

Piloting development of species conservation action plans in Guinea

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Abstract Conservation action plans need to be devised and implemented if we are to reduce the extinction risk faced by globally threatened plants. However, most plant species categorized as threatened globally on the IUCN Red List lack conservation action plans. In West Africa, Guinea is one of the most diverse countries in terms of botanical species. In total, 273 plant species in Guinea have been assessed as being threatened globally, reflecting increasing pressure from the extractive industry and a growing population requiring food and fuel. In parallel with the implementation of an Important Plant Area programme in Guinea, we developed conservation action plans for 20 threatened plant species through a pilot study. We outline the methods we used and demonstrate the importance of adopting a collaborative approach and having up-to-date field information. The need for such plans is urgent, with recent estimates suggesting that one-third of African plants are threatened with extinction. Based on our experience with the first 20 conservation action plans for Guinea species, we suggest that the preparation of multi-species conservation action plans would be an efficient use of the limited resources available for species conservation.

Keywords Conservation action plans, fieldwork, Guinea, Important Plant Areas, IUCN Red List, pilot study, threatened plant species, Tropical Important Plant Areas

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Introduction

Conservation scientists seek to identify and protect globally threatened species and achieve species recovery. The impacts of conservation actions are recorded in terms of extinctions avoided (e.g. Bolam et al., 2021; Grace et al., 2021) or using other metrics such as Green Status (Akçakaya et al., 2018; IUCN, 2021a). The IUCN has published seven conservation action plans concerning plants: six taxon-based and one area-based. These plans address taxa or areas encompassing c. 65,000 species, most of which have not been assessed but are unlikely to be threatened. The total number of globally threatened species specified in five of the taxon-based plans is 4,872. This accounts for only 22% of the threatened species on the IUCN Red List (IUCN, 2021b). To help address this deficit, we conducted a pilot study to develop conservation action plans for threatened plant species in Guinea, West Africa. We discuss insights derived from this process, which could inform the development of conservation action plans by conservation practitioners in other tropical African countries.

In West Africa, Guinea is one of the most diverse countries in terms of botanical species. According to our recent analysis (G. Gosline, unpubl. data, 2021) there are 826 additional recorded angiosperm taxa at the species or infra-specific level in Guinea in addition to the c. 3,000 species that have already been listed (Lisowski, 2009). This increase in the number of species reflects extensive research to inventory the flora of Guinea through the digitization of historical herbarium records (Magassouba et al., 2014; GBIF, 2019), complemented by targeted field expeditions to understudied areas of Guinea by the staff of the National Herbarium of Guinea and the Royal Botanic Gardens, Kew (hereafter

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Kew; Cheek & Magassouba, 2018; Cheek et al., 2018; van der Burgt et al., 2018, 2019b).

The comparatively high plant diversity in Guinea reflects its variety of species-rich habitats and the isolation of its highland areas. For example, the central Fouta Djallon highlands have 42 endemic plant species in a variety of habitats such as sandstone cliffs, sandstone and ferrallitic bowal (treeless hardpan) and submontane forest (Couch et al., 2019a). However, over centuries this area has undergone significant changes because of the expansion of agricultural systems. Intact submontane forest has now largely disappeared from the Fouta Djallon (Lebbie, 2001). A recent 3-year project to identify Tropical Important Plant Areas in Guinea (Couch et al., 2019a) showed that of 35 threatened species not seen by botanists for 60 years or more, 25 are endemic to Guinea and 19 occur in the Fouta Djallon. Despite targeted searches, *Habenaria jaegeri* and *Kotschyia lutea* have not been seen in the Fouta Djallon for 57 and 82 years, respectively, and are considered extinct there.

