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*Full Length Research Paper*

# Lichens abundance and diversity in Jalingo and Ngel-Nyaki, Taraba state, Nigeria

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**The lichen abundance and diversity of some selected areas of Jalingo town (Kona, Magami, Mile six, Nukkai and Sabon-gari) was studied and compared to the abundance and diversity in Ngel-Nyaki Montane Forest Project (NMFP) to ascertain the effect of pollution due to overcrowding in both locations. The Line Transect Method was adopted for the studies, from where lichen species encountered were identified, counted and recorded. The results showed that 856 lichens individuals were encountered during the study period, with Ngel-Nyaki (544) having more individuals while Jalingo (312) followed. In general, all the three (3) types of lichens were recorded ((Crustose: 593; 69.28%); (Foliose: 209; 24.42%) and (Fruticose: 54; 6.3%)) during this study with all three (3) occurring in Ngel-Nyaki and only two (2) (Crustose and Foliose) were recorded in Jalingo. A total of fourteen (14) taxa were recorded, out of which the taxa Lecanora (9) had the highest species, followed by Melanelia, Ramalina and Usnea regording three (3) species each; Bryoria, Lecidella and Xanthoria recorded two (2) species each while Amandinea, Chrysothrix, Evernia, Lepraria, Lobaria, Permalia and Peltajera had one (1) species each. In Jalingo, *Lecidella euphoria* (Crustose Lichen) had the highest occurrence of twenty nine (29) while *Lecanora pulsaris* (Crustose Lichen) had the least occurrence of nine (9). In Ngel-Nyaki, *Lecanora symmicta* (Crustose Lichen) had the highest occurrence of fifty eight (58) while *Usnea subfloridana* (Fruticose Lichen) recorded the least with a frequency of two (2). Shannon-Weiner Diversity Index ($H'$) showed that Ngel-Nyaki is more diverse 3.20 compared to Jalingo with Diversity Index of 2.95. Hence, it could be deduced from the results that Ngel-Nyaki, a reserved land has less anthropogenic influence and more environmental quality than Jalingo, an unreserved land with more anthropogenic influence and less environmental quality.**

**Keywords:** Ngel-Nyaki, Jalingo, Diversity, Abundance, Lichens

## INTRODUCTION

Air pollution have been observed as one of the key drivers of climate change, with the tendency of contaminating both indoor and outdoor environment, and could bring about changes in the physical, chemical and biological components of the atmosphere. Climate change was defined by the United Nations Framework Convention on Climate Change (UNFCCC) as the any form of change in the climate of an area attributed partly or wholly to anthropogenic activities, which have the potentials of altering the global atmospheric component observed over a comparable period (UNFCCC, 1994)

Climate change and air pollution not only affect humans but also other species of flora and fauna globally (Kumar *et al*., 2012; Khan and Siddiqui, 2014; Malik, 2014; Panigrahy *et al*., 2015;). Many research findings have documented these effects on both plants and animals. Parmesan (1996) and Parmesan *et* al. (1999), reported that about two-third (⅔) of butterfly species in Europe have shifted their ranges northwards with about 150 miles. Thomas and Lennon (1999), reported that many birds species in Britain have moved up northwards by an average of 18.8km. Primack *et al*. (2004), have found out that plants at Boston's Arnold Arboretum are flowering

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eight (8) days earlier than they use to in the early 20th century, while Dutta *et al*. (2014) found out that climate change is responsible for the decline in population of reptiles in India.

Biological parameters have been used to measure environmental quality (De Groot *et al*., 1995; Hughes, 2000; Parmesan and Yohe, 2003; Inouye, 2008 and Miller-Rushing and Primack, 2008).

Lichen is a product of the symbiotic relationship between algae and fungi. During this association, the algal component is called the phycobiont while the fungal component is referred to as the mycobiont. With three (3) distinct types, Crustose, Folios and Fruticose, they are found growing on other plants, rocks and old monuments or buildings. The important requirement for their growth and abundance is adequate moisture, light and altitude, unpolluted air and undisturbed environment (Perennial Substratum) (Nayaka, 2014). Because of their simple nature, fragility and sensitivity, lichens have been used as monitors of environmental conditions for early warning against deteriorating environments. Lichen species composition is an important tool of information gathering about changes in climate, air quality and biological processes. They respond quickly to environmental changes through changes in their diversity, abundance, morphology and physiology (Godoy *et al*., 2001; Upreti *et al*., 2005; Marmor and Randlane, 2007 and Denise and Thompson, 2014).

