk areas are either abandoned or not yet fully established and are earmarked for removal by the forestry guards.

Discussion

This pilot study has resulted in the development of a useful tool to identify which threats are present in Tropical Important Plant Areas in Guinée-Forestière and how these threats are perceived by the forestry agents. Our data shows that agriculture is the main threat to forest loss in the Guinée-Forestière TIPAs, particularly Mt Béro (68/105) and Southern Simandou Mountains (45/77) (Fig 3, Table 2, Supplem. Material I).

This was evident in fieldwork undertaken in Diécké and Mt Béro, where the local communities have started to clear areas for cultivation within the boundary of the classified forests. This ground-truthed data supports the remote sensing analysis by Fitzgerald et al (2022), who singled out Mont Béro as the area with the largest rate of deforestation in relation to area, primarily driven by subsistence agriculture. Awareness training and working with the communities to install plant nurseries for threatened and useful plant species aims to promote conservation and rehabilitation of these forests. The Southern Simandou Mountains (Pic de Fon) showed more threats relating to the mining activities in the area, particularly road building and invasive plants. All areas show that forest resources are harvested as NTFPs, with some being more intensive than others. Sustainable harvesting methods need to be explored with local communities (Supplementary Material I).

The use of a four-point scale for determining the level of threat was helpful to maintain consistency, though opinions of perceived threats can differ. Further training on threats and how they are presented and classified according to the IUCN hierarchy will be needed to ensure consistency across TIPAs. Through the training exercises it was noted that some exploitation of particular species was recorded as a threat when in fact it is not, since the species concerned, *Harungana madagascariensis* Lam. Ex Poir. (Hypericaceae) is widespread and grows in a variety of habitats. Therefore, this could be termed sustainable use, since only a few stems were extracted. Equally, the threat of unsustainable harvesting of *Raphia hookeri* G.Mann & H.Wendl. (Arecaceae), "raffia palm", and clearance around these trees, needs better defining to understand the threat processes. This register and repeated monitoring at sites could be used to gain a deeper understanding of the use of species and habitats by local communities.

This tool can be used for all threats, not just those pertaining to the forest/plant elements as was the focus here. It is hoped that this could provide a simple method for ecoguards to monitor and manage threats within TIPAs and other protected areas. All those involved in the pilot study felt that it was a useful tool and could be used for monitoring as well as registering threats, if a suitable database was created to store and access the data. This is part of follow-on funding secured until 2026. It is hoped that the database will automate the process of producing the risk register, which is currently very time-consuming. Progress will be monitored by resurveying the same areas over time to see if there is a reduction in the RAG status i.e. more activities registered as green, than amber or red as a result of effective mitigation measures, when a new register is generated. Moreover, this data can directly feed into IUCN Red List assessments at national, regional or global levels, providing more accuracy and detail on conservation measures and research required. Currently, Guinea does not have sufficient distribution data to conduct national plant Red List assessments, however, these data will contribute to future assessments. The data can also be applied to assessments for the Red List of Ecosystems which requires a review of threats to an ecosystem during the evaluation process (IUCN, 2016). Thus, our data can assist with future red listing efforts of species and ecosystems both nationally and globally. Using the same system for recording threats will facilitate comparison between countries and projects. We think this could be relevant to other projects across West Africa or globally who are trying to monitor threats to their research areas.

The authors are unaware of other studies using a risk register approach to record and monitor threats to plants and the wider landscape (e.g. TIPAs or KBAs) in other African countries. A recent update to the Management Effectiveness Tracking Tool (METT) (Stolten & Dudley, 2016, Stolten et al, 2020) now includes a datasheet using the IUCN threat hierarchy to assess threats which our data can directly feed into, if METT analysis is performed on any of the study areas.

Protected Area Management Effectiveness systems are often done through interviews with protected area managers, stakeholders, with spatial analysis etc., and require a level of existing knowledge about the threats such as RAPPAM (Ervin, 2003) or Priority Threat Management (Carwadine et al, 2019), which may not exist quantitatively. Threats to mammals or birds may be

more obvious and therefore better recorded than those threats to plants which for many get lumped into 'deforestation' or 'habitat degradation' but are not well defined and could be affecting some species more than others. This relative approach may be useful for higher level e.g. regional or national park management (Battisti et al, 2106). For areas of particular conservation interest, our absolute approach detailing classified threats that have been mapped, quantified and monitored can provide insights into where management interventions are most needed for areas of high plant diversity.

