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EVALUATING A POPULATION DYNAMICS OF *TERMINALIA IVORENSIS A.CHEV.* - A THREATENED TREE SPECIES IN NIGERIA

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ABSTRACT

Ivory Coast Almond *(Terminalia ivorensis* A.Chev.) is a threatened tree species in Nigeria that is being widely harvested by local people for several uses. This study examined a wild population of this species in Ijebu Igbo, Ogun State, Nigeria to determine the status of this population. Data were generated from basal stem diameter and stem height of individuals of this species in the population sampled. Population distribution curves were constructed. There was a bell shape curve of the population distribution which depicts population with poor regeneration capacity, non-viable population and a population strongly affected by ecological disturbances. This study revealed there is a potential increase in local extinction risk of *Terminalia ivorensis* if populations of this species remain unviable. It is recommended that regeneration of this species be encouraged within areas suitable for its growth and development and reforestations using this species should also be encouraged.

Keywords: Ecological disturbances; Extinction risk; Population dynamics; Regeneration; Threatened species.

INTRODUCTION

Biological conservation is a global concern in every part of the world (Barnosky *et al.,* 2011; Pacifici *et al.,* 2015). The sporadic rate of species decline from the earth has generated interests in determining how these extinction patterns are taking place (Nic Lughadha *et al*., 2020). It has created necessity in designing different unique methods for controlling these trends of extinction risk in relation to peculiarities of the causes of extinction (Chichorro *et al.,* 2019). Considering specificity of species in terms of addressing the extinction problem is also important in biodiversity conservation (Chrystal *et al.,* 2015). With factors such as explosive human population growth, increase in reliance on biological resources, expansion in urbanization and climate change, trend of species extinction might keep going on the increase in a way that has not been witnessed in the past extinction

crisis (Sala *et al.,* 2000; Mukwevho, 2014; Kimmel *et al.,* 2022). It is therefore important to keep looking for effective ways biodiversity extinction crisis can be mitigated (Visconti *et al.,* 2016).

Ivory Coast Almond *(Terminalia ivorensis)* is a plant species in the genus *Terminalia* in the Combretaceae family (Chika *et al.,* 2020). It is a threatened species due to habitat destruction, harvest for medicinal uses, timber and wood production (Borokini, 2014; Salami *et al.,* 2023). In some parts of West Africa, this species is protected considering its vulnerability to ecological disturbances (Opuni-Frimpong *et al.,* 2021). Ethnobotanical uses of *Terminalia ivorensis* in Nigeria is a contributing factor to decline of its population and increase in its risk of extinction (Adeoluwa *et al.*, 2015; Mohammed *et al.,* 2019). A recent study by Bamigboye *et al.* (2023) showed that *Terminalia ivorensis* has a wide range of local uses in the study area (Ijebu Igbo, Ogun State, Nigeria) being examined in this study. These uses are Medicinal uses, wood production, perfume, dye, charcoal, firewood, animal fodder, shade source, basketry and spiritual purposes with bark, leaves, stem, whole plant and the canopy of this species being harvested for these local human uses (Bamigboye *et al.,* 2023). Continuous harvest of this species for these uses will further aggravate the decline of its populations and can lead to their local expirations in future. In this study, a population study was conducted in a location where ethnobotanical study was conducted by Bamigboye *et al.*, (2023) to determine possible impact of harvesting of this species for local uses on its population distribution. The aims and objectives of this study were:

To determine the population distribution curve of *Terminalia ivorensis* in a wild population in Ijebu-Igbo, Ogun State, Nigeria based on the basal stem diameter and stem height of the individuals in the population where the local harvest of this species is common.

To make conservation interpretations based on the nature of the results generated from the population distribution of this species within this study area where this species is heavily utilized.

