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*Correspondence: Bamigboye, S.O. Department of Plant Sciences, Olabisi Onabanjo University, 2002, Ago-Iwoye, Nigeria.
Tel: +2349078490525
Email: reachtoba@gmail.com

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Studies on Extinction Risk of Genus *Afzelia* in Nigeria from Biogeographical Perspective

Bamigboye, S.O.[1*], Odewo, S.A.[2], Jimoh M.O.[1], Lasisi, I.A.[1], and Momo, B.O[1]

[1] Department of Plant Sciences, Olabisi Onabanjo University, 2002, Ago-Iwoye, Nigeria. [2]Forest Research Institute of Nigeria, 5054, Ibadan, Nigeria.

ABSTRACT

Taxa in genus *Afzelia* are trees of great economic importance and they have provided several ecosystem services to man and the environment. This genus have been heavily exploited to meet several human needs which includes medicinal uses, timber production and source of food for man and animals. These taxa that meets several demands should be evaluated for conservation purpose. This is because much reliance on plant resources is fast depleting plant global biodiversity and resulting into massive plant extinction risk. In this study literature was consulted to determine the number of species in genus *Afzelia.* Their conservation status were extracted from the IUCN (International Union of Conservation of Nature) Red List. Herbarium records for *Afzelia* taxa in Nigeria were collected to determine region of species diversity of *Afzelia* in Nigeria. This study revealed that *Afzelia* is made up of very small number of taxa in which majority are threatened. In Nigeria these taxa are well distributed in the Southern and middle belt region of Nigeria. From this study it can be clearly concluded that *Afzellia* is a threatened genus and needs to be given conservation intervention anywhere they are around the world. A current population survey of *Afzelia* taxa in all the locations in Nigeria identified in this study is recommended to keep track the level of decline and to design conservation intervention plans and programs for this threatened genus.

Keywords: Biogeography, biodiversity loss, conservation, extinction risk, threats

INTRODUCTION

Plant taxa extinction risk has been predicted to go on a new level of increase in decades to come (Tali *et al.,* 2015). This is due to recent sporadic reliance on plant resource utilization (Crain *et al.,* 2015) which can be linked to human population increase (Mukwevho 2014). Anthropogenic pressure has played a significant role in the past extinction crisis. It is currently a major player in the current one and the future extinction risk is also relying on this ecological force which will in turn produce adverse effect on future ecosystem services (*Barnosky et al., 2011; Bamigboye, 2020;* Gagneux, 2021). One of the factors that is of great concern especially in Africa is excessive crave for timber which produces indiscriminate

felling of trees and many populations of threatened tree taxa have been wiped out due to this practice (Assogbadjo *et al*., 2009). Habitat destruction due to infrastructural development is also a great threat to the survival of many tree taxa (Santo-Silva *et al.,* 2013). During this processes, there are always indiscriminate felling of trees to pave way for certain urban developments which poses threats to some tree taxa.

Biogeographical patterns gives a clue on regions to focus on in the process of conservation of threatened species (Bamigboye, 2018). This is why mapping species that requires conservation interventions is one of the steps towards a positive direction in species conservation. Natural occurrence records from the herbarium are great sources of information that can be processed into relevant data to analyze areas of geographical interests in respect to conservation of some species which will assist conservationist to make informed decisions (Greve *et al.,* 2016). These herbarium records are used in modelling the response of taxa to factors such as climate change and changes in vegetation composition which will enhance the predictions of these taxa in response to these changes in the future (Laidlaw *et al.,* 2012; Carin *et al.,* 2018).

The genus *Afzelia* is made up of tree taxa (Donkpegan *et al.,* 2020). And these tree taxa have been servicing human needs and the needs of the ecosystem. Some economic importance of species in genus *Afzelia* are charcoal and firewood production, making drums, furniture production, food seasoning, medicinal uses and fodder for agriculture (Jimoh *et al.,* 2012; Biara *et al.,* 2021). Species heavily exploited for these purposes are always at risk of extinction which will later create gap in human sustainability and environmental development (Bamigboye 2018; Bamigboye 2020). It is therefore very important to evaluate the current conservation status of this genus and also look at the taxa from biogeographical perspective in Nigeria since Nigeria harbor some species of this genus.