## MATERIALS AND METHODS

### Study Areas

**Jalingo:** The city of Jalingo (centre of Muri Emirate) is roughly located between latitude $8^{o}$ 47′ to $9^{o}$ 01′N and longitude $11^{o}$ 09′ to $11^{o}$ 30′E. It is bounded to the north by Lau Local Government Area (L.G.A), to the East by Yorro L.G.A, to the south and west by Ardo-Kola L.G.A. (Figure 1). It has a total land area of about 195.071 km2. Its altitude from free seas is 351 meters. Jalingo L.G.A has a population of 139,845 people according to the 2006 population census, with a projected growth rate of 3% (Oruonye and Abbas, 2010). Presently, it has a projected population (2013) of 167,548 based on the 2006 population census figure of 139, 845 at 2.83% annual growth rate. Politically and administratively, the city is divided into 10 wards (Turaki A, Turaki B, Sintali A, Sintali B, Majidadi, Sarkin Dawaki, Kachalla Sembe, Barde, Kona and Yelwa). It is estimated that about 72% of the population in the metropolis live in informal or unplanned settlements (Yavini and Musa, 2013).

**Ngel-nyaki Forest Reserve (NNFR):** Was gazetted as a forest reserve in 1969, it is located on the western escarpment of Mambilla Plateau in the south eastern corner of Taraba State, Nigeria at an altitude of 1450-1600m asl, on latitude $07^{o}$ 14′ N and longitude $11^{o}$ 04′ E. It is a mosaic of mountain top grassland and sub-montane closed canopy forest limited to the streams' valleys and covers an area of about 46$km^2$ with a woody plant density of 669/ha (Ihuma *et al*., 2011). It is one of the most floristically diverse montane –submontane forest stands in Nigeria and the most diverse on Mambilla plateau (Chapman and Chapman, 2001). It contains many plants which are endemic to the afromontane region which makes it a priority for conservation (Fishpool, 1997). NNFR has more than 146 vascular plants out of which 25 are in the IUCN Red Data List (Borokini *et al*., 2012) four of which are endangered and several are new to Nigeria (eg. *Anthonotha noldeana*) (Chapman and Chapman, 2001). The forest is also rich in birdlife (Ihuma et al, 2011) and has been classified as an Important Bird Area by Birdlife International and a critical site for biodiversity conservation (Ezealor, 2002). The climate is seasonal with dry season lasting from November to March and rainy season from April to October with a mean annual rainfall of 1780mm (Chapman and Chapman, 2001).

### Sampling Methods

In each of the study sites (Jalingo and Ngel-nyaki), filed survey method was employed using the line transect method as described by Buckland *et al*. (2001) and Thomas *et al*. (2002). The methods involve a two-line transects of 2km separated by 100m apart was mapped out and studied, and for each tree came across, it was studied for lichens occurrence and type. Jalingo was tagged site A and was divided into five (5) different sampling units, that is, Kona, Mile Six, Magami, Nukkai and Sabongari. While Ngel-nyaki was tagged site B and was taken holistically as a single entity considering its size being less than that of Jalingo. From these sites, lichens were collected and identified using the methods and techniques of Nayaka (2014).

### Statistical Analysis

Simple percentages and bar-charts were used to present number of lichens while Shannon-Wiener diversity index was used to ascertain the abundance and diversity of the lichens species encountered.

## RESULTS

From the results obtained, it can be seen that site A (Jalingo) recorded only two (2) types of lichens (Crustose and Foliose), while site B (Ngel-nyaki) recorded all the three (3) types of lichens (Crustose, Foliose and Fruticose). Ngel-nyaki also recorded the highest number of lichens 544 (63.55%) than Jalingo 312 (36.45%). Overall, Crustose lichens had the highest occurrence of 593 (69. 28%), followed by Foliose 209 (24.42%) while Fruticose appears the least 54 (6.30%). In Ngel-nyaki,

