JASEM ISSN 1119-8362

Full-text Available Online at
www.ajol.info and
www.bioline.org.br/ja

J. Appl. Sci. Environ. Manage. *March 2013*
Vol. 17 (1) 75-80

Ecogeographical Amplitude and Habitat of Two Species of the Genus- *Terminalia* (Combretaceae) In the Central Niger Delta Areas in Rivers State.

[*1]EDWIN-WOSU, N.L.; OMARA-ACHONG, T.; NYANNANYO, B.L

E-mail: edy2000_ecoland@yahoo.co.uk
Department of Plant Science and Biotechnology,
University of Port Harcourt, Choba P.M.B. 5323, Port Harcourt, Rivers State, Nigeria.
[2]Raw Materials Research and Development Council,Cross River State Liaison Office, Calabar.

Key Words: *Terminalia catappa*, *Terminalia ivonensis*, tropical rainforest, fresh Water forest, mangrove forest, agro-ecological zones, amplitude.

ABSTRACT: A systematic study involving phytogeography was carried out on two species of the genus- *Terminalia* in the Central Niger Delta Areas in River State. This research was aimed at establishing their biodynamic distribution and habitat in the study areas using the simple random sampling method based on standard procedure for ecological assessment. Result shows that both species are successfully adapted to the area as mesophytes but are distinct in all aspect, thus have marked preference for and /or by displaying restricted occurrence in certain ecological habitat. *Terminalia ivorensis* does occur wildly and in abundant in the forest than *T. catappa,* which is frequently cultivated around homes and residential areas, though occurred more in fresh water ecozone. Both species are deciduous with annual foliar senescence. Both species were also observed to be utilized for different purposes such as environmental conservation, beautification, parks and habitat and as shade creating plants and domestic source of fuel in the Central Niger Delta. © JASEM

The amplitudinal distribution of plant species over the earth surface could be described as phytogeography, which tends to reflect the dynamic trend of species richness and diversity. Such trend of amplitude do imply biological barrier that create biotic difference on the natural biota with variation in the morpho-anatomical structures in relation to agro-climatic and environmental influences that dictate such macrophytic amplitude. Variation in species richness in relation to species-latitude and species area relationship with elevation has been known for over a century (Pianka, 1966; Lomolino 2001).

Report from world exploration in the 18th and 19th century have shown slight differences in some species within a genus in their habitat from region to region as a result of variation in edapho-climatic factors. One species might be in mountain, one in low lands, others along the coast and were considered as variants of single species due to geographical distribution (Elliot-Weiser *et al.*, 1974). Several studies have found a decreasing trend in species richness with increasing elevation (Hamilton, 1975; Steven, 1992; and Gentry 1998), whereas other found a hump shaped relationship between species richness and elevation (Odland and Birks, 1999; Grytnes and Vetaas, 2002). This argument is further supported by the fact that landscapes are never static, their elements are in permanent temporal and spatial flux (Stemier and Koliler, 2003; Brown and Laband. 2006).

The elevation gradient in species richness pattern is commonly explained by similar factors such as climatic, productivity and other energy related factors (Grytnes *et al.*, 1999). This assertion could be reaffirmed by a macro scale study, which has attributed species diversity richness to be a product of water energy dynamics (O' Brein *et al.*, 1988). Lomolino (2001) had pointed out that many components of climatic and local environments such as temperature, precipitation, seasonality and disturbance regimes vary along species amplitudinal gradient, which ultimately create variation in their richness. The concept of ecogeography (among other systematic lines of evidence) in taxonomy could be utilized in revealing species frequency distribution among other plant species in Nigeria, and the ecological amplitude in terms of distribution and habitation of some species of *Terminalia* within the central Niger Delta Area of Nigeria.

The Genus *Terminalia* Linn. belonging to the family combretaceae with 250 species is a predominantly tropical genus (Airy-Shaw, 1985). About 25 species are present in West Africa (Hutchinson and Dalziel, 1954). Combretaceae is noted as a small family of trees, shrubs and climbers with opposite or alternate leaves and stipules. *Terminalia* in Latin refers to the leaves being borne in tufts. Larger numbers are trees, widely distributed through out the tropics. The leaves are alternate, often in tufts at short upright shoots. In all the Nigerian species the flowers are borne in a slender raceme or spikes, one in each

Correspondence E-mail: *E-mail: edy2000_ecoland@yahoo.co.uk*

axil of newly developed leaves and with the bisexual flower at the base of the spike and male at the upper section of the raceme (Onochie, 1964). Of the 25 species, two species –*Terminalia catappa* Linn. (Indian almond fruit) and *Terminalia ivorensis* A. Chev. (Indigo black afara) are of economic importance in the Niger Delta areas of Nigeria (Keay, 1989).

