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# Van Sangyan

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## Note to Authors:

We welcome the readers of Van Sangyan to write to us about their views and issues in forestry. Those who wish to share their knowledge and experiences can send them:

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The articles can be in English, Hindi, Marathi, Chhattisgarhi and Oriya, and should contain the writers name, designation and full postal address, including e-mail id and contact number.

TFRI, Jabalpur houses experts from all fields of forestry who would be happy to answer reader's queries on various scientific issues. Your queries may be sent to The Editor, and the expert's reply to the same will be published in the next issue of Van Sangyan.

**Cover Photo:** Panoramic view of Achanakmar-Amarkantak Biosphere Reserve

**Photo credit:** Dr. N. Roychoudhury and Dr. Rajesh Kumar Mishra, TFRI, Jabalpur (M.P.)

## From the Editor's desk



*Forest plantations, which are expanding rapidly in the tropics and sub-tropics will clearly play a very important role in the future world wood supply. Currently, eucalypts and pines are the most commonly used species in tropical timber plantations; together, they account for 43 percent of all tropical plantation area. Pines dominate temperate and boreal plantations; 54 percent by area. E. camaldulensis is a highly adaptable tree with ability to tolerate extreme conditions such as drought and soil salinity, coupled with prolific seed production, potentially rapid growth and the ability to reproduce at a young age. These characteristics contribute to its ability to become invasive and it is a declared invasive in a number of countries.*

*Reliable estimation of total biomass for standing trees and forests or their components such as stem wood, stem bark, living and dead branches, foliage, stump and roots are very essential parts of forest carbon. Destructive harvesting of forest trees is not always possible because it is time-consuming and there is high risk of uncertainty when the obtained results are extrapolated to larger areas. Undoubtedly, the most common approach is to obtain biomass estimates at standing level. Biomass is a function of diameter at breast height (DBH), height (ht) and wood density ( $\rho$ ) in a given location. However, the contribution of these variables to the above ground biomass (AGB) differs from site to site, succession stage of the forest, disturbance levels, species composition, etc. Several attempts have been made to estimate biomass involving all the parameters such as DBH, tree height and wood density or specific gravity with different regression equations. It was found that there is a strong relation of biomass with these parameters.*

*E. camaldulensis grows under a wide range of climatic conditions, from warm to hot and sub-humid to semi-arid. In Australia, for the northern variety, the mean maximum temperature for the hottest month is in the range 28-40°C; the mean minimum for the coldest month is in the range 6-22°C; and the absolute minimum temperature has been reported as being in the range -3 to 6°C. For the southern variety, the mean maximum temperature of the hottest month is in the range 21-41°C; the mean minimum temperature for the coldest month is in the range 0-14°C; and the absolute minimum temperature has been reported as being in the range -5 to -7°C. Up to 40 frosts a year may be experienced in southern and inland areas which experience the lowest absolute minimum temperatures. The mean annual rainfall in the natural range of E. camaldulensis is mostly 250-600 mm, although a few areas receive up to 1250 mm, exceptionally up to 2500 mm, and some as little as 150 mm. In low rainfall areas E. camaldulensis relies on seasonal flooding and/or the presence of a high water table, such that minimum rainfall figures do not give a reliable indication of the tolerance of the species to drought. Depth and texture of the soil are also important factors in determining minimum rainfall for successful growth. Rainfall distribution varies from a winter maximum in southern areas to a monsoonal type in northern Australia, falling mostly between November and March. Rainfall variability is very high in inland regions with frequent long, dry spells.*

*In line with the above this issue of Van Sangyan contains an article on An inventory to estimate the volume, diameter and height of Eucalyptus camaldulensis plantation. There are other useful articles viz. Vegetation: A sink for atmospheric pollutants, Genetic tools for timber forensics, Trees – The most precious gift of nature, वनोत्पत्ति: एक असहाय प्राणी विलुप्ति की राह पर (in Hindi), Documentation of lichens diversity, Diversity of Macro-fungi in central India-XI: Trametes lactinea on Terminalia arjuna, a new host record and Biodiversity of Quercus oblongata and Columba leuconota.*