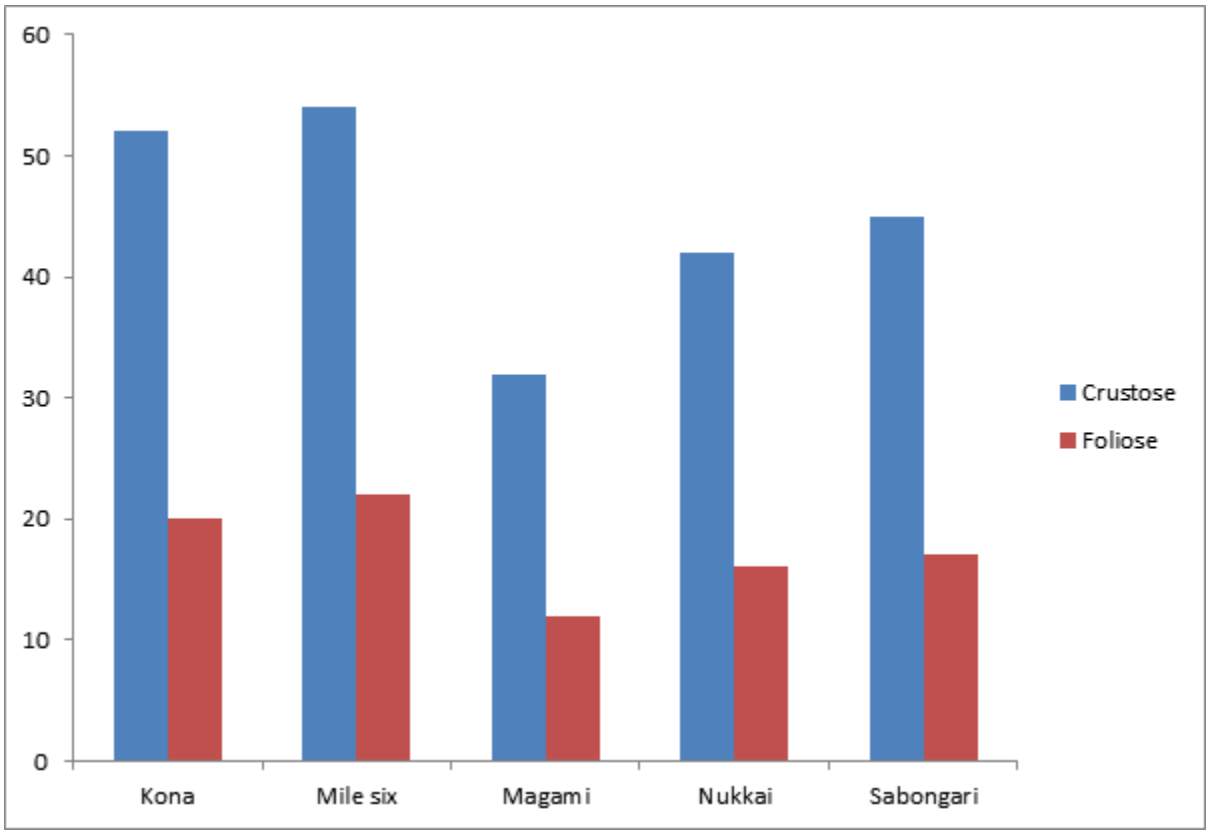


**Figure 1.**: Lichen Abundance in Jalingo Metropolis

**Table 1.** Lichens Abundance in the Study Areas

| Sites | Lichens Type | | | Total |
|---|---|---|---|---|
| | Crustose | Foliose | Fruticose | |
| A | 225 | 87 | - | 312 |
| B | 368 | 122 | 54 | 544 |
| **Total** | **593** | **209** | **54** | **856** |

Crustose lichens had a frequency of 368 (67.65%), Foliose had a frequency of 122 (22.43%) while the least was Fruticose lichens with a frequency of 54 (9.92%) as revealed in Table 1.

Figure 1 showed the occurrence of lichens in site A (Jalingo) and it can be deduced from the figure that of the five (5) different sites studied, a total of 312 lichens were encountered. And the abundance of Crustose lichens is in the following order. Mile six (unit 2) had 54 (24.0%), Kona (unit 1) had 52 (23.1%), Sabongari (unit 5) recorded 45 (20.0%), Nukkai (unit 4) recorded 42 (18.7%) while the least was observed in Magami (unit 3) as 32 (14.2%). In the case of Foliose lichens, it follows the same order with the Crustose lichens where Mile six (unit 2) had 22 (25.2%), Kona (unit 1) had 20 (22.9%), Sabongari (unit 5) recorded 17 (19.5%), Nukkai (unit 4) recorded 16 (18.3%) while the least was observed in Magami (unit 3) as 12 (13.7%). No Fruticose lichens were observed in site A during the cause of this study.