MATERIALS AND METHODS

Ijebu-Igbo is a small community in Ogun State in South-western part of Nigeria. It is a region characterized by high deciduous rainforest (Figure 1). It also possesses some

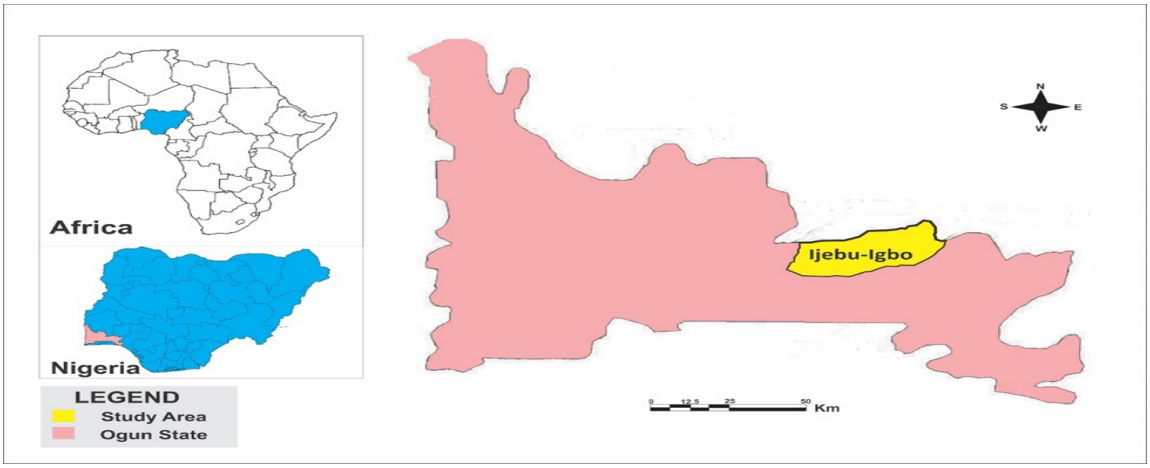

Figure 1: Map of Ogun State Agricultural Development Project Zones

swampy areas (Figure 1). There are many species of trees, shrubs and herbs in this area that the local people collect these plants for many uses. Some forests in these areas have been transformed to oil palm plantations while some are transformed into Plantain plantations as way of local sustenance of the local people (Figure 1). Harvest of tree species for timber production, firewood and charcoal production is a common practice in this local community. This community is made up of Yoruba speaking people.

Experimental site

In a wild population in the study area (6.9792° N, 3.9980° E) where a study has revealed that *Terminallia ivorensis* is under intense local uses (Bamigboye at al. 2023), 50 individuals of this species were sampled in Ijebu Igbo, Ogun State Nigeria. The area where the population sampling was carried out was mapped out with the use of a line transect with an area measurement of 50 m by 5 m. Measurement of the basal stem diameter and stem height was done through the use of the measuring tape and height measuring pole on individuals found in this population. The data collected in the fieldwork were recorded on spreadsheet. A Table was generated for the field data collected. Through the Microsoft excel, a size class distribution curve was generated for the basal stem diameter and the stem height. The nature of the size class distribution curved revealed the viability and unviability of this population.

Sample Background

The study species (*Terminalia ivorensis*) is a tree species that grow up to 16m in height and the wild population of this species sampled must have existed for several decades based on qualitative information from the indigenous knowledge holders around the study area. The space between the individuals of this species in the wild population is about 1.4m apart on the average. There are no fertility maintenance for the wild populations because the population is not protected. The growth status of the population is subjected to ecological disturbances.

RESULTS AND DISCUSSION

The size class distribution curve, based on the basal stem diameter of the individuals in this population showed a bell shape curve (Figure 2). Bell shape curve for plant population distribution based on basal stem diameter are indications of a population affected by harvesting and poor regeneration potential (Maua *et al*., 2020). The result of the population sampling carried out in the study area in this study revealed that the population is an unhealthy population and this might be due to high ecological disturbances within the plant community in the area sampled (Figure 2).

The size class distribution based on the stem height of individuals of this species is a continuous bell shape curve (Figure 3). This is a typical characteristic of a population with poor regeneration potential and non-thriving population (Victor *et al*., 2023). The result of the population sampled might also be due to impact of ecological disturbances on this population (Maua *et al.* 2020). This depict that regeneration of this species is extremely important to reduce the threats to the survival of this species and also reduce the risk of extinction.