Conclusions

This study has shown that there are significant threats to plants in TIPAs of Guinea Forestiere, supporting the results of Fitzgerald et al (2021) who identified agriculture as the most significant threat. The threat risk register is easy to use, by gathering data using KoboCollect and the Excel format can provide a simple way to present the data, though this would be more efficient if it can be automatically generated from the database currently in development. Our approach can be used more widely across TIPAs or KBA networks to record and monitor threats to plants and the wider landscape using a system that is comparable across areas and countries. The data required will be useful for national and regional level Red List species and ecosystem assessments and particularly for those in Guinea in the near future. It will also raise awareness of plant specific threats among park rangers/ conservators by identifying other significant threats to threatened or useful plant species not just wood cutting and harvesting of NTFPs and identify where interventions are needed.

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Figure 1

Map of Tropical Important Plant Areas in Guinée-Forestière, N'Zérékoré Governorate.

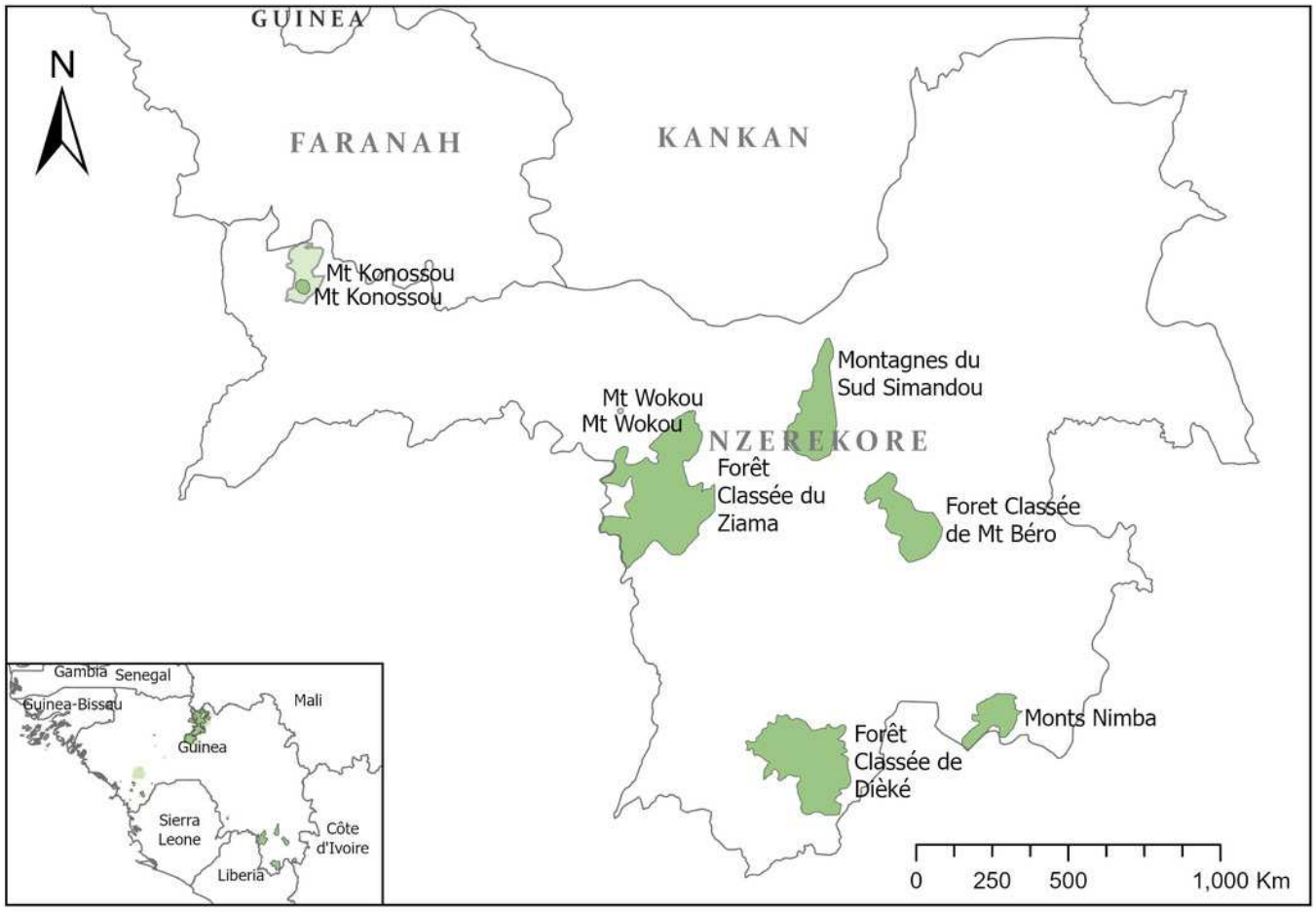

Figure 2

Percentage of threats per IUCN tier 1 threat class for all TIPAs.