The Tropical Important Plant Areas of Guinea project identified nine threatened habitats and delineated 22 Tropical Important Plant Areas (Couch et al., 2019a). Tropical Important Plant Areas (Royal Botanic Gardens, Kew, 2016) are assessed using three criteria: the presence of (1) threatened species, (2) botanical richness (including species of socio-economic interest) and (3) threatened habitats (Darbyshire et al., 2017). Each Tropical Important Plant Area assessment also documents past, present and future threats as well as current protection. A variety of threats endanger the flora of Guinea, including mining. Guinea is one of the leading exporters of bauxite, exporting 95% of the African and 15% of the global production of bauxite (Sengupta, 2019). It also has considerable reserves of iron ore, gold and diamonds (Guinean Ministry of Mines and Geology, 2016). However, for many of the country's habitats, in particular the lowland evergreen forest and submontane forest, the main threats are unsustainable agricultural practices and the cutting of wood for charcoal. By the late 20th century, 96% of Guinea's original forest had disappeared (Sayer et al., 1992). In the bowal areas, the main threats are from cattle-ranging practices that increase the frequency of fires.

Funding and governance provisions for new large-scale projects (e.g. in the mining sector and for hydroelectric power) require companies to carry out detailed social and environmental impact assessments. These studies involve the identification of threatened plant species. Specifically, Performance Standard 6 of the International Finance Corporation (on Biodiversity Conservation and Sustainable Management of Living Natural Resources) requires concession holders to identify any areas of Critical Habitat. This definition includes habitats of significant importance to Critically Endangered and/or Endangered species. Project activities must not be implemented in such areas unless

they demonstrably do not lead to a net reduction in the global and/or national/regional population of any threatened species. To date, only 13% of plant species have been assessed globally for the IUCN Red List (IUCN, 2021b), including almost one-third (29%) of the Guinean flora; therefore, the majority of species await assessment. Thus, decisions continue to be made based on incomplete data, risking the possibility of a net reduction in populations of threatened species and in Critical Habitat over time.

The past 5 years have seen an increasing focus on documenting the extinction risk of the Guinean flora. In 2016, the project 'Towards a Red Data Book for Guinea', in collaboration with the Darwin Initiative-funded Tropical Important Plant Area project, assessed c. 200 plant species from Guinea using the IUCN Red List Categories and Criteria (IUCN, 2012b). A preliminary list of threatened plant species for Guinea was produced in 2017 and revised throughout the implementations of these projects (Couch et al., 2019b) to update stakeholders ahead of the publication of a comprehensive Red Data Book for all threatened plants of Guinea. This list will also be incorporated into an update of the Monographie Nationale (Guinea's national biodiversity management action plan), which has not been revised since 1997. The process of inclusion in the Red List involves the documentation of recommended, ongoing and required conservation actions. However, these are high-level actions that usually lack the level of detail required for planning or implementing concrete conservation actions.

We conducted a pilot study to trial the development of individual species conservation action plans for 20 plant species assessed as threatened on the IUCN Red List. These plans recommend the conservation actions needed to safeguard each of these threatened species both in situ and ex situ. Here we outline the methods piloted to assemble the first 20 species conservation action plans for Guinean plants. We demonstrate the importance of having up-to-date field information and adopting a collaborative approach and how these action plans will improve conservation efforts in Guinea. We also consider how the implementation of these plans could lead to greater recognition of plant conservation needs both in Guinea and regionally in West Africa.

Methods

The preparation of species conservation action plans must take into consideration several key questions, the first being: who should be involved in this process? To address this, a joint working group to advance the assessment of Tropical Important Plant Areas and the preparation of conservation action plans was formed in May 2018. The working group brought together for the first time representatives from the National Herbarium of Guinea, Kew, the Guinean Ministry of Environment, Water and Forests,

the National Parks and Reserves Office, the Centre for Biological Observations and Monitoring, the environmental NGOs Guinée Ecologie and Protection et Gestion de l'Environnement, the Centre for Environmental Research Studies at the Université Gamal Abdel Nasser de Conakry and the Sérédou Herbarium (Institut de Recherche Agronomique de Guinée).