Table 2 showed the checklist of lichen species across all studied sites during the course of this studies and it can be seen that *Lecanora symmicta* had the highest abundance of 79 (9.23%) individuals while *Usnea subfloridana* had the least abundance of 2 individuals which is equivalent to 0.23%. Across orphological types as revealed in Figure 2, lichens abundance followed the order Crustose > Foliose > Fruticose with the following respective percentages of 69% (593), 25% (209) and 6% (54).

## DISCUSSION

The features portrayed by lichens in this study as concerns their occurrence and diversity have agreed to

**Table 2.** Checklist of Lichens Species Observed During the Studies

| S/No. | Name of Lichen | Lichen Type | Site A | Site B | Total |
|---|---|---|---|---|---|
| 1. | *Amandinea punctata* | Cr | 10 | 25 | 35 |
| 2. | *Bryoria capillaries* | Fr | - | 08 | 08 |
| 3. | *Bryoria fuscescens* | Fr | - | 10 | 10 |
| 4. | *Chrysothrix candelaris* | Cr | 10 | 16 | 26 |
| 5. | *Evernia prunastri* | Fo | 20 | 31 | 51 |
| 6. | *Lecanora carpinea* | Cr | 11 | 18 | 29 |
| 7. | *Lecanora chlaretera* | Cr | - | 13 | 13 |
| 8. | *Lecanora conizoides* | Cr | 19 | 40 | 59 |
| 9. | *Lecanora hagenii* | Cr | 16 | 31 | 47 |
| 10. | *Lecanora leptyrodes* | Cr | 14 | 28 | 42 |
| 11. | *Lecanora pulicaris* | Cr | 09 | 18 | 27 |
| 12. | *Lecanora sambuci* | Cr | 14 | 08 | 22 |
| 13. | *Lecanora symmicta* | Cr | 21 | 58 | 79 |
| 14. | *Lecanora varia* | Cr | 28 | 37 | 65 |
| 15. | *Lecidella elacodiroma* | Cr | 17 | 17 | 34 |
| 16. | *Lecidella euphorea* | Cr | 29 | 28 | 57 |
| 17. | *Lepraria spp* | Cr | 27 | 31 | 58 |
| 18. | *Lobaria pulmonaria* | Fo | 10 | 15 | 25 |
| 19. | *Melanelia exasperatula* | Fo | 11 | 08 | 19 |
| 20. | *Melanelia subergentifera* | Fo | 13 | 23 | 36 |
| 21. | *Melanelia subaurifera* | Fo | 10 | 14 | 24 |
| 22. | *Permalia sulcata* | Fo | 12 | 06 | 18 |
| 23. | *Peltajera membranacea* | Fo | 11 | 13 | 24 |
| 24. | *Ramalina farinacea* | Fr | - | 11 | 11 |
| 25. | *Ramalina fastigiata* | Fr | - | 06 | 06 |
| 26. | *Ramalina fraxinea* | Fr | - | 10 | 10 |
| 27. | *Usnea filipendula* | Fr | - | 03 | 03 |
| 28. | *Usnea hirta* | Fr | - | 04 | 04 |
| 29. | *Usnea subfloridana* | Fr | - | 02 | 02 |
| 30. | *Xanthoria candelaris* | Fo | - | 03 | 03 |
| 31 | *Xanthoria perietina* | Fo | - | 09 | 09 |

**NB:** Cr = Crustose; Fo = Foliose; Fr = Fruticose; $N_A$=312; $N_B$=544; $H'_A$= 2.95; $H'_B$=3.20; $E_A$ =0.93; $E_B$=0.78