*I hope that readers would find maximum information in this issue relevant and valuable to the sustainable management of forests. Van Sangyan welcomes articles, views and queries on various such issues in the field of forest science.*

*Looking forward to meet you all through forthcoming issues.*

**Dr. R. K. Verma**  
Scientist 'G' & Chief Editor

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## An inventory to estimate the volume, diameter and height of *Eucalyptus camaldulensis* plantation

Moses Fayiah<sup>1</sup> and Edward Sama<sup>2</sup>

<sup>1</sup>School of Environmental Sciences

Beijing Normal University, Beijing, P.R.C, China

<sup>2</sup>School of Natural Resources Management

Njala University, Njala Campus, Sierra Leone

### Abstracts

In Sierra Leone, factual inventory data and estimate of plantation forest are still lacking or, if available not complete, reliable, or up to date. An inventory was done on Njala Campus to determine the productivity of a young stand (9 Years) of *Eucalyptus camaldulensis* through height and volume estimation. The total area of the stand was 0.45ha and has a spacing of 3m x3m. A total six plots of 6m radius were laid within the given site with a 4m distance from each plot.

All trees (59) in the plots above 7cm were considered for enumeration and those below 7cm were left out. The Diameter at breast height (Dbh) for all trees in the plots was taken at 1.3m using metal caliper and diameter tape. The height was also measured with the help Suunto clinometer (recent version).

The total volume estimated from the stand was 108.3m<sup>3</sup>/ha, while the total basal area calculated was 11.83m<sup>2</sup>/ha. The linear regression function for height and Dbh for the stand was  $1.082 \text{ Dbh} + 1.098$  with R<sup>2</sup> of 0.915. The average Diameter at breast height of trees per plots was 9.3cm while the average height of trees was 14.8m<sup>2</sup>. The Dbh, volume and height results suggested that the species was growing well on Njala Campus but need to be protected from seasonal wildfire outbreak.

**Key Words:** Volume, Height, Diameter, Plantation and Estimation

### Introduction

Forest plantations covered 187 million hectares in 2000, of which Asia accounted for 62 percentages. The global volume of growing stock was estimated at 386 billion cubic metres in 2000. The regions with the largest volume were Europe (including the Russian Federation) with 30 percent (116 billion cubic metres) and South America with 29% (111 billion cubic m) (FRA, 2000). Forest plantations also provide additional non-wood forest products, from the trees planted or from other elements of the ecosystem that they help to create. They contribute environmental, social and economic benefits. Forest plantations are used in combating desertification, absorbing carbon to offset carbon emissions, protecting soil and water, rehabilitating lands exhausted from other land uses, providing rural employment and, if planned effectively, diversifying the rural landscape and maintaining biodiversity (FAO, 2000a; 2000b; 2000c). Wood fuels from plantations or natural or semi-natural forests are particularly important in developing countries, providing about 15 per cent of their total energy demand (WEC, 1999). Forest plantations also provide additional non-wood forest products, from the trees planted or from other elements of the

ecosystem that they help to create. In Ethiopia, the equivalent of over 200,000 ha of *E. globulus* and *E. camaldulensis* has been planted on farms. Between 1981 and 1988, farmers in India planted roughly 8,550 million trees on private lands, more than 80 percent of them *Eucalyptus tereticornis*, equivalent to about 2.5 million ha of plantations at the average spacings used (Saxena 1991).