MATERIALS AND METHODS

A comprehensive literature search was conducted to determine the number of species present in genus *Afzelia*. IUCN (International Union of Conservation of Nature) Red List 2021 version was employed to determine the current conservation status of each of the species. Their population trend and the threats they are facing were also extracted from the IUCN Red List. Herbarium records for all *Afzelia* taxa in Nigeria was extracted from the national herbarium in Forest Research Institute of Nigeria (FRIN) herbarium Ibadan, Oyo-State Nigeria. This is the largest herbarium with the highest number of collections in Nigeria. The records were examined to determine the number of species of *Afzelia* in Nigeria, the records of the natural distribution of *Afzelia* in Nigeria and the habitat type of taxa in genus *Afzelia* in Nigeria. A geographical distribution map was constructed based on the herbarium records to show areas of natural distribution of *Afzelia* in Nigeria. The georeferencing coordinates of natural locations of all the species in genus *Afzelia* were inserted into the ArcGIS to generate distribution maps showing natural records of all *Afzelia* species in Nigeria. Histograms were generated showing the habitat types of *Afzelia* was constructed to show prominent habitat type of this genus in Nigeria. The graphical representation showing prominent habitat types were generated from the excel spreadsheets based on the numbers of each types of habitat for each species of *Afzelia* as found in the herbarium.

RESULTS

The results gotten from the search of literatures showed that there are 11 species in genus *Afzelia*. Out of the 11 species, 7 of them (64%) are threatened and near threatened. The ones that are not threatened on IUCN Red List are facing some ecological forces that are potential threats to them (e.g *Afzelia bella*). The major factors promoting

their extinction risk is timber production although there are still other ecological forces like habitat destruction and harvesting of these plant species for medicinal purposes. In Nigeria there are four species of *Afzelia* based on FRIN herbarium records. These taxa are *Afzelia africana* Sm, *Afzelia bella* Harms, *Afzelia bipindensis* Harms, *Afzelia pachyloba* Harms. *Afzelia africana* has a wider distribution than the rest of the *Afzelia* in Nigeria. There is more distribution of these species in the Southern part of Nigeria except for *Afzelia africana* that have a wider spread and extended to the middle belt region in Nigeria. The prominent habitat type for *Afzelia africana* is savanna woodland unlike the rest of the *Afzelia* in Nigeria whose prominent habitat type is rainforest.

Table 1: List of *Afzelia* taxa, their IUCN Red List status, population trend status and the threats they are facing as found on IUCN Red List.

Species	IUCN Red List Status	Population trend on IUCN	Threats
Afzelia Africana Sm. ex Pers.	Vulnerable	Decreasing	Medicinal uses, timber production, livestock feeding, habitat destruction
Afzelia bella Harms	Least concern	stable	Timber production
Afzelia bipindensis Harms	Vulnerable	Unspecified	Timber production
Afzelia pachyloba Harms	Vulnerable	Unspecified	Timber production
Afzelia palembanica Baker	Near threatened	decreasing	Timber production, habitat destruction
Afzelia parviflora (Vahl) Hepper	Least concern	Stable	No threat
Afzelia quanzensis Welw	Least concern	decreasing	Timber production, reproductive failure
Afzelia peturei De wild	Vulnerable	Decreasing	Habitat destruction
Afzelia javanica (Miq) J. Léonard	Least Concern	Unknown	No threat
Afzelia rhomboidea (Blanco) S. Vidal	Vulnerable	Unknown	Timber production
Afzelia xylocarpa (Kurz) Craib	Endangered	Unknown	Habitat destruction, timber production