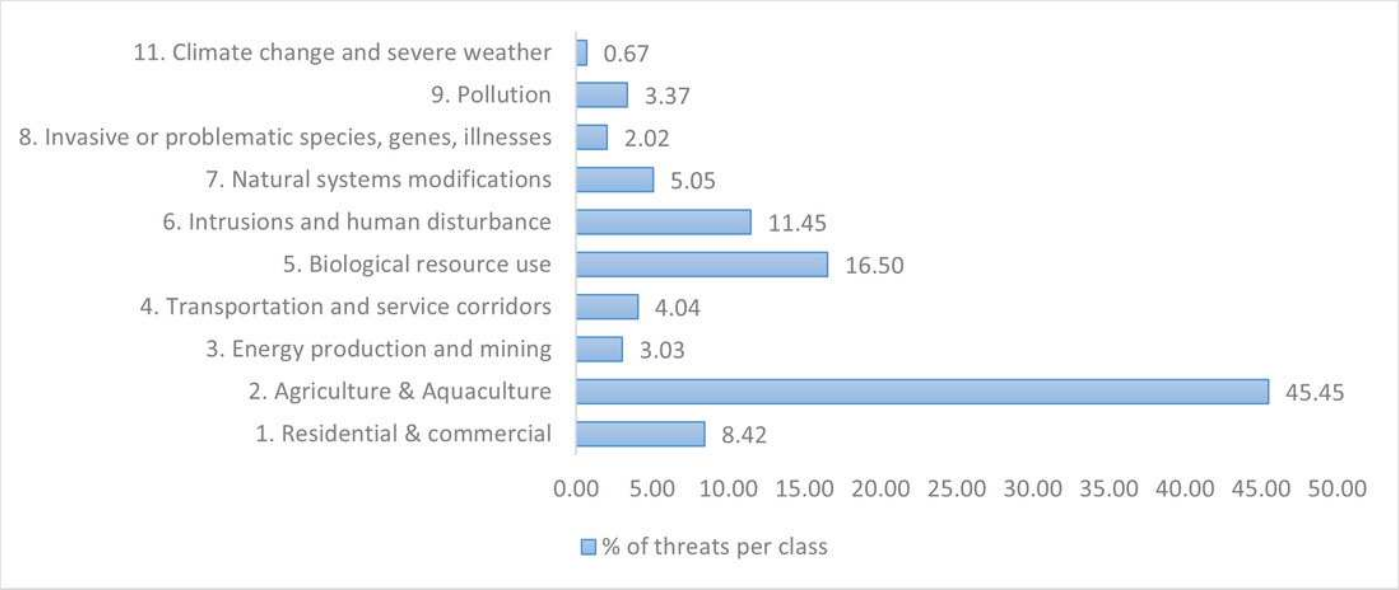

Figure 3

Total number of threats recorded per TIPA

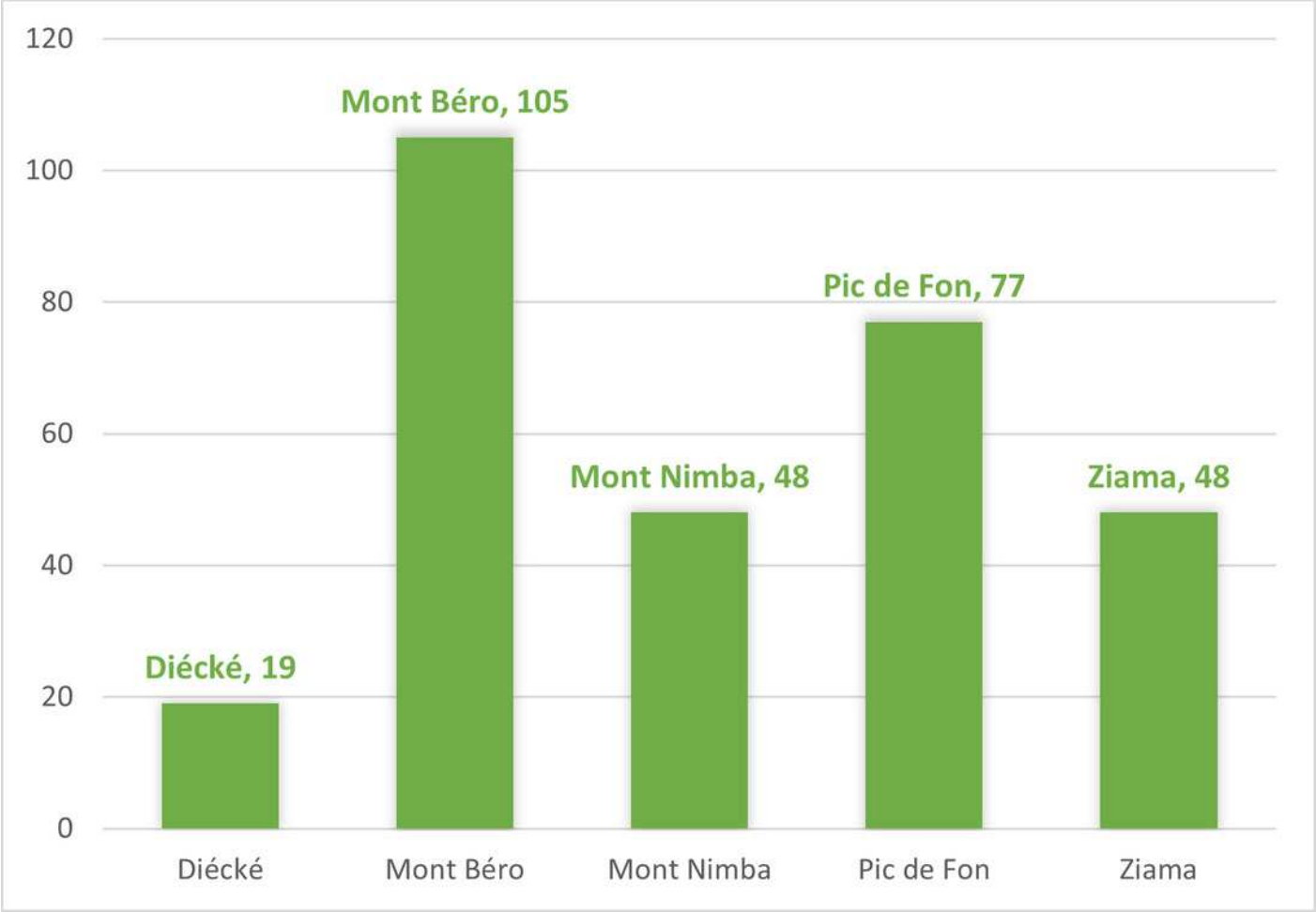

Figure 4

Maps depicting the different threat types and their location at the five TIPAs.

A) Mt Bero, B) Ziama, C) Diecke, D) Monts Nimba, E) Southern Simandou Mountains (Pic de Fon).