We drafted the protocol for preparing the plans prior to the establishment of the working group, and the protocol was subsequently discussed and approved by the group (Couch, 2019). The protocol was based in part on the experience of CC in writing similar plans in Mauritius and also on the *Conservation Action Planning Handbook* (The Nature Conservancy, 2007), which has been used in tropical Asia, Latin America, Micronesia, the Caribbean and the USA. The format and style drew upon earlier species recovery plans for non-Guinean taxa (JNCC UK 2010a,b; Panjabi et al., 2011), informed by the range of potential conservation actions identified during the extinction risk assessment process for relevant species. The group became aware of the Botanic Gardens Conservation International (BGCI) and International Association of Botanic Gardens (IABG) Species Recovery Manual (Heywood et al., 2018) only after the protocol had been agreed and adopted for the drafting of the first plans.

We drew up a shortlist of candidate species for the development of conservation action plans from the preliminary list of 273 Guinean threatened species (Couch et al., 2019b). The 20 species chosen were categorized as threatened and had completed IUCN Red List assessments that had undergone peer review, although not all had yet been published on the Red List. Species were selected from a range of taxa across a variety of threatened habitats (Table 1).

The first section of each conservation action plan sets out the context for the focal species, including nomenclature, morphology, ecology, phenology, habitat and uses, as well as geographical distribution and population details if available. Existing documentation on Guinean flora is incomplete and often outdated. Many already listed names (Lisowski, 2009) are out of date (Cheek et al., 2015) as they are based on the *Flora of West Tropical Africa* (Keay & Hepper, 1954–1972). Use of these already listed names (Lisowski, 2009) and older documents has perpetuated the use of outdated names or synonyms by Guinean researchers in reports and policy documents. Subsequently, field surveys have led to the discovery of more than 20 species previously unknown to science, all endemic to Guinea (Cheek & Haba, 2016; Phillipson et al., 2019; Xanthos et al., 2020). Furthermore, numerous herbarium specimens collected during 2015–2019 in Guinea have been recognized as representing extensions to the known ranges of species not previously recorded there.

Desk-based research was vital to complement fieldwork, to ensure the focal species were clearly defined, mitigating

the risk of scarce conservation resources being directed towards taxonomically doubtful entities. When we prepared an action plan for a recently described species, we used the protologue (original scientific publication) as the primary source for the taxonomic information, including the species circumscription. For other species, we used the *Flora of West Tropical Africa* as the default source of species circumscriptions, which were then updated using more recent publications focused on these species where available. Descriptions of the plant species were taken from either Lisowski (2009) or the protologues of newly described species. We collated data largely from herbarium specimen labels. Names were checked against the African Plant Database (2019), the International Plant Names Index (2019) and Plants of the World Online (2022).

Each action plan includes geographical distribution data, particularly within Guinea, including historical records and, where known, the number of individuals in the population or in each subpopulation. We produced a specimen-based distribution map for each species using *ArcGIS Pro 2.9* (Esri, Redlands, USA), with simple x, y coordinates uploaded and mapped onto a world base map (Fig. 1).

The first part of each plan includes information on threats both past and present, and both direct and indirect, gathered from literature and from > 20 field expeditions carried out during 2016–2019, targeting rare species and priority threatened habitats. We aligned the threats with the IUCN threat categories (IUCN, 2012a,b). The second part of each plan sets out a summary plan for the management and conservation of the species. Details are provided of any protected areas in which the species is currently found and whether the species is present within any of the newly designated Tropical Important Plant Areas (Couch et al., 2019a). In situ and ex situ conservation actions are then proposed for the protection of the species.

Recommendations for in situ conservation include carefully documenting the size, location and condition of the site and the number(s) of mature individuals in the (sub)population(s) present there. These data can be used to support the legal protection of the sites and species. They serve as a baseline for future monitoring of both sites and species and inform future adaptive management planning, amongst other uses.

Proposed ex situ conservation actions focus on the propagation of the species outside its range, including seed collection and banking where applicable, and the potential for translocation to a protected area or botanical garden. The results of any propagation or translocation experiments previously undertaken are also documented for future reference.