Poor regeneration capacity has been reported by Borokini (2014) as a threat to *Terminalia ivorensis*. The result of the population distribution of this species in this study further revalidate the point that this factor

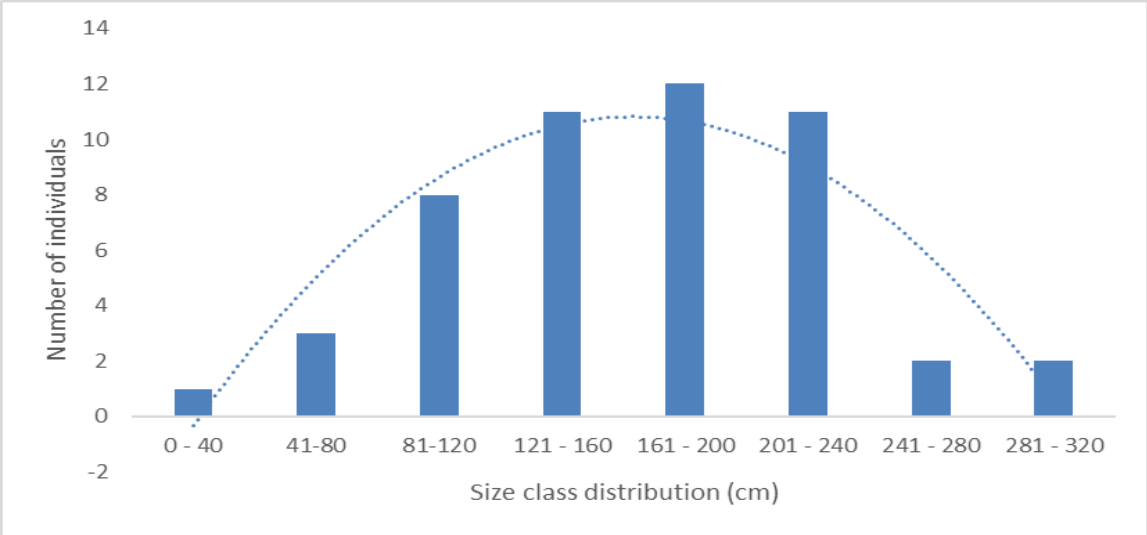

Figure 2: Population distribution curve based on basal stem diameter of *Terminalia ivorensis*

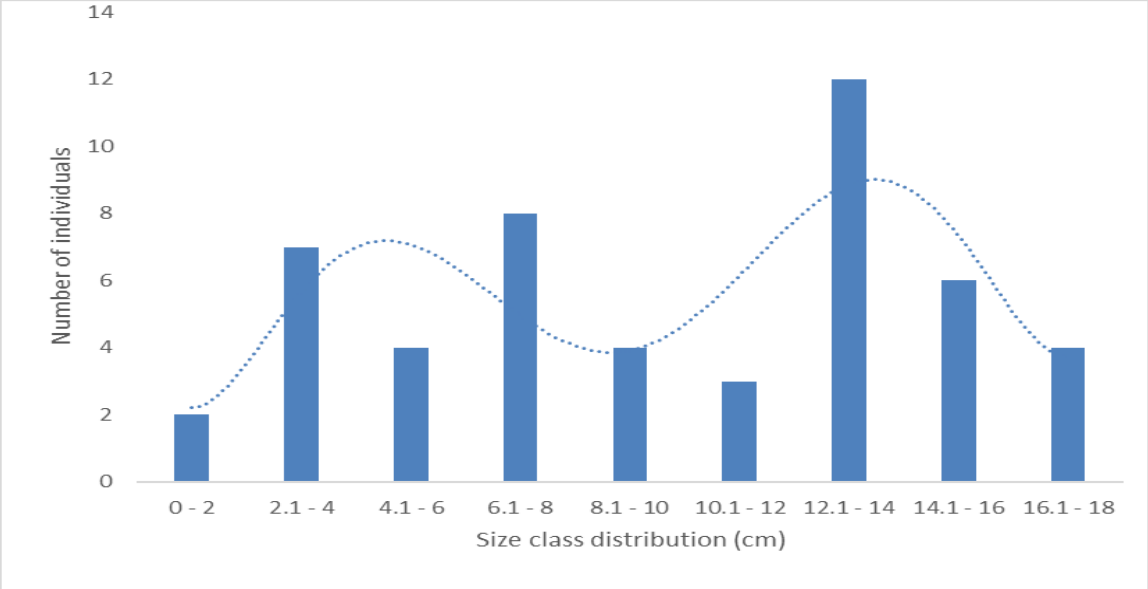

Figure 3: Population distribution curve based on stem length for *Terminalia ivorensis*

might still be a threat to several populations of this species, hence increasing the extinction of several populations of this species, except for conservation interventions.