#### ***Eucalyptus camaldulensis* species and its uses**

*Eucalyptus camaldulensis* Dehnh. (river red gum) is a tree native from Australia which has been widely planted around the world. It belongs to a genus, in the Myrtaceae family, with about 800 species, all of them restricted to Australasia. Eucalypts are evergreen, fast-growing, deep-rooting trees, tolerant of poor soil conditions, drought and moderate salinity (Navarro *et al.*, 2016). *Eucalyptus camaldulensis* wood is suitable for many applications, such as railway sleepers, poles, post, floorings, wharves, ship building, and heavy construction because the density of wood is 900-980kg/m<sup>3</sup> at 12%. The main uses of Eucalyptus plantations in the country is to provide raw material for pulp production, which accounts for approximately 80 % of the total harvest, while timber, saw logs, poles, and other end products make up the remaining purposes (Godsmark, 2009). These plantations further provide pulp, paper, timber, fuel wood, essential oil, medicine, bioenergy and nectar for honeybees, and mitigate human pressures on native forests. They are the most widely planted hardwood forest trees in the world, covering more than 15 million ha in 100 countries (Davidson, 1993; Myburg *et al.*, 2014). Spacing between and within rows

of the stands were approximately 3 and 2.4m, respectively. Such spacing is recommended in intensive silvicultural plantations of *Eucalyptus grandis* (Pallett and Sale, 2004). Other research conducted by (Kargbo, 2009; Adams, 2012; Mygatt, 2006 and FAO, 2010) further throws light on natural and plantation forests.

#### **Estimating volume**

Estimating individual tree volume is one of several necessary components for forest growth and yield modeling. The eucalyptus genus has been one of the forest resources most used industrially around the world (Özçelik, and Göçeri, 2015). Assessment of volume and height of trees especially *Eucalyptus camaldulensis* species is very critical for assessing productivity in forestry. The volume of wood contained in the stem of a tree is mostly affected by the local climate and the silvicultural practices applied. Volume could be measured directly or on felled trees or logs but is often estimated from dimensions such as minimum piece of length (Brack, 2008). Tree volume is one of many parameters that are measured to document the size of individual trees and it also serve a variety of purposes, some economic, some scientific, and some for sporting competitions. Volume typically can be calculated for each tree, followed by aggregation to a plot or stand level, given the availability of necessary information at individual tree level. Measurement may include just the volume of the trunk, or the volume of the trunk and branches depending on the detail needed and the sophistication of the measurement methodology. The tendency of direct relationship between volume and it's under estimation can also be explained by the underestimation of volume

estimation to an extent of affecting the significance level (Tesfamichael, 2010).

### **Tree height and DBH**

Tree height and DBH are the most common independent variables needed for the estimation of tree volume (Avery and Burkhart, 2001). Basal area and subsequent DBH are derived from dominant (maximum) heights (Tesfamichael, *et al*, 2010). The diameter of a tree is a measure of tree performance and is a very useful parameter for estimating tree volume. Conventionally, the diameter of trees is measured at 1.3 cm above the standing ground of a straight tree and that point is referred to as Diameter at Breast Height (Dbh). This measurement can be done both under bark and over bark. However, the over bark is the most used method for estimating Diameter at Breast height. Tree basal area is the area of a given section of land that is occupied by the cross section of tree trunks or a stem at the base (Whitemore, 1983).

### **Inventory and stock assessment**

Inventory helps to determine the height, volume and basal area in a natural and artificial forest plantation, and also help determine the growth rate of species. Forest structural assessment is an important component in timber resources management (von Gadow and Bredenkamp, 1992). In addition, it has increasingly become pressing to monitor forest resources with the aim of tackling problems related to ecosystem dynamics (Brown, 2002). In forestry, stocking is the quantitative measure of the area occupied by trees, usually measured in terms spaced trees or basal area per hectare. (Leigh et al. 1985), states that in younger forest, a hectare plot contain roughly 110 species respectively, the stem over 2.5cm DBH. A

stand may be under stocked (too few trees), fully stocked (just the right amount of trees), or over stocked (too many trees) for good tree growth.