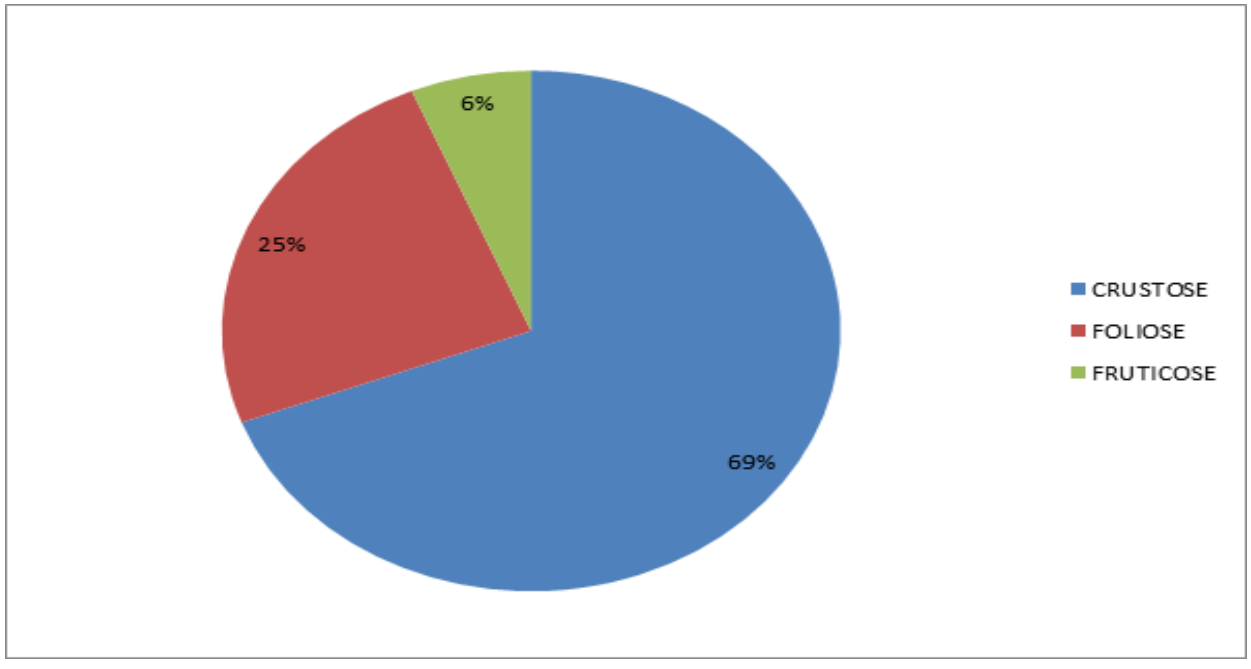


**Figure 2.** Distribution of Number of Species across Orphological types

the fact that their morphological differences and abundance is influenced by the environment they occur in. From the study Crustose lichens were the most abundant and diverse in Ngel-nyaki as they occur both at the edge and deep inside the forest. In Jalingo, although the species diversity was reduced, they were still the most abundant type encountered despite the change in temperature, substratum and increased atmospheric pollutant load. This study agrees with the work of Huckaby (1993) and Denise and Thompson (2014) who independently reported that of the three (3) kinds of lichens, Crustose lichens are the most environmentally tolerant species.

The climate and vegetation of Ngel-nyaki has no doubt created a supportive environment as all three (3) types were recorded, hence, an index of good climate that could influence air quality subsequently leading to lichen abundance. In Jalingo, the many anthropogenic activities such as housing, farming and vehicular emissions have the ability to affect the air quality and lichens abundance. This is because a lot of disturbance in the form of tree clearing which could result to habitat destruction is needed in building a house or a farm and this can also lead to global warming and climate change, conversely reducing substratum for the lichens and hence, their abundance. This is in conformity with the work of Belnap *et al*. (1993) who reported that vehicular emissions in the same environment over a long period of time have the potentials of limiting the range and diversity of lichens as smog, nitrogen oxides and volatile organic compounds may allow the growth of resistant species only which may be evident in the absence of Fruticose lichens in the whole of Jalingo.

Shanon-Weiner Diversity Index revealed that Ngel-Nyaki is more diverse at 3.20 than Jalingo with Diversity Index of 2.95, although Jalingo had shown more evenness of 0.93 than Ngel-Nyaki (0.78).

## REFERENCE


Belnap J (1993). Recovery rates of cryptobiotic crusts: inoculant use and assessment methods. Great Basin Nat. 53(1):89 – 95

Borokini TI, Babalola FD, Amusa TO, Ivande ST, Wala ZJ, Jegede OO, Tanko D, Ihuma, JO (2012). Community-based forest resources management in Nigeria: Case study of Ngel Nyaki Forest Reserve, Mambilla Plateau, Taraba State, Nigeria. J. Trop. For. and Env. 2(1):69 – 76

Chapman JD, Chapman HM (2001). The forests of Taraba and Adamawa States, Nigeria. An ecological account and plant species checklist. Uni. of Canterbury,Christchurch. New Zealand.

De Groot RS, Ketner P, Ovaa A H (1995). Selection and Use of Bio-indicators to Assess the Possible Effects of Climat Change in Europe. J. Bio 22(4/5):935 – 943

Denise EM, Thompson EO (2014). Diversity of lichens and Host Plant Species in University of Uyo Campuses. Int. J. Mod. Plant. Anim. Sci., 2(1): 50 – 59

Dutta TK, Sou SK, Mondal RP (2014). Current Status and Possible Causes of Reptile's Decline. Int. Res. J. Env. Sci., 3(9): 75 – 79.