Habitat destruction of tree taxa due to agricultural activities, urbanization and exploitation of tree species for timber and wood production are factors that has been detected to be threat to global tree taxa (Shaltout and

Table 1: Ecological parameters of individuals of *Terminalia ivorensis* in a wild population in Ijebu Igbo Ogun State, Nigeria.

S/No.	Basal stem Diameter (cm)	Plant height (m)	S/No.	Basal stem Diameter (cm)	Plant height (m)
1.	45	2.11	26	220	17.50
2.	200	7.50	27	230	15.30
3.	168	4.99	28	160	12.00
4.	180	10.00	29	150	10.00
5.	180	10.00	30	275	12.50
6.	180	13.00	31	180	12.50
7.	220	15.00	32	210	11.90
8.	140	16.20	33	125	5.70
9.	320	14.10	34	125	4.80
10.	260	16.80	35	115	7.20
11.	210	13.00	36	220	7.20
12.	300	13.00	37	210	10.00
13.	170	12.50	38	100	5.75
14.	230	13.00	39	210	6.50
15.	160	13.00	40	150	6.125
16.	165	15.00	41	165	7.00
17.	173	15.30	42	64	7.5
18.	175	17.50	43	30	2.70
19.	160	14.40	44	120	3.60
20.	160	12.50	45	140	2.30
21.	145	12.50	46	90	2.30
22.	190	11.50	47	120	3.30
23.	120	6.125	48	100	1.00
24.	220	12.5	49	80	0.70
25.	220	13.50	50	100	2.50

Bedair, 2022). *Terminalia ivorensis* has been reported to be facing local threats due to habitat destruction (Borokinin, 2014). This makes it extremely important to sample several populations of this species and determine how they are surviving and thriving in the midst of high ecological disturbances. Recent field surveys revealed some habitats of this species have been cleared for oil palm plantations and Banana plantations within the region where this study was conducted. Continuous degradation of the habitat will further affect the population dynamics of this species, hence resulting into significant decline of this species over a long period of time.

Human anthropogenic force is one major ecological force still driving plant extinction risk and crave of plant resources to satisfy human needs has made many tree taxa in the wild highly vulnerable to extinction (Jimoh *et*

al., 2012; Gagneux, 2021). Forest ecosystems have been degraded by intense utilization of forest resources especially trees and this will keep declining ecosystem services and will keep promoting loss of genetic diversity (Beech *et al.,* 2017). *Terminalia ivorensis* has many ethnobotanical uses. It is a species that many of the parts including the leaves, stem, roots and seeds are being harvested for different medicinal purposes (Bamigboye *et al.,* 2023). Medicinal uses are threats to tree species of poor regeneration potential (Mir *et al.,* 2021). If there are no sustainability practices in harvest of this species for medicinal purpose, this will further decline the populations of this species over a long period of time.

Plant population dynamics can reveal the survival potentials of populations in the long term which is also a product of the regeneration capacity of the populations (Tshisikhawe et al., 2013). The number of individuals in the size class of young seedlings is an indication that a population is a thriving population which has the capacity to grow and survive over a long period of time or not (Bakali *et al.,* 2017). The population sampled in this study has few seedlings based on the result of basal stem diameter and stem height measurement (Figures 2 and 3). This is an indication that this population might face a risk of extermination in decades except for human introduction of seedlings and juvenile individuals. This still further buttress that reproductive failure might still be a threat to this species. The combined effect of other ecological disturbances and reproductive failure will exacerbate the decline in populations of this species, leading to increase in the risk of extinction.

CONCLUSION AND RECOMMENDATION

Unsustainable utilization of this species will keep making the populations unviable and they will become prone to extinction in future. The regeneration of this species in local communities to ensure this species keeps providing ecosystem services is to be encouraged among the local people and local conservation authorities. The continuous regeneration will make the populations viable and also reduce the risk of extinction of this species in Nigeria. It is recommended that studies on genetic manipulations that can improve the regeneration potential of this species and hence increase its populations should be conducted to prevent local extinction of this species.