It has been observed that elevation gradient and related climatic factors can contribute important insights into developing a general theory of species diversity. By the endemic origin and geographical dynamics, *Terminalia* has been associated with only three regions of the six phytogrographical regions of India due to the enormous edapho-climatic factors existing in the Indian region (Dutta, 1982). It is a seashore plant native to Malaysia and Western Pacific, introduced and present in the West African region in higher rainfall area (Burkill, 1985).

Inspite of the information on the phytogeographical trend of *Terminalia* and species, data on its ecological amplitude or diversity distribution especially in the Central Niger Delta area of Rivers State are either not available or scanty. In the light of this inadequacy, the research is aimed at carrying out a survey toward establishing the species amplitude and geographical distribution trend in the Central Niger Delta Area i.e. Rivers State.

MATERIALS AND METHODS

Location and geomorphological description of the study area

Rivers State is located within latitudes 6^{O} 23^{1}E to 7^{O} 36^{1}E and longitudes 4^{O} 18^{1}N to 5^{O} 45^{1}N. It is bounded to the East by the Imo River and Akwa-Ibom State and to the West by Bayelsa State. It is equally bounded to the North by Imo and Abia States and to the South by the Atlantic Ocean (Fig. 1). Geographically the Central Niger Delta area covered in this study extends from latitude 6^{O} 23^{1}E to 7^{O} 10^{1}E and longitude 4^{O} 18^{1}N to 5^{O} 45^{1}N. Part of the study area is made up of 12 local government areas out of the 23 local government areas of the entire State. It includes part of Ogba-Egbema Ndoni (ONELGA), Ahoada West and East (ALGA), Ikwerre (KELGA), Abua – Odual (ABOLGA) and Emohua (EMOLGA) local government areas in the Northern part of the State, while the Southern part includes Obio/Akpor (OBALGA), Port Harcourt (PHALGA), Asaritoru (ASALGA). Wakirike (WALGA), Degema (DELGA) and Akukutoru (AKULGA) local government areas (Fig.2).

All the areas of study are found within the three agro-ecological zones of the forest ecosystem (i.e. Coastal Mangrove forest, brackish swamp forest, fresh water raffia palm swamp forest, barrier island forest and the low land rainforest ecozones) of Rivers State based on altitude, vegetation, ecological and geographical factors in the Southern part of Nigeria (Teme, 2001; Ogbe, 2003).

The Central Niger Delta area of Rivers State is characteristically of sandy silt and clayey soils often alkaline and salty, sometimes acidic, mean temperature of 25^{O}C, relative high rainfall pattern, humid under the influence of seasonal and latitudinal variations, often comparatively uniform due to the proximity of the ecozone to the Atlantic Ocean (Alagoa, 1999). The diurnal and seasonal changes characterize the areas with dry and rainy seasons. The seasonal rainfall energetic in downpour with variability and appreciable energy content from radiation occurs south of latitude 05^{O}N every month of the year. This last from February to October while dry season last from November to February.

Within the Central Niger Delta, some areas have exhibited variation in rainfall following differences in latitudinal locations and elevation. Port Harcourt stands out as having high rain days as a result of its latitudinal physiographic elevation of 15.25m as highest point in the State and surrounding station. The effect of increased air pollution may also account for an increase in urban rainfall.

Like rain days, mean annual rainfall is influenced by proximity of the coast as well as physiography. As such stations like Choba in OBALGA close to Port Harcourt also exhibit pronounce effect of elevation on mean annual rainfall. Other areas with pronounced effect of proximity to the coast on mean annual rainfall include AKOLGA, DELGA and WALGA. The mean annual rainfall of the study area shows that the Central Niger Delta has a relatively high mean annual rainfall ranging between 1500 and 4000mm (Kuruk, 2004).

Species assessment: The study involves extensive field trips in part of the Central Niger Delta in the State. During the field trips, collections were made of life specimens in cultivation around homes and

in the wild for qualitative and distribution assessment using the simple random sampling method based on standard procedure for ecological assessment for each location in the study area. Attempts were made to identify the specimens to species level in the field.

RESULT AND DISCUSSION

The observation of the vegetation distribution in the Central Niger Delta of Rivers State has three major ecosystem groups. These are the wetland (salt mangrove forest, and fresh water raffia swamp forest) and the tropical rainforest.