Results

The 20 conservation action plans produced during this pilot study represent 7% of the threatened species of

TABLE 1 List of species chosen for conservation action plans, with the IUCN Red List status (IUCN, 2021c), growth form and collection data in Guinea resulting from recent fieldwork. See supplementary materials for links to individual conservation action plans.

Species (action plan)	IUCN status ¹	Growth form	Threatened habitat type (Couch et al., 2019)	Date of first collection in Guinea	Date of latest 20th century collection in Guinea	Date of first post 2000 collection ²	Number of new collections in Guinea (incl. sight records)	No. of new sites since recent collections	Endemic	Range extension	Year new species published
<i>Anisotes guineensis</i> Lindau (Molmou & Couch, 2019b)	EN	Shrub	Sandstone cliffs.	1905	1955	2016	8	5	x		
<i>Marsdenia exellii</i> C.Norman (Couch et al., 2019g)	EN	Liana	Interface of forest and open bowal or inselberg			2009	7	5		x	
<i>Xysmalobium samoritourei</i> Goyder (Couch et al., 2019n)	EN	Herb	High altitude ferralitic bowal			2008	6	6		x	2009
<i>Stylochaeton pilosus</i> Bogner (Couch et al., 2019i)	EN	Herb	Lowland forest			2012	22	14		x	
<i>Vernonia djalonensis</i> A.Chev. (Couch et al., 2019m)	CR	Herb	High altitude ferralitic bowal	1907	1962	2016	7	2	x		
<i>Pitcairnia felicianana</i> (A.Chev.) Harms & Mildbr. (Couch & Molmou, 2019c)	CR	Herb	Sandstone cliffs	1937	1996	2019	15	5	x		
<i>Scleria guineensis</i> J.Raynal (Couch et al., 2019c)	CR	Herb	Low altitude sandstone bowal	1943	1943	2011	2	0	x		
<i>Diospyros felicianana</i> Letouzey & F.White (Couch et al., 2019e)	EN	Tree	Lowland forest	1904	1956	2016	21	7	x		
<i>Acalypha guineensis</i> J.K.Morton & G.A. Levin (Molmou & Couch, 2019a)	VU	Herb	Interface of submontane forest and submontane grassland	1907	1907	2006	18	7			
<i>Coleus (Plectranthus) linearifolius</i> (J.K. Morton) A.J.Paton (Couch et al., 2019d)	EN	Herb	Inselberg	1969	1969	2012	9	6	x		

TABLE 1 (Cont.)

Species (action plan)	IUCN status ¹	Growth form	Threatened habitat type (Couch et al., 2019)	Date of first collection in Guinea	Date of latest 20th century collection in Guinea	Date of first post 2000 collection ²	Number of new collections in Guinea (incl. sight records)	No. of new sites since recent collections	Endemic	Range extension	Year new species published
<i>Talbotiella cheekii</i> Burgt (Couch et al., 2019o)	EN	Tree	Lowland forest			2015	33	11	x		2018
<i>Eriosema triformum</i> Burgt (Couch et al., 2019p)	CR	Herb	High altitude ferralitic bowal			2012	15	2	x		2012
<i>Pterocarpus erinaceus</i> (DC.) Polhill & Wiens (Couch et al., 2019h)	EN	Tree	Woodland/Wooded grassland				13				
<i>Cailliella praerupticola</i> Jacq.-Fél. (van der Burgt et al., 2019a)	EN	Shrub	Sandstone cliffs/high altitude sandstone bowal	1937	1937	2016	18	7	x		
<i>Habenaria jaegeri</i> Summerh. (Couch & Molmou, 2019a)	EN	Herb	High altitude ferralitic bowal	1945	1962	2006	5	0			
<i>Inversodicraea pepehabai</i> Cheek (Couch & Molmou, 2019b)	EN	Herb	Waterfalls and rapids			2016	1	1	x		2016
<i>Keetia susu</i> Cheek (Couch et al., 2019f)	EN	Shrub/Tree	Lowland forest			2015	12	9	x		2018
<i>Tarenna hutchinsonii</i> Bremek. (Couch et al., 2019j)	CR	Shrub/Tree	Lowland forest			2008	28	8		x	
<i>Vepris felicis</i> Breteler (Couch et al., 2019l)	CR	Shrub	Lowland forest	1937	1954	2012	6	5			
<i>Tieghemella heckelii</i> (A.Chev.) Pierre ex Dubard (Couch et al., 2019k)	EN	Tree	Lowland and submontane forest		1949	2003	14	6			