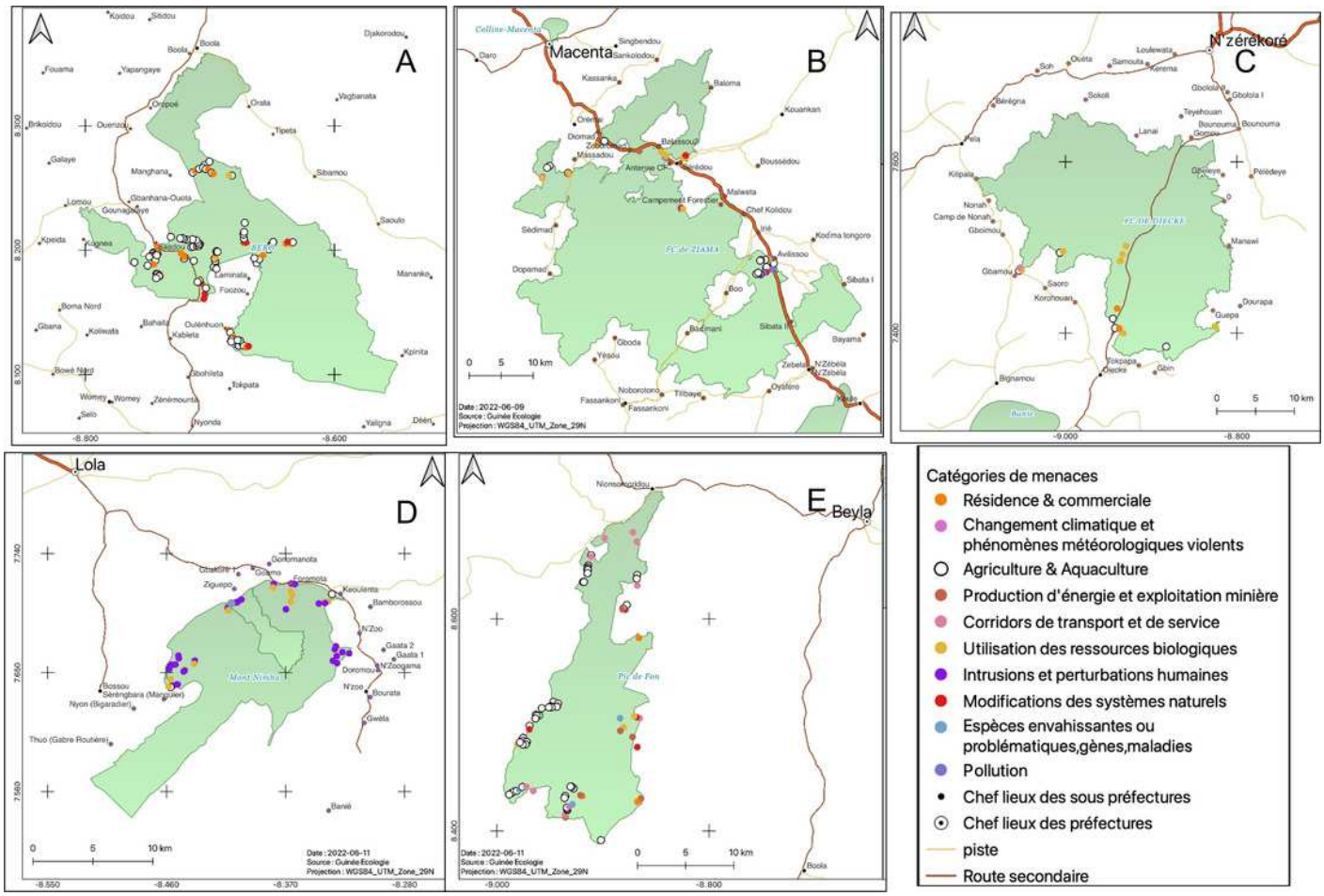

Figure 5

Tree map showing the proportion of threats and their RAG status at Mt Béro for threat class 2.1 Agriculture and Aquaculture subclasses.