The ecological amplitude of the two species of *Terminalia* shows that they are mesophytic in environmental and habitat adaptation. The species are mainly distributed in parts of the tropical rainforest and fresh water forest zones of the study area. Further observation on vegetative and floral features and information from geographical distribution have also indicated that all the species, however their mesophytic inclination are annual deciduous with high level of foliar senescence marked with preference for tropical climates. The species were often observed to display very restricted occurrence in certain ecological habitat or zone as is being observed in the discrete mangrove ecozone (Fig. 3) devoid of both species, while in some area under investigation, both species are found to exist either in the wild or in cultivation.

The tropical rainforest is found in areas located in the northern most past of the study area ONELGA, ALGA east and west, EMOLGA, KELGA, and ABOLGA, and encroaches southward to OBALGA, PHALGA, ASALGA and WALGA. In these areas *Terminalia catappa and Terminalia ivorensis* are cultivated and occur in association with *Terminalia belerica* or are found in the forest habitat in association with some timber producing big tree species amongst which are *Melicia excelsa* (Welw) C. Berg. C. Moraceae (Iroko), *Khaya ivorensis* A. Chev. Meliaceae (Mahogany) and *Hallea ledermannii* (K. Krause) Verde. Rubiaceae (Abura).

The fresh water swamp forest is found in areas like ASALGA, DELGA and parts of ONELGA, ALGA east and west, and ABOLGA. These areas are dominated by *Raffia hookeri* and a few stands of both species of *Terminalia* and other timber producing species (Fig. 3).

The mangrove vegetation is observed to occur in pockets of discrete forest located along AKULGA, parts of DELGA, ASALGA and WALGA areas. It is a very simple and discrete vegetation compared to the other two vegetation types in terms of structure and diversity of plant species. It is also devoid of *Terminalia* spp (Fig. 3)

The phytogeographical amplitude of plants over the earth's surface has found application in taxonomy. Information from such distribution studies provides clues to agro-climate and environmental factors necessary for plant development. Plant often reflect temporarily integrated environmental conditions and are therefore particularly useful indicators when values averaged over time are needed. When the value of an environmental factor in the past is required, the only possible approach may be to base it on historical vegetation data. The Central Niger Delta has three major agro-ecological zones, which are the coastal mangrove forest, freshwater swamp and tropical rainforest zones.

The phytogeographical assessment of the species shows that they are all mesophytic in environmental and habitat adaptation and occurs in some parts of the tropical rainforest and fresh water swamp forest ecological subzones of Rivers State. It has been observed that the taxa exhibit a pattern of distribution that coincidences with the areas occupied by related taxa that has a bearing on the classification of the group, especially when its evolution is taken into consideration (Stace, 1980). It is relatively desirable to classify species by their distribution among habitats defined by fixed topographic or edaphic features of the area (Hubbell and Foster 1986). Further observation on vegetative, floral features, information from the geographical distribution of the species investigated have also indicated that all the species (whatever their inclination) are marked with preference for tropical climates, hence the study area is geographically located in the rainforest axis of the country.

A number of factors including available moisture, soil type, exposure, and disturbances are known to influence the relative abundance of species in a forested habitat (Walker, 1992; Archer 1995). Though the study area of *T. catappa* and *T. ivorensis* is mainly situated in the tropical rainforest zone, one of the reasons for higher species diversity in the area could be variation in

micro-habitat features and occurrence of several associations. This corroborate with the assertion of Shukla (2009). However they sometimes display restricted occurrence in certain ecological habitats or zone as a result of innate variation in environmental cues. Ecological amplitude is the capability of a species to establish in various habitats lying along an environmental gradient. The species have also displayed some level of ecological amplitude. This argument corroborate with the assertion that landscapes are never static, their element are in permanent temporal and spatial flux (Stemier and Koliler 2003, Brown and Laband 2006). This could be reaffirmed by a macro scale study, which has attributed species diversity richness to be a product of water energy dynamics (O' Brien *et al,* 1988), while Lomolino (2001) had pointed out that many component of climate and local environments such as temperature, precipitation, seasonality and disturbance regimes vary along species amplitudinal gradient, which ultimately creates variation in their richness.