REFERENCES

Adeoluwa, O. A., Aderibigbe, A. O., Agu, G. O., Adewole, F. A. and Eduviere, A. T. (2015). Neurobehavioural and analgesic properties of ethanol bark extract of Terminalia ivorensis A Chev.(Combrataceae) in mice. *Drug research* 65(10): 545-551.

Ajayi, S. A., Ofusori, D. A., Ojo, G. B., Ayoka, O. A., Abayomi, T. A. and Tijani, A. A. (2011). The microstructural effects of aqueous extract of *Garcinia kola* (Linn) on the hippocampus and cerebellum of malnourished mice. *Asian pacific journal of tropical biomedicine* 1(4): 261-265.

Albani Rocchetti, G., Armstrong, C. G., Abeli, T., Orsenigo, S., Jasper, C., Joly, S., Bruneau A., Zytaruk M. and Vamosi, J. C. (2021). Reversing extinction trends: new uses of (old) herbarium specimens to accelerate conservation action on threatened species. *New Phytologist* 230(2): 433-450.

Bamiboye S.O., Akande A.O., Adesola P.T., Owolawi O.T., Ashefon B.B., Kalejaiye B.T. and Adeoba M.I. (2023). Utilization of *Terminalia ivorensis* A. Chev. a threatened tree species in Nigeria and the implication on its risk of extinction. *Natural Sciences: Journal of Science and Technology* 12(2):1 -5.

Bakali M., Ligavha-Mbelengwa, M.H., Potgieter, M.J. and Tshisikhawe, M.P. (2017). Impact of ethnobotanical utilization on the population structure of *Androstachys johnsonii* Prain. in the Vhembe Area of the Limpopo Province, South Africa. *Insights for Forest Research* 1 (1): 50-55.

Barnosky, A.D., Matzke, N., Tomiya, S., Wogan, G.O.U., Swartz, B., Quental, T.B.,
Marshall, C., McGuire, J.L., Lindsey, E.L., Maguire, K.C., Mersey, B. and Ferrer, E.A. (2011). Has the Earth's sixth mass extinction already arrived? *Nature* 471: 51–57.

Beech, E., Rivers, M., Oldfield, S. and Smith, P.P. (2017). GlobalTreeSearch: The first complete global database of tree species and country distributions. *Journal of Sustainable Forestry* 5: 454–489.

Borokini, T.A. 2014. Systematic Compilation of IUCN Red-listed Threatened Plant Species in 177 Nigeria. International Journal of Environmental Science 104–133.

Chichorro, F., Juslén, A. and Cardoso, P. (2019). A review of the relation between species traits and extinction risk. *Biological Conservation*, *237*, 220-229.

Chika, P. J., Sakpere, A. M., and Akinropo, M. S. (2020). Effect of pretreatments on germination of seeds of the timber plant, *Terminalia ivorensis* and *Mansonnia altissima* (a. Chev.). *Notulae Scientia Biologicae 12*(2): 334-340.

Chrystal, S., Mantyka-Pringle, C.S., Visconti, P., Di Marco, M., Martin, T.G., Rondinini C. and Rhodes, J.R. (2015). Climate change modifies risk of global biodiversity loss due to land-cover change. *Biological Conservation* 187: 103-111.

Gagneux, P. (2021). "Anthropogeny", In Evolution of the Human Genome II: Human Evolution Viewed from Genomes, ed. N. Saitou (Springer, Tokyo), 3–27. DOI: https://doi.org/10.1007/978- 4-431-56904-6 1

International Union of Conservation of Nature (IUCN) Red List, (2022) version https://www.iucnredlist.org/species/61967837/61967853

Jimoh S.O., Amusa T.O. and Azeez, I.O. (2012). Prevalence, Utilization and Conservation Strategies for Non-Timber Forest Products in South western Zone of Nigeria. *Resources and Environment* 2(1): 46-54.

Kimmel, K., Clark, M. and Tilman, D. (2022). Impact of multiple small and persistent threats on extinction risk. *Conservation Biology 36*(5): e13901.

