Biological Conservation 221 (2018) 323–333

Contents lists available at ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon

Low extinction risk for an important plant resource: Conservation assessments of continental African palms (Arecaceae/Palmae)

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ARTICLE INFO

Keywords:
Africa
Conservation
IUCN criteria
Palm
Rain forest
Red List

ABSTRACT

Although the palm flora of continental Africa totals just 66 species, they are amongst the most useful plants across the continent, providing many important resources for human populations. Studies have shown that African palms will likely be negatively affected by global change, leading to increased threats to their survival. Here we conduct the first full global conservation assessment for 61 continental African palm species following IUCN Red List Categories and Criteria. Our study revealed that fewer than 10% of the evaluated species were assessed as Threatened. Within the Threatened category, one species was assessed as Critically Endangered, three as Endangered and two as Vulnerable. These results underline an overall low extinction risk for African palms in the immediate future, which is substantially lower than the global estimate of 21% for all plants. These results could be linked to the generally large distribution patterns of African palm species, the broad ecological amplitudes of most species and their good representation inside the African protected areas network. However, a non-negligible number of species (~15%) lack sufficient data to be properly assessed. This highlights the importance of further studies to improve our basic understanding of their distribution and threats. Our study provides a rather optimistic view of this highly important African plant resource yet, some widespread species are becoming locally rare due to over-harvesting for human use. At a local level, palm resources are generally non-sustainably exploited, which, coupled with climate change, could lead to a rapid increase in threat status over time.

1. Introduction

The palm family (Arecaceae/Palmae) comprises 181 genera and ca. 2600 species (Baker and Dransfield, 2016; Dransfield et al., 2008) mainly distributed in tropical regions of the world. Palms are considered to be keystone species of tropical ecosystems, especially within tropical rain forests (Couvreur and Baker, 2013; Henderson, 2002). Palm species richness is highest in Asia (with c. 1200 species) and South America (with c. 730 species). This contrasts sharply with mainland Africa where only 66 species, in 17 genera, are currently recognized (Couvreur and Niangadouma, 2016; Dransfield et al., 2008; Stauffer et al., 2014, 2017). Seven genera are endemic to the continental landmass.

Palms are one of the most important components of various vegetation types across Africa (Dransfield, 1988). The majority of the species occur in tropical rain forests while a few species inhabit dry and open habitats (inland and coastal savannas, deserts and sub-desert steppes). In addition, an important component of the African palm flora is associated with riparian forests or waterlogged soils such as swamps or marshes (Dransfield, 1988; Tuley, 1995). Across Africa, palms are among the most economically important plant resources (Sunderland et al., 2008), especially for rural households. In addition, several species have a multi-purpose utility as sources of food, construction materials, medicine, and crafts (Burkill, 1997; Dransfield, 1988; Gruca et al., 2015). This is a rare attribute for African species providing non timber forest products (Ingram, 2014).

African palms are negatively affected by threats impacting their survival linked to habitat loss and habitat degradation (Cosiaux et al.,

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https://doi.org/10.1016/j.biocon.2018.02.025
Received 17 October 2017; Received in revised form 9 February 2018; Accepted 19 February 2018

2017), mainly resulting from land conversion to agriculture coupled with other human activities (logging, mining, urbanization). Future climate change is thought to exacerbate and add to these threats. A recent study underlined that African palm species will experience a decline in climatic suitability in > 70% of their current ranges by 2080 (Blach-Overgaard et al., 2015). However, to date, the overall extinction risk of most continental African palm species remains unknown and no consistent approach has yet assessed their overall conservation status.

A major step in biodiversity conservation relies on better understanding the threats and the extinction risks species may face. Assigning these threat levels allow the identification of conservation priorities, improve the effectiveness of protected areas and guide conservation actions (Rodrigues et al., 2006). The IUCN Red List of Threatened Species, developed by the International Union for Conservation of Nature (IUCN), is recognized as the most comprehensive, authoritative and objective global mechanism for evaluating the conservation status of species. The Red List uses a standardized set of criteria (IUCN, 2012; IUCN Standards and Petitions Subcommittee, 2016) to classify taxa into a category according to its extinction risk. The IUCN Red List of Threatened Species plays a prominent role in guiding conservation actions of governments, industry, NGOs, and scientific institutions. For the world palm flora, currently just 558 species have been officially assessed following IUCN criteria, including a complete assessment of the conservation status of all Madagascan palm species (Rakotoarinivo et al., 2014). Prior to this study, a total of 3877 plant species from the continental African flora had been formally 'Red Listed', including just 19 palm species.

Here, we present the first extinction risk assessment of any continental African plant group to date. Specifically, we 1) assess the current extinction risk of continental African palms; 2) identify major and minor threats to these African palms based on an extensive literature review and field work and 3) compare our results with other regional or global assessments for palms and plants in general.