Terminalia ivorensis is relatively more in abundant in the forest in comparison to *Terminalia catappa. Terminalia catappa* is however more in the fresh water zone and planted more around homes and residential area for shelter and environmental beautification quality and aesthetics. Similar studies have also been made to analyse the patterns of plant species diversity in human dominated landscape, especially in relation to time scale (White *et al.,* 2006; Carey *et al.*, 2007). Also studies on analysis of vegetation have been carried out particularly in terms of phytosociology, species diversity, richness and abundance across different physiognomic unit in various parts of the world (Ganesh *et al*., 1996; Pandey and Shukla 1999, 2003, 2005; Tripathi and Shukla, 2007). This agrees with the postulation that the tropical rainforest in normally made up of intricate mixture of plants belonging to different plant families, genera and species

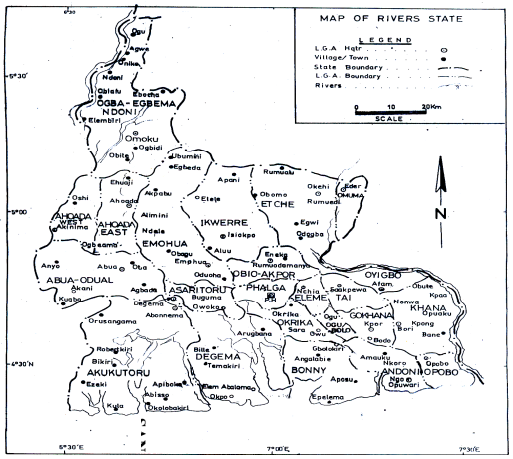

Fig. 1: Map of Rivers State

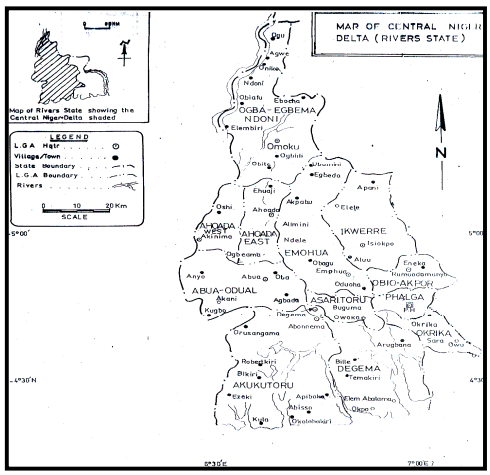

Fig. 2: Map of Central Niger Delta (Rivers State)

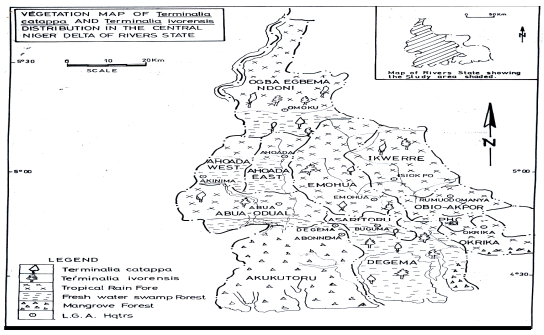

Fig. 3: Vegetation Map of *Terminalia catappa* and *Terminalia ivorensis* distribution in the Central Niger Delta of Rivers State

REFERENCES

-Shaw, H.K. (1985). *Willis Dictionary of the Flowering Plant and ferns.* (5th Edition) Cambridge University Press, Cambridge.

Alagoa, E.J. (1999). *The Land and People of Rivers State, Central Niger Delta.* Onyema Research Publication, Port Harcourt, Rivers State, Nigeria.

Archer, S. (1995). Herbivore mediation of grass – woody plant interactions. *Tropical Grasslands* 29: 218 – 235.

Brown, J.H.; Leband, D.N. (2006). Species imperilment and spatial patterns of development in the United States. *Conservation Biology* 20 (1): 239-244.

Burkill, H.M. (1985). *Useful Plant of West Tropical Africa* Ed. Vol. 1, Cambridge University Press, Cambridge.

Carey, S. A.; Ostling, J.; Harte, J.; del Moral, R. (2007). Impact of curve construction and community dynamics on the species – time relationship. *Ecology* 88: 2145 – 2153.

Dutta, A.C. (1982). *Botany for Degree student* (6th edition). Oxford University Press, Oxford.

Elliot-Weiser, T.; Ralph, S.C.; Michael, G.B. (1974). *Botany, an Introduction to Plant Biology* (5th edition), John Wiley and Sons, New York.

Ganesh, T.; Ganesan, R.; Devy, M.S.; Davidar, R.; Bawa, K.S. (1996). Assessment of plant biodiversity at a mid elevation evergreen forest of Kala Kad – Mundane thura Tiger Reserve, Western Ghats, India. *Current Science* 71: 379 – 392.

Gentry, A.H. (1988). Changes in Plant community diversity and Floristic Composition of climate and geographical Gardens. *Annals of the Missouri Botanical Gardens*, 75: 1-34

Grytnes, J.A.; Birks, H.J.B.; Peglar, S.M. (1999). Plant species Richness in Fennoscandia; Evaluating Relative Importance of Climate and History. *Nordic Journal of Botany*, 19: 489-503.