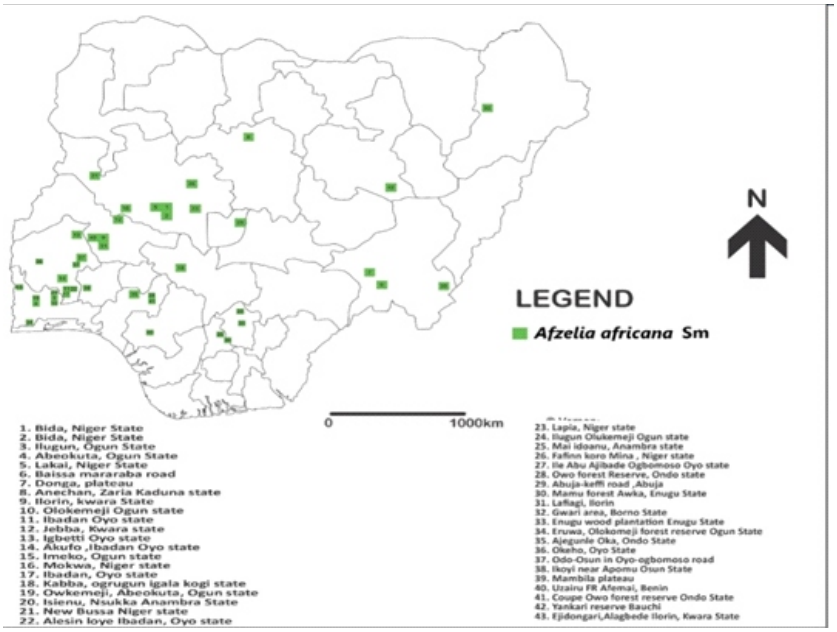

Figure 1: Map of distribution of *Afzelia africana* in Nigeria based on the natural occurrence records from the herbarium

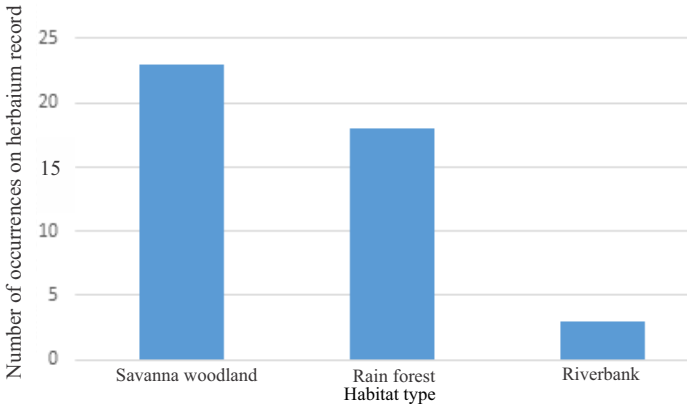

Figure 2: Habitat type of *A. africana* in Nigeria based on herbarium records

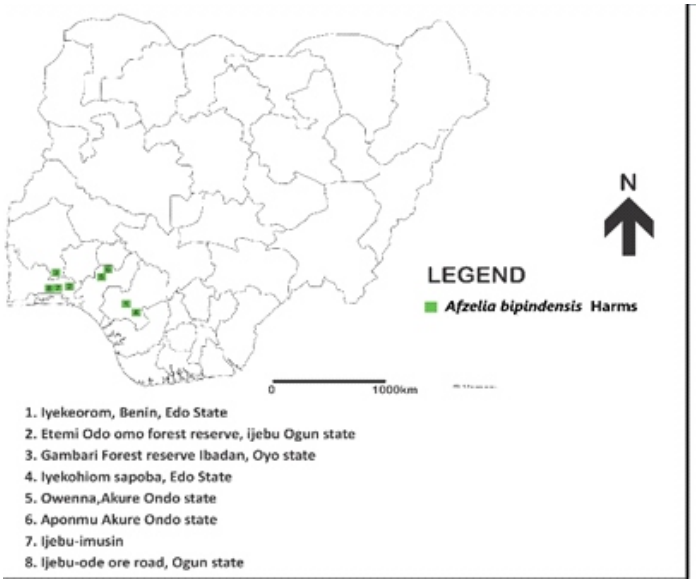

Figure 3: Map of distribution of *Afzelia bella* in Nigeria based on the natural occurrence records from the herbarium

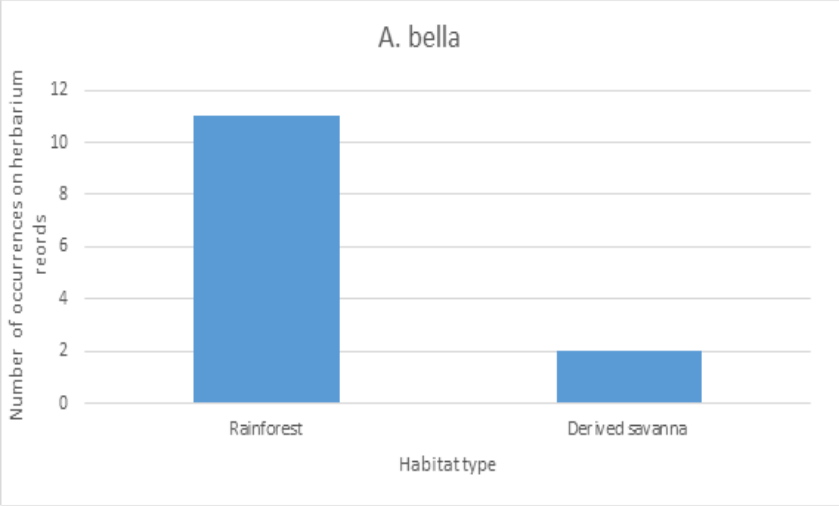

Figure 4: Habitat types of *Afzelia bella* in Nigeria based on herbarium record

Figure 5: Map of distribution of *Afzelia bipindensis* in Nigeria based on the natural occurrence records from the herbarium