2. Material and methods

2.1. Study area

Continental Africa is defined here as the mainland and the continental islands of the Gulf of Guinea. The island of Pemba (Tanzania) and Zanzibar were not included in our study as their floras are considered as part of the Indian Ocean flora (Dransfield et al., 2008). Thus, *Dypsis pembana* (H.E.Moore) Beentje & J.Dransf. endemic to the island of Pemba was not taken into account here. In the same way, Cape Verde islands were excluded from our study as their floras are regarded as part of the Macaronesia flora (excluding the Cape Verde endemic *Phoenix atlantica* A.Chev. form our study (Barrow, 1998)).

The geographic range of six species is not restricted to continental Africa: *Hyphaene coriacea*, *Phoenix reclinata* and *Raphia farinifera* also occur in Madagascar, *Phoenix caespitosa, Hyphaene reptans* and *Livistona carinensis* also occur in the Arabian Peninsula. In order to produce global IUCN Red List Assessments, the study area was extended to these regions for these species.

2.2. Data acquisition

Distribution data for all studied species were extracted from the high quality expert-derived RAINBIO database (Dauby et al., 2016; Sosef et al., 2017). Distribution information for palms is particularly well documented as RAINBIO contains all data from Blach-Overgaard et al. (2010), a comprehensive dataset of all African palm occurrences derived from herbarium records and identified via expert knowledge (Bayton, 2007; Sunderland, 2012; van Valkenburg et al., 2008; van Valkenburg and Sunderland, 2008). For one specimen, the RAINBIO identification was incorrect, and we thus re-identified it. Other georeferenced occurrence records were collected from literature (Couvreur and Niangadouma, 2016; Ford and Baily, 2004; Hall et al., 2008; Kilian et al., 2004), fieldwork observations (Fred Stauffer, Thomas Couvreur, pers. comm.), and the most comprehensive database of Madagascar palms available (Mijoro Rakotoarinivo pers. comm.).

2.3. IUCN Red List conservation status assessments

Complete global conservation status assessments were carried out following the IUCN Red List Categories and Criteria, version 3.1 (IUCN, 2012; IUCN Standards and Petitions Subcommittee, 2016). Each species was assigned one of the IUCN categories according to its extinction risk: Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC) or Data Deficient (DD). Most species in this study were assessed using Criterion B which uses geographic range size and evidence of declining or fragmenting populations (Gaston and Fuller, 2009). Criterion B is suitable for estimating conservation status even when data is limited and the distribution of a taxon is only known from a few georeferenced herbarium collections (Schatz, 2002). For a few species, however, where appropriate data were available, criteria A or D were also applied in the assessment.

Full global conservation assessments were conducted species by species. The R package *ConR* (Dauby et al., 2017) was used to quantify the distribution range of each species (corresponding to the sub-criteria B1 and B2 via the Extent of Occurrence (EOO) and Area of Occupancy (AOO)) using occurrence records extracted from the RAINBIO database. All of the species were assessed for their entire global range. *ConR* calculates the EOO by constructing the minimum convex polygon around all known occurrences. AOO was calculated as the sum of occupied cells after superimposing a grid with cells of 2 km × 2 km. When the species was known from less than three unique occurrences only the AOO was calculated. For ten species (see Table 1), however, the EOO and AOO were finally calculated using the web service GeoCAT (Bachman et al., 2011). The occurrence records of these 10 species were extracted from the RAINBIO database, to which additional records were added. *ConR* was also used to calculate the number of collections within protected areas (PA) based on a shapefile of known protected areas downloaded from the World Database on Protected Areas (WDPA, https://www.protectedplanet.net/). When a species occurred in five or fewer PAs, detailed information about the effectiveness of each PA was obtained from literature, expert field observations and reports, in order to assess if the species could be facing potential threats within each PA. Then, for each species, we manually determined the number of threat-defined locations, inferred population trends, and estimated potential major and minor threats. A threat-defined location is considered by the IUCN to be a geographically or ecologically distinct area within which a single threatening event can rapidly affect all individuals of the taxon present (IUCN Standards and Petitions Subcommittee, 2016). Population trends, such as a continuing decline in the number of sub-populations, continuing decline in the number of mature individuals, and the fragmentation of the population, were identified for each species. In each case we scrutinized literature sources, expert field observations, herbarium specimen labels and reports, in order to obtain all available data on each species. To estimate or infer the continuing decline of the area, extent and/or quality of habitat, we proceeded as above, and satellite imagery from Google Earth was used to identify areas where species may be affected by habitat loss or habitat degradation.

2.4. Uses

Data about the known uses of each species were gathered from a wide range of different literature sources (Adu-Anning, 2004; Amwatta, 2004; Arbonnier, 2009; Barrow, 1998; Burkill, 1997; Cunningham and Milton, 1987; Defo, 2004; Dijkman, 1999; Dransfield, 1986; Dransfield and Beentje, 1995; el-Mashjary et al., 2001; Kahindo et al., 2011; Kahn and Luxereau, 2008; Kgathi et al., 2005; Konstant et al., 1995; Latham