¹CR, Critically Endangered; EN, Endangered; VU, Vulnerable.²Includes verified georeferenced observations.



FIG. 1 The known distribution of four endemic Guinean species: (a) *Anisotes guineensis*, (b) *Talbotiella cheekii*, (c) *Diospyros feliciana* and (d) *Eriosema triflorum*.

Guinea (Supplementary Material 1) and 0.5% of its total flora. Of the 273 threatened species of the flora of Guinea (7% of the total number of species), 25% are woody (10% being widespread timber species) and the remainder are herbaceous or climbing species. In this pilot study we developed plans for eight woody species (including two widespread timber species) one climbing species and 11 herbaceous species. Eleven of these concern species endemic to Guinea; this represents 15% of the 77 plant species considered to be endemic. The over-representation of endemic species in our study reflects the concern of the working group to maximize the protection of those plant species for which Guinea has unique responsibility.

The 20 species are subject to eight main types of threat (Fig. 2). The threats affecting most of these species are: increase in fire frequency (7.1.1; 75%), mining and quarrying (3.2; 60%), wood harvesting (5.3; 45%) and urbanization (1.1; 40%). Two of the species are directly threatened by pollution (9) and all of the woody species (8) are threatened by clearance of habitat (e.g. 2.1.1 shifting agriculture or wood harvesting).

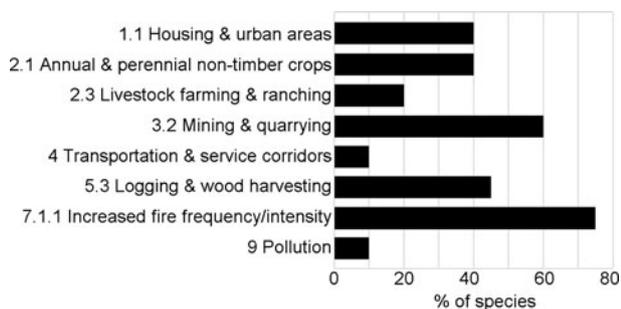


FIG. 2 Per cent of the 20 species for which we prepared conservation action plans (Table 1) subject to each of eight threat types of the IUCN Threat Classification Scheme (IUCN, 2012a).

Nine of the 20 selected species are found in at least one current protected area and all of the species are present within one or more of the newly designated Tropical Important Plant Areas. However, these areas either lack management plans or have management plans that are outdated and lack specificity regarding the species conservation actions needed for plants.

Eight of the selected species have seed collections banked in Guinea at the National Herbarium of Guinea or with Simfer S.A. (a mining company), and the Millennium Seed Bank at Wakehurst, UK. Four of these (*Cailliella praeurpatica*, *Habenaria jaegeri*, *Pitcairnia feliciani* and *Pterocarpus erinaceus*) have reached the recommended seed banking target threshold of 10,000 seeds (Way & Gold, 2014), but no data are available as to the extent to which they are genetically representative of their source populations. We trained seed collectors to ensure that genetic variation across the population was captured. Some seed collections are small because there are few known individuals or individuals do not produce many seeds each season. Some species have large seeds and are expected to be recalcitrant (i.e. they are unsuitable for conventional seed banking) because the seeds die when dried (e.g. *Talbotiella cheekii*). *Tarenna hutchinsonii* and *Keetia susu* are probably recalcitrant but remain untested.