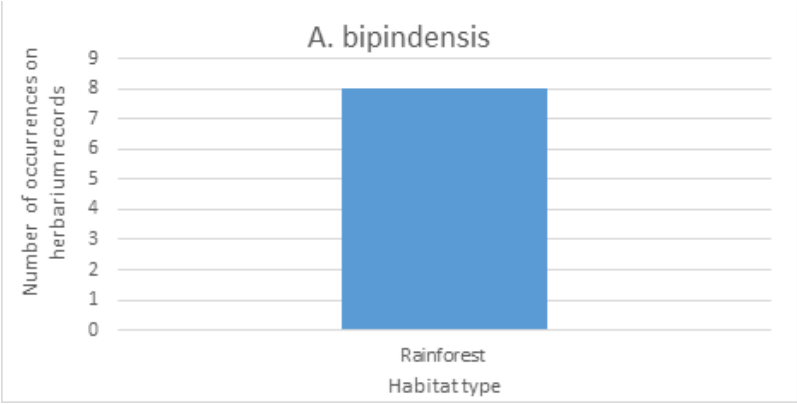

Figure 6: Habitat type of *Afzelia bipindensis* in Nigeria based on herbarium records

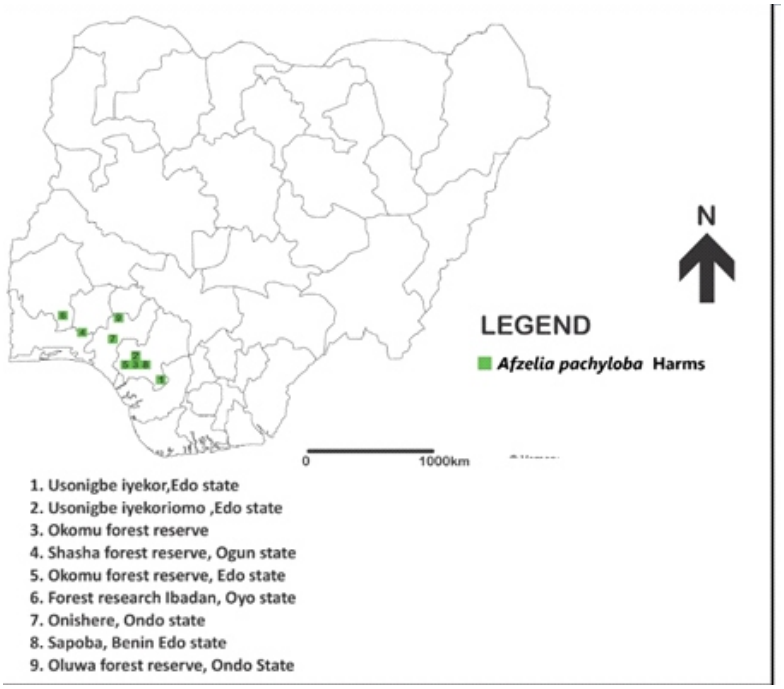

Figure 7: Map of distribution of *Afzelia pachyloba* in Nigeria based on the natural occurrence records from the herbarium

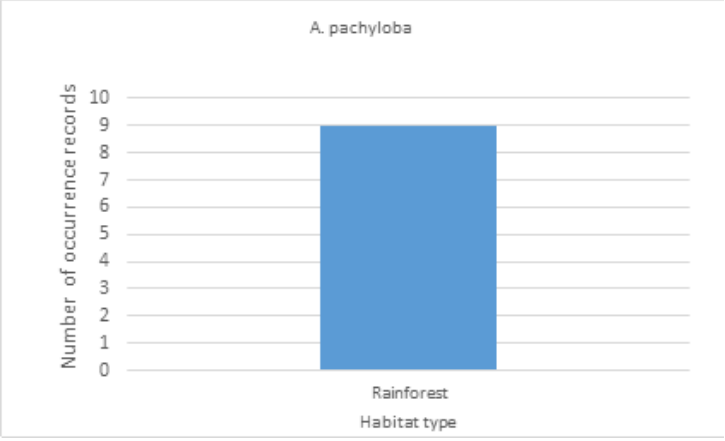

Figure 8: Habitat type of *Afzelia pachyloba* in Nigeria based on herbarium records