Kumar, S., Sharma, S. and Chattopadhyay, S. K. (2013). The potential health benefit of polyisoprenylated benzophenones from Garcinia and related genera: Ethnobotanical and therapeutic importance. *Fitoterapia 89*: 86-125.

Maua, J. O., MugatsiaTsingalia, H., Cheboiwo, J. and Odee, D. (2020).

Population structure and regeneration status of woody species in a remnant tropical forest: A case study of South Nandi forest, Kenya. *Global Ecology and Conservation* 21: e00820.

Moran, D. & Kanemoto, K. (2017). Identifying species threat hotspots from global supply chains. *Nature Ecology & Evolution* 1 (1): 0023.

Mohammed, A. I., Ejeh, S. P., Amartey, Y. D. and Ocholi, A. (2019). Determined uncertainty models of reference material properties and the en 338 strength class of Nigerian grown Terminalia ivorensis (black afara) timber. *Nigerian Journal of Technology 38*(2): 302-310.

Mukwevho, P. (2014). Investigating the correlates of extinction risk at regional scale: A case study of the Southern African flora. Mini-dissertation.Magister Scientiae, Department of Botany and Plant Biotechnology, University of Johannesburg.

Mir, T. A., Jan, M., Khare, R. K., & Bhat, M. H. (2021). Medicinal plant resources: threat to its biodiversity and conservation strategies. *Medicinal and Aromatic Plants: Healthcare and Industrial Applications*, 717-739.

Nic Lughadha, E., Bachman, S. P., Leão, T. C., Forest, F., Halley, J. M., Moat, J., ... & Walker, B. E. (2020). Extinction risk and threats to plants and fungi. *Plants, People, Planet 2*(5): 389-408.

Opuni-Frimpong, E., Gabienu, E., Adusu, D., Opuni-Frimpong, N. Y. and Damptey, F. G. (2021). Plant diversity, conservation significance, and community structure of two protected areas under different governance. *Trees, Forests and People 4*: 100082.

Pacifici, M., Foden, W.B., Visconti, P., Watson, J.E., Butchart, S.H., Kovacs, K.M., Scheffers, B.R., Hole, D.G., Martin, T.G. and Akçakaya H.R. (2015). Assessing species vulnerability to climate change. *Natural Climate Change* 5: 215–224.

Sala, O.E., Chapin, F.S., Armesto, J.J., Berlow, E., Bloomfield, J., Dirzo, R., HuberSanwald, E., Huenneke, L.F., Jackson, R.B., Kinzig, A., Leemans, R., Lodge, D.M., Mooney, H.A., Oesterheld, M., Poff, N.L., Sykes, M.T., Walker, B.H., Walker, M. and Wall, D.H. (2000). Biodiversity – global biodiversity scenarios for the year 2100. *Science* 287: 1770–1774.

Salami, A. O., Gbadebo, J. O. and Shittu, E. A. (2023). Germination and early growth of Terminalia ivorensis A. Chev. AND Khaya senegalensis (Desr.) A. Juss. *Renewable 3* (1): 55-62.

Shaltout, K. and Bedair, H. (2022). Diversity, distribution and regional conservation status of the Egyptian tree flora. *African Journal of Ecology* 60(4): 1155-1183.

Thiault, L., Marshall, P., Gelcich, S., Collin, A., Chlous, F. and Claudet, J. (2018). Mapping social–ecological vulnerability to inform local decision making. *Conservation biology 32*(2): 447-456.

Tshisikhawe, M.P, and Van Rooyen, M.W. (2013). Population biology of *Elaeodendron transvaalense* Jacq. in the presence of harvesting. *Phyton International Journal of Experimental Botany* 82: 303-311.

Victor P.M., Tshisikhawe P.M. and Magwede K. (2023). Population dynamics of *Spi-*

rostachys africana Sond. a species highly exploited amongst some communities of Limpopo Province, South Africa. *Biodiversitas* 24 (1): 492-497. DOI10.13057/biodiv/d240157

Visconti, P., Bakkenes, M., Baisero, D., Brooks, T., Butchart, S.H., Joppa, L., Alkemade, R., Marco, M.D., Santini, L. and Hoffmann, M. (2016). Projecting global biodiversity indicators under future development scenarios. *Conservation Letters* 9(1): 5-13.

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