Plantation forest growth information and record in Sierra Leone is very scanty and in most cases not available. This gap has made plantation establishment less attractive by the government and other private sectors. This research therefore seeks to close this gap by estimating the Volume, Height and Diameter of the nine year *Eucalyptus camaldulensis* plantation. This information will be vital to the government as well as the private individuals who feel establishing exotic species plantation in Sierra Leone is a waste of time and such species doesn't even grow in Sierra Leone.

### **Methodology**

#### **Description of study area**

This study was carried out at on Njala Campus, Moyamba District, Southern Sierra Leone. Njala is located approximately 150km from the capital city, Freetown. Sierra Leone has a tropical humid climate with two distinct seasons, namely the wet season starting from May-October and the dry season from November to April, each lasting for about six months. Diurnal temperatures vary from 25 degree to 34 degree Celsius although they could be as low as 16 degree Celsius at night during the harmattan. The average monthly temperatures are around 26 degree Celsius (Blinker, 2006).

Njala University, Njala Campus is located within Kori Chiefdom in Moyamba District, Southern Sierra Leone (Statistics Sierra Leone 2004). The topography of the chiefdom is a vast flat land climaxed by grass land and sparse vegetation (Kamara, 2013). The soil ranges from clay to loamy



at Njala, majority of the people in the chiefdom depends on this type of soil for their farming activities (Jusu, 1990). Njala campus is the main Hub of Njala University with the campus hosting 5 schools out of the eight schools in the University.

**Study design and sampling method**

Six circular plots of radius 6m were laid at the site. Plots were randomly demarcated within the 1ha plantation using a measuring tape. The spacing in the stand was 3m×3m and distance of 4m apart from each plot was left as buffer zone. All trees with diameter at breast height greater than ≥ 7cm were enumerated with a metal caliper to measure the (DBH). Suunto Clinometer (recent/standard version) was used to determine the height of each tree in the sample plots. A spread sheet was used to record all information’s obtained in the field.

**Data collection method**

**Basal area**

The basal area for every tree was calculated using the formula; (Hamilton 1983)

$$= \frac{(D)^2}{(40,000)}$$

Where; D = Diameter at breast height (cm)

g= Tree basal area (m<sup>2</sup>)

**Volume per ha**

The volume of trees (m<sup>3</sup>) per/ha were estimated as per (Philip, 1983, Hamilton 1983) fomular.

$$V = \frac{TBA \times Ht}{3}$$

Tree volume (m<sup>3</sup>) TBA = Tree Basal Area (m<sup>2</sup>) x Tree Height (m) / 3

**Results**

The calculated wood volume for the *Eucalyptus camadulensis* was 108.3 m<sup>3</sup>/ha. Six circular plots were demarcated within the Eucalyptus camaldulensis plantation at a 3mx 3m spacing. Plot 5 recorded the highest Dbh (18.5cm), followed by plot 6 and 4 (18.3, 18.0) respectively. The plot with the highest height was 6 (20.9) followed by plot 4 (20.6) and plot 5 (20.4). The lowest Dbh reading was recorded in plots 6, 1 and 2 (7.2, 7.6 and 7.7m) respectively Table 1. Alternately, plot 6 recorded the highest height followed by plot 4 and 5 (20.9m, 20.6m and 20.4m). The total number of trees enumerated in the plantation was 59 with an average of 9 trees per plot. The average basal area for the six plots was (11.83cm<sup>2</sup>) while the total volume of the 59 trees enumerated was (108.34m<sup>3</sup>) as seen in table 1.