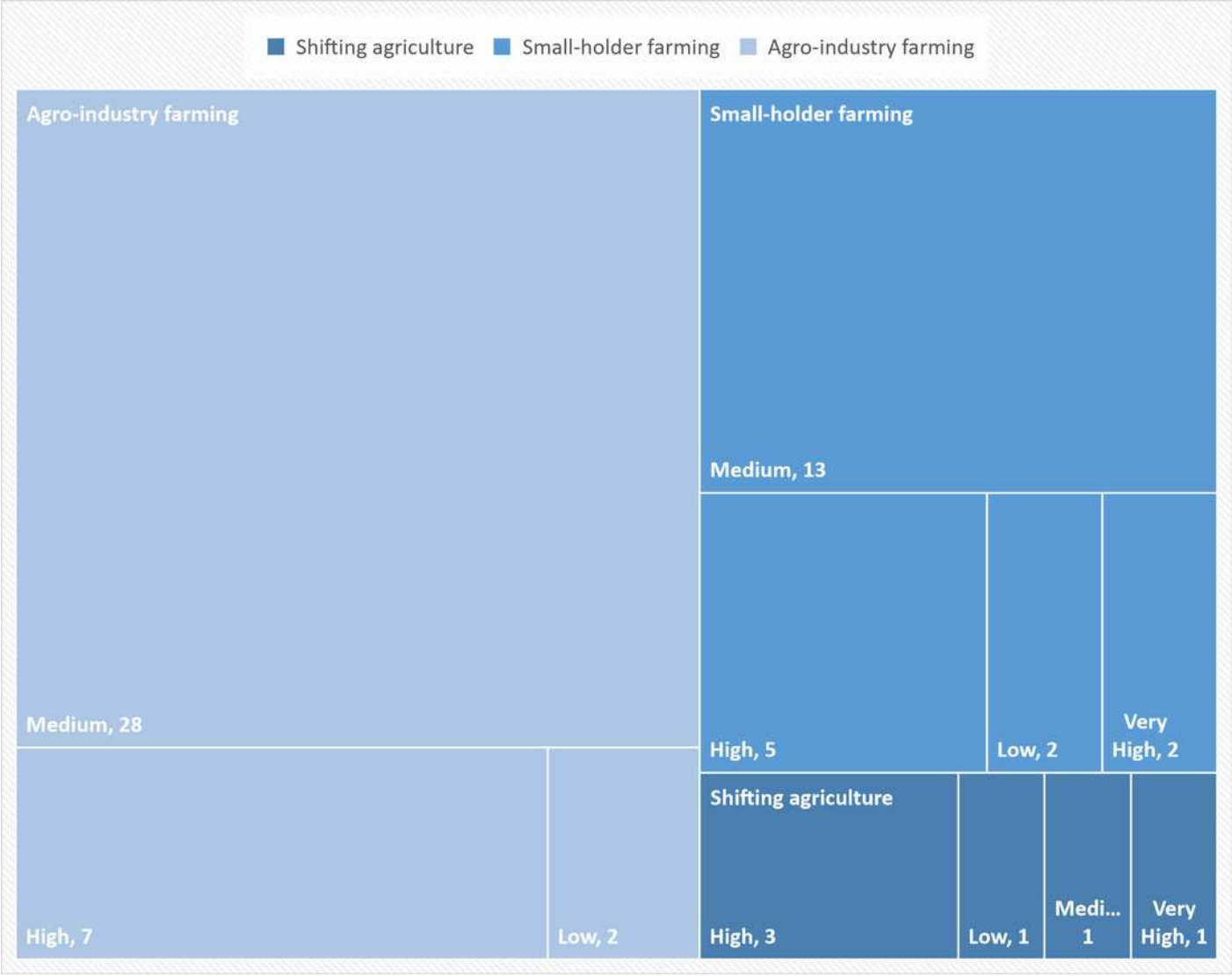

Table 1(on next page)

Total number of threats per IUCN threat class and per TIPA in Guinée-Forestière.

TABLE 1 Total Number of threats per class and TIPA in Guinee-Forestiere

Threat Class	**Diécké**	**Mont Béro**	**Mont Nimba**	**Pic de Fon**	**Ziama**	**Total # of threats per class**
1. Residential & commercial	2	19		3	1	*25*
2. Agriculture & Aquaculture	6	68	2	45	14	*135*
3. Energy production and mining			1	7	1	*9*
4. Transportation and service corridors	1		1	10		*12*
5. Biological resource use	10	7	10	4	18	*49*
6. Intrusions and human disturbance			32		2	*34*
7. Natural systems modifications		10		3	2	*15*
8. Invasive or problematic species, genes, illnesses			2	4		*6*
9. Pollution		1			9	*10*
11. Climate change and severe weather				1	1	*2*
Total number of threats per area	*19*	*105*	*48*	*77*	*48*	*297*

Table 2(on next page)

Number of threats per IUCN tier 3 class at Mt Béro

Tier 3 category	Number of threats
2.1.1 Shifting agriculture	6
2.1.2 Small-holder farming	22
2.1.3 Agro-industry farming	37
2.3.1 Nomadic grazing	1
2.3.2 Small-holder Grazing, ranching or farming	1
2.3.3 Agro-industry grazing, ranching or farming	1
7.1.1 Increased Fire frequency/ intensity	10
7.1.2 Suppression of fire frequency/ intensity	1
7.2.1 Abstraction of ground water	1
7.2.2 Abstraction of surface water	1
7.2.3 Small Dams	1
7.2.4 Large Dams	1
9.2.1 Oil spills	1
9.2.2 Seepage from Mining	1
9.5.1 Acid rain, smog, ozone	1

1 Table 2. Number of tier 3 category threats recorded at Mt Bero
2