For the majority of the selected species no propagation information is available and therefore experimentation will be required. However, for 25% of the species propagation protocols had previously been developed as part of mitigation measures for Simfer S.A. These protocols were researched using a variety of methods (e.g. micropropagation for *H. jaegeri* (Cheek, 2017) and cuttings for *T. hutchinsonii* (Cheek et al., 2015) and *Marsdenia exellii* (Cheek,

2013). Currently, only five of the 20 species have been identified as suitable for potential reintroduction.

Compilation and refinement of the 20 conservation action plans took place over a period of 9 months and the time invested was estimated to be 1,200 person-hours (i.e. 60 h per plan). This total excludes fieldwork because the fieldwork targeted many more species than the 20 selected. However, the importance of recent fieldwork as a foundation for the preparation of conservation action plans became evident in the course of our work. Table 1 documents the contributions of recent fieldwork to our knowledge of the target species. Fieldwork since 2000 enabled the re-discovery of 10 of the selected species, which had not been observed by scientists for several decades. Three endemic species (*Anisotes guineensis*, *Diospyros felicianana* and *C. praerupticola*) were recollected from their original historical locality after 61, 60 and 79 years, and recorded at five, seven and seven additional sites, respectively. Four of the selected species were described as new to science in the past decade, first collected during 2012–2018, and a further four species are new records for Guinea, since 2008, of species previously known only from other countries (i.e. range extensions). Thus, all but two of the conservation action plans were influenced significantly by data resulting from fieldwork conducted during the past decade.

Discussion

The projects Towards a Red Data Book for Guinea and Tropical Important Plant Areas of Guinea have attracted the attention of both national and international audiences to the threatened and unique plant species of the country. The conservation action plans resulting from these projects are the first to be written for threatened plant species in Guinea and are a result of the growing collaboration between the members of the working group. The partnerships and expertise on plant conservation built during these projects did not exist previously. Following the conclusion of both projects in March 2019, the working group has continued to collaborate to address, review and contribute to government policy. The collaboration has gained support from all sectors concerned with plant conservation, and through the publicity for the recently identified Tropical Important Plant Areas (Couch et al., 2019a) it is promoting plant conservation in Guinea on the national agenda. To the best of our knowledge, this is the first time that such a programme for globally threatened plant species has been devised and acted upon in a West African country.

The 20 species conservation action plans highlight the importance of fieldwork for providing up-to-date information on target species. IUCN Red List assessments can be written based on literature and herbarium records but knowing the status of a population and the current

threats the species faces is invaluable when writing a conservation action plan. For most of the plants in our study, conservation action plans developed without these recent field data would be, at best, less useful than they could be and, at worst, irrelevant. Fieldwork has facilitated better population estimates and the identification of suitable areas for protection as Tropical Important Plant Areas. The identification of subpopulations will improve ex situ conservation measures by facilitating the capture of genetic diversity across the population.

The implementation of these plans is the next stage in this process. The plan for *Vernonia djalonenensis* (Supplementary Material 1) has already been the focus of a successful funding bid and is being implemented to safeguard this species, which was selected as the people's choice in the national flower of Guinea campaign (Couch, 2018) involving state school pupils, local communities and authorities. There is little awareness amongst Guinean residents that their country has a unique flora. The national flower of Guinea campaign enabled the introduction of this concept, and a guide for secondary school teachers (Cheek & Magassouba, 2018) has been produced to engage children and teachers in appreciating and conserving Guinean flora. Raising awareness is written into the conservation action plans to capitalize on these efforts and engage a broader audience, encouraging pride in the Guinean native flora and highlighting the importance of conserving it.