Grytnes, J.A.; Vetaas, O.R. (2002). Species Richness and Altitude, a comparison between simulation Models and Interpolated Plant Species Richnessa long the Himalayan Altitudinal Gradient Nepel. *American Naturalist.* 159: 294-304.

Hamilton, A.C. (1975). A Quantitative Analysis of Altitudinal Zonation in Uganda Forests. *Vegetation*, 30: 99-106.

Hubbell, S.P.; Foster, R.B. (1986). *In Community Ecology* (eds. Case, T.J. and Diamond, J.) Harper and Row, NewYork pp. 314 – 329.

Hutchinson, J.R.; Dalziel, J.M. (1954). *Flora of West Tropical Africa.* Revised by Keay, R.W.J. Vol. 1. Part 1. Crown Agents for oversea Government and Administration. London.

Keay, R.W.J. (1989). *Trees of Nigeria*. A revised edition, Clarendon Press Oxford.

Kinako, P.D.S. (1989). *Ecology and Conservation of Natural Resources*, Belk Publishers Port Harcourt, Rivers State, Nigeria.

Kuruk, P. (2004). Customary water loss and practices: Nigeria. http: //www.FAO.org/legal/advisery/FAOIUCNS/Nigeria.pdf

Lomolino, M.C. (2001). Elevation Gradients of Species Richness, Historical and prospective Views. *Global Ecology and Biogeography*, 10: 3-13

O' Brien, E.M. Whittaker, R.J.; Field, R. (1988). Climate and Woody Plant Diversity in Southern Africa, Relationship at Species, Genus and Family Levels. *Ecography* 21: 495-509.

Odland, A.; Birks, H.J.B (1999). The altitudinal gradient of vascular plant species richness in Aurland, Western Norway. *Ecography*, 22: 548-566.

Ogbe, M.G. (2003). "Biodiversity And Oil Industry In The Niger Delta – a sensitive Environment". *Nigerian Environmental Society Journ*. 1(1): 95 – 112.

Onochie, C.F.A; Keay, R.W.Y; Stanfield, D.P. (1964). *Nigerian Trees* Vol. 1 Crown Agents London.

Pandey, S.K.; Shukla, R.P. (1999). Plant diversity and community patterns along the disturbance gradient in plantation forests of Sal (*Shorea robusta* Gaertn) *Current Science* 77: 814 – 818.

Pandey, S.K.; Shukla, R.P. (2003). Plant diversity in managed Sal (*Shorea robust* Gaertn) forest of Gorakhpur, India: species composition, regeneration and conservation. *Biodiversity and Conservation* 12: 2295 – 2319.

Pandey, S.K.; Shukla, R.P. (2005). Plant community and diversity patterns within the forested landscape of north – eastern U.P. *Indian Forester* 131: 1217 – 1226.

Pianka, E.R. (1966). Latitudinal Gradients in Species Diversity of Review of Concept. *American Naturalist*, 100: 33-36.

Shukla, R. P. (2009). Patterns of plant species diversity across Terai landscape in North – eastern Uttar Pradesh, India. *Tropical Ecology* 50(1): 111 – 123.

Stace, C.A. (1980). *Plant Taxonomy and Biosystematics.* Edward Arnold, London

Stemier, N.C.; Kohler, W. (2003). Effect of landscape pattern on species richness, a modeling approach. *Agriculture, Ecosystem and Environment* 93: 353-361

Steven, G.C. (1992). The Elevation Gradient in altitudinal Range, An Extension of Report's Latitudinal Rule to Altitude. *American Naturalist*, 140: 893-911.

Teme, S.C. (2001). Environmental Peculiarities of the Niger Delta in Petroleum Exploration Operations. *In: the national conference of pipeline Vandalisation and Degradation of the Niger Delta Environment.* Rivers State Ministry of Environment and Natural Resources of Collaboration with green House Foundation and B. Jean Communication Limited Port Harcourt, Rivers State. 27th -29th Nov. 2001.

Tripathi, S.L.; Shukla, R.P. (2007). Effect of clipping and grazing on the various vegetational parameters of grassland communities of Gorakhpur. *Tropical Ecology* 48: 61 – 70.

Walker, B. (1992). Biodiversity and ecological redundancy. *Conservation Biology* 6: 18 – 23.

White, E. P.; Adler, P. B.; Leuenroth, W.K.; Gill, R.A.; Greenberg, D.; Kaufman, D.M.; Rassweiler, A.; Russak, J.A.; Smith, M.D.; Steinbeck, J.R.; Waide, R.B.; Yao, J. (2006). A comparison of species - area relationship across ecosystem and taxonomic groups. *Oikos* 112: 185 – 195.