Ezealor AU (2002). Critical sites for biodiversity conservation in Nigeria. NCF, Lagos. 110p

Fishpool LDC (1997). Important Bird Areas in Africa. IBA criteria categories, species lists and population thresholds. Birdlife International, Cambridge.

Godoy R, Oyarun CE, Gerding V (2001). Precipitation Chemistry in Duciduous and Evergreen Nothofagus Forests of Southern Chile under Low-deposition Climate. B. Appl. Ecol., 2:65 – 72.

Huckaby LS (1993). Lichens as bioindicators of air quality. Rocky Mountian Forest and Range Experiment Station, U.S. Dep. Agric. For. Ser. Gen. Tech. Rep., RM-224.

Hughes L (2000). Biological Consequences of Global Warming: is the signal already apparent? Tre. Ecol. Evol., 15(2):56 – 61.

Ihuma J, Chiuma UD, Chapman HM (2011). Tree species diversity in a Nigerian montane forest ecosystem and adjacent fragmented forests. ARPN J. Agric. and Biol. Sci., 6(2):17 – 22.

Inouye DW, (2008). Effect of Climate Change on Phenology, Frost Damage and Floral Abundance of Montane Wildflowers. Ecol. 89(2):353 – 362

Khan RR, Siddiqui MJA (2014). Review on the Effect of Particulates; Sulfur Dioxide and Nitrogen Dioxide on Human Health. Int. Res. J. Env. Sci. 3(4): 70 – 73

Kumar S, Himanshu SK, Gupta, KK (2012). Effect of Global Warming on Mankind – A Review. Int. Res. J. Env. Sci., 1(4): 56 – 59.

Malik P (2014). Impact of Global Warming on Environment. Int. Res. J. Env. Sci. 3(3): 72 78

Marmor L, Randlane T (2007). Effect of Road Traffic on Bark pH and EpiphyticLichens in Tallinn. Fol. Crypt. Est. 43:23 – 37

Miller-Rushing AJ, Primack RB (2008). Global Warming and Flowering Times in Thoreau's Concord: A Community Perspective. Ecol., 89(2):332 – 341.

Nayaka S (2014). Methods and Techniques in Collection, Preservation and Identification of Lichens, In: Rana TS, Nair KN, Upreti DK (eds), Plant Taxonomy and Biosystematics: Cla and Mod Meths, 101 –105.

Panigrahy BP, Singh PK, Tiwari AK, Kumar B (2015). Impact of Climate Change on Ground Water Resources. Int. Res. J. Env. Sci., 4(3): 86 – 92.

Parmesan C (1996). Climate and Species Range. Nat. ,382:765 – 766.

Parmesan C, Yohe G (2003). A Globally Coherent Fingerprint of Climate Change Impacts Across Natural Systems. Nat., 421:37 – 42.

Parmesan C, Ryrholm N, Stefanescu C, Hill JK, Thomas CD, Descimon H, Huntly B, KailaL, Kullberg J,

Tammaru T, Tennet WJ, Thomas JA, Warren M (1999). Polewards Shift in Geographical Ranges of Butterfly Species Associated with RegionalWarming. Nat. 399:597 – 583

Primack D, Imbers C, Primack RB, Miller-Rushing AJ, Tredici PD (2004). Herbarium Specimens Demonstrate Earlier Flowering Times in Response to Warming in Boston. Am. J. Bot. 91(8): 1260 – 1264

Thomas CD, Lennon JJ (1999). Birds Extend their Range Northwards. Nature, 399: 213

Thomas L, Buckland ST, Burnham KP, Anderson DR, Laake JL, Borchers DL, Strindberg S (2002) Distance sampling. - In: El-shawaari H, and Piegorsch WW(Eds.); Encyclopedia of environmetrics. John Wiley and Sons, Chichester, United Kingdom, pp. 544-552.

United Nations Framework Convention on Climate Change (UNFCCC) (1994).

Upreti DK, Divakar PK, Nayaka S (2005). Commercial and Ethnic Use of Lichens in India. Econ. Bot. 59(3):269 – 273

Yavini TD, Musa AA (2013). Munincipal Solid Waste and pollution Management in Jalingo Metropolis: Problems, Challenges and Strategies. J. Env., 2(5):125 – 133