DISCUSSION

The IUCN Red List is a globally recognized platform that can be used to unravel patterns of extinction risk in certain taxonomic groups (Tingley *et al.,* 2013; Bamigboye *et al.,* 2016). This is because this platform contain detailed information of species that have been assessed based on species population size, species distribution range, ecological forces mounting pressure on the survival of the species and reproductive biology of species (Rodrigues *et al.,* 2006). The IUCN Red List revealed that many taxa in genus *Afzelia* are threatened and the population trend revealed that majority of these species are tending towards higher risk of extinction in the future (Table 1). This clearly revealed there has to be high level conservation intervention for this genus to prevent their complete extirpation.

Taxa in genus *Afzelia* are exploited for medicinal purposes with the bark, leaves and the fruits as part desired for different medicinal purposes (Oyedemi *et al.,* 2011; Jimoh *et al.,* 2012). Some plant genera that have been reported in literatures to be desired for their medicinal values have been facing high risk of extinction (Bamigboye, 2020; Bamigboye and Tshisikhawe, 2020). Also the result of this study revealed medicinal uses as one of the threats to one species of *Afzelia* (*Afzelia Africana*) (Table 1). *Afzelia* taxa are also being exploited for timbers and wood production (Oshingboye *et al.,* 2017) and exploitation of trees for wood production is fast promoting plant taxa extinction crisis in recent times (Diaz *et al.,* 2019). In this study the exploitation for timber still stood out as the main threat making taxa in this genus vulnerable to extinction (Table 1). All these have contributed immensely to the decline of the taxa of this genus in the wild. Also increase in urbanization has fragmented several habitats of these species. With these ecological forces promoting extinction risk in this genus, prioritizing the conservation of this genus in any geographical region where they are located becomes extremely important.

Biogeographical mappings of threatened species allow conservationists to determine regions of high importance with respect to species that are of conservation concern (Bamigboye, 2018). The species distribution map generated from herbarium records in this study revealed that *Afzelia* conservation is needed more in the Southern and middle belt region of Nigeria (Figures 1,3,5,7). Apart from *Afzelia africana* that have a wider distribution and extends towards the middle belt region from the south in Nigeria (Figure 1), all other *afzelia* taxa in this study are within the southern region of the country (Figures 3,5,7).

Habitat type of species can reveal the kind of places where to look for their original and fragmented population for conservation purpose (Mace *et al.,* 2008). Rainforests and the derived savanna which is the prevailing habitats (Figures 2, 4, 6, 8) should be combed within the Southern and middle belt region of Nigeria to see if there are other locations that is yet to be captured on the herbarium records but harbours *Afzelia* taxa. For instance a recent survey in Botany department in Olabisi Onabanjo University Nigeria revealed that there is a fragmented population located in a village called Akobalamu which is few miles away from the University campus in Ago-Iwoye, Ogun-State Nigeria. The population have been disturbed due to plantation cultivations by the local people. Survey such as this should be encouraged to see if there are still unknown populations of these species that are at the verge of extinction.

CONCLUSION

This study detect that *Afzelia* is a genus that contains small number of taxa and Nigeria as a country is lucky to still harbor this threatened genus with very little number of taxa. It was also revealed in this study that *Afzelia* is a threatened genus that needs to be given attention in terms of their conservation everywhere they are found. It

was revealed in this study that these threatened taxa are well distributed in Southern and middle belt region in Nigeria. Harvesting of these species for timber production, harvesting for medicinal uses and habitat destruction were identified in this study as major threats promoting extinction risk in this genus.

Recommendations

High level consideration is required for conserving genus *Afzelia* everywhere these species are currently located. An effective conservation plan for genus *Afzelia* is also recommended in Nigeria. Also effective propagation of these taxa should also be encouraged. A current, well updated and thorough population survey of this genus in all the locations identified from the herbarium records and all the habitat type locations in the Southern and Middle belt region of Nigeria is highly recommended. Conservation policies on indiscriminate harvest and protection of taxa in genus *Afzelia* should be put in place by relevant authorities to prevent extinction of this genus in Nigeria.

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