**Table 2: Tree production parameters per plot**

No. of plots	Individual trees	Basal area (cm <sup>2</sup> /ha	Volume (m <sup>3</sup> /ha
1	10	9.954722222	82.95517538
2	7	6.620416667	55.0282551
3	11	13.33701389	117.9112607
4	8	10.18506944	96.34423801
5	10	14.25402778	140.8483105
6	13	16.63097222	156.9662009
Average	<b>9.833333</b>	<b>11.83037037</b>	<b>108.3422401</b>

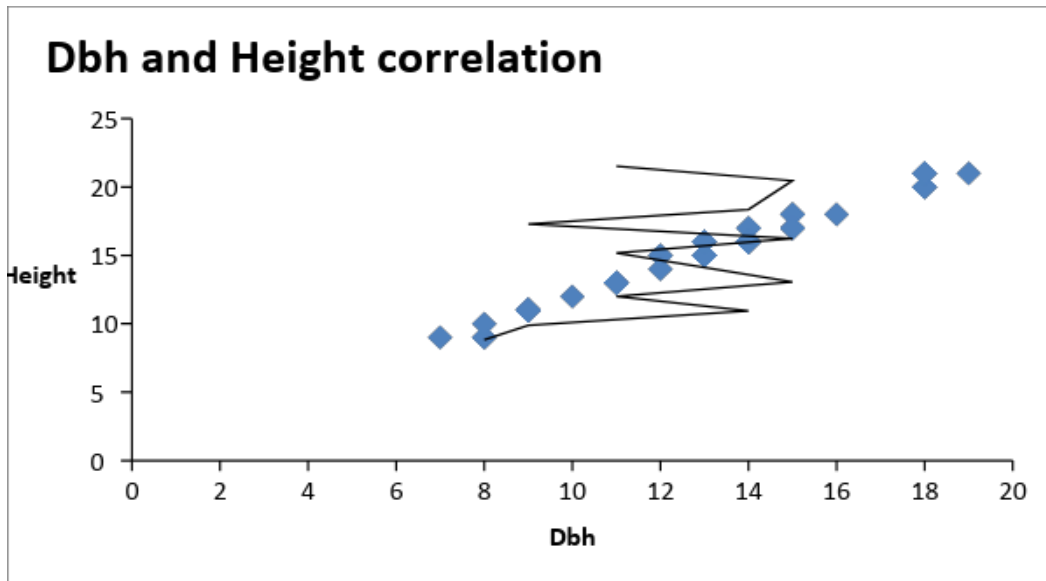


Fig. 1: Tree height versus Dbh correlation

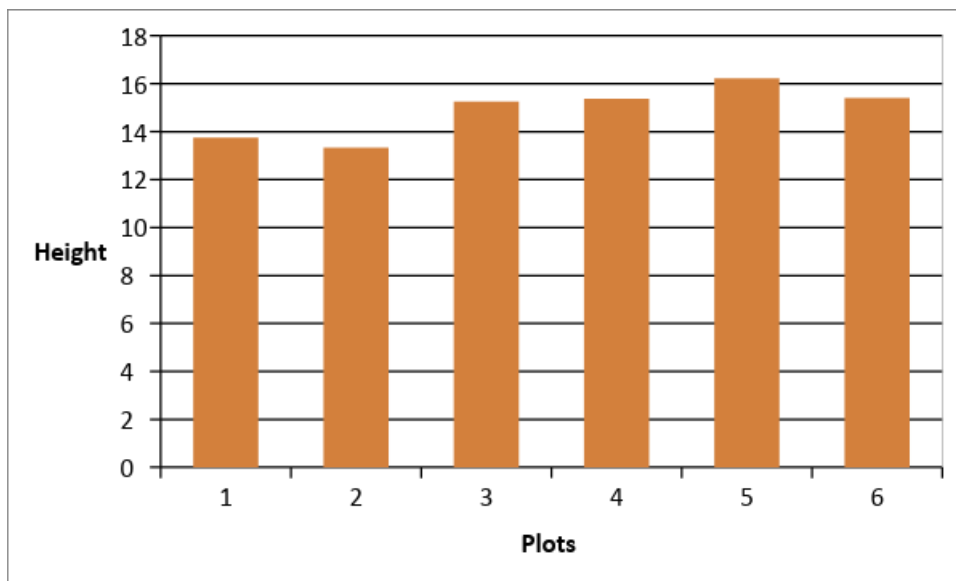


Fig. 2: Average height per plots

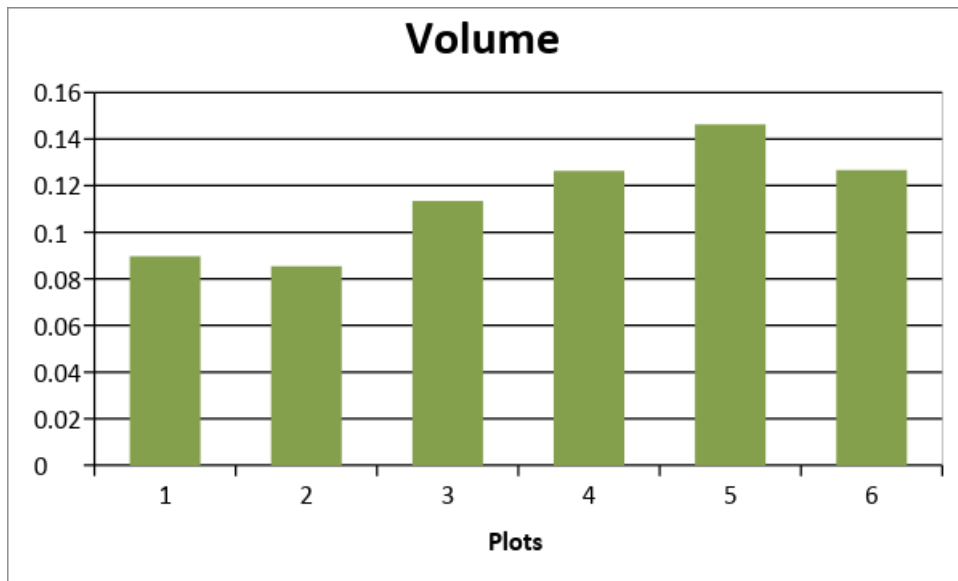


Fig. 3: Average volume per plots

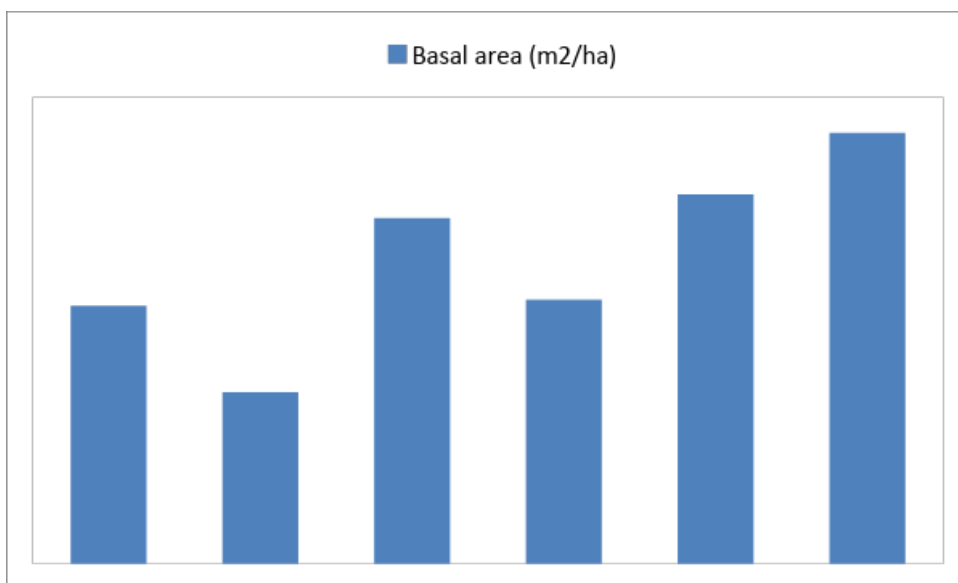