The Guinean national economic and social development plan predicted a median economic growth of 6.5% between 2016 and 2020, with 12.3% occurring because of the revitalization of the mining subsector (OECD, 2017). However, it is not necessary for development to involve destruction of the environment and global extinction of species. Good management based on reliable data and analysis can improve industry practices. Mining projects in Guinea are responsible for mitigating their environmental impact, including the conservation of threatened plant species occurring in the concessions in which they operate. Species new to science have been collected as a result of vegetation surveys conducted in such projects (Goyder, 2009; Fischer et al., 2011; van der Burgt et al., 2012; Cheek & Williams, 2016). In some instances, effective mitigation has been achieved following the discovery of key species during such surveys. One example occurred when botanists found and assessed four threatened species (*Stylochaeton pilosus*, *M. exellii*, *Raphionacme caerulea* and *T. hutchinsonii*) on a coastal inselberg at an intended new port site for Simfer S.A. in Senguelen. Responding to the risk that these species would be affected significantly by the port construction, Simfer S.A. amended its construction plans to avoid damaging the plants and funded programmes to bank their seeds and develop propagation protocols for them (Couch et al., 2014, 2019a).

Most of the existing conservation efforts in Guinea are focused on mammals, especially the western chimpanzee

Pan troglodytes verus (Sugiyama & Soumah, 1988; Fleury-Brugière & Brugière, 2010; Humle et al., 2011). Conservation efforts have also focused on birds, on species threatened by trade, on ecosystem services or on landscape-level protection (e.g. the transboundary Nimba Mountains; Brugière & Kormos, 2008; Correia et al., 2010; Nganje et al., 2014). Conservation of endemic and near-endemic plant species has not previously been on the national government agenda. Over 20% of global plant species are estimated to be threatened (Brummitt et al., 2015; Nic Lughadha et al., 2020) and one-third of African plant species are at risk of extinction (Stévant et al., 2019; but see Walker et al., 2020). Guinea has > 270 threatened species, of which 77 are endemic. Given the person-hours required (c. 1,200 h over 9 months) to write 20 conservation action plans for threatened species, our experience suggests that some endemic species could be treated more effectively using local area action plans addressing multiple species. These could be based on the 22 identified Tropical Important Plant Areas provided that these adequately cover the species' distribution (Monteiro et al., 2018). Fieldwork has yielded many new data points, which could facilitate an examination of whether most or all of the known/modelled subpopulations of the endemic species in question are encompassed within Tropical Important Plant Areas.

Most of the currently protected areas in Guinea do not overlap with concentrations of threatened plant species (Couch et al., 2019a). Although the Tropical Important Plant Area framework does not require that all Tropical Important Plant Areas be legally protected (Darbyshire et al., 2017), in 2019 the government of Guinea committed to incorporating the 22 Tropical Important Plant Areas into the protected area network. Although formal reserve or national park status would be most appropriate for some of the larger Tropical Important Plant Areas, 10 of them are small (0.1–15 km²) and could be better conserved through community protection.

The 20 conservation action plans will be used to target plant conservation and to seek funding, but not only in protected areas. They also have the potential to form the basis of conservation planning and mitigation strategies for the extractive industries in those cases where project footprints intersect with those of the threatened plant species. Currently, seven of the 20 species we assessed occur within mining concessions. As conservation action plans are written for only 20 of the 273 threatened species in Guinea, much research remains to be done. This study demonstrates that whilst developing individual species conservation action plans can be useful for seeking funding for specific species, it is not necessarily the most efficient use of the limited resources available. Broader multi-species conservation action plans or local area conservation action plans based on Tropical Important Plant Areas are potentially more effective means of conservation planning that reduce the

timeframe needed for development and thus facilitate more rapid implementation.

In October 2020, a new project was launched to conserve threatened trees in three Tropical Important Plant Areas in coastal Guinea. As part of this project, the Working Group on Tropical Important Plant Areas and Conservation Action Plans is initiating a multi-species national conservation action plan for the 42 tree species known to be threatened. Funding to pilot the incorporation of species conservation action plans in existing management plans for protected areas was obtained in March 2020. Implementation of the current conservation action plans and the formulation of multi-species conservation action plans will assist in updating and modifying the conservation action plan protocol, rendering it a more useful and relevant tool in future conservation planning.

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Conflicts of interest None.

Ethical standards This research was carried out in accordance with the *Oryx* code of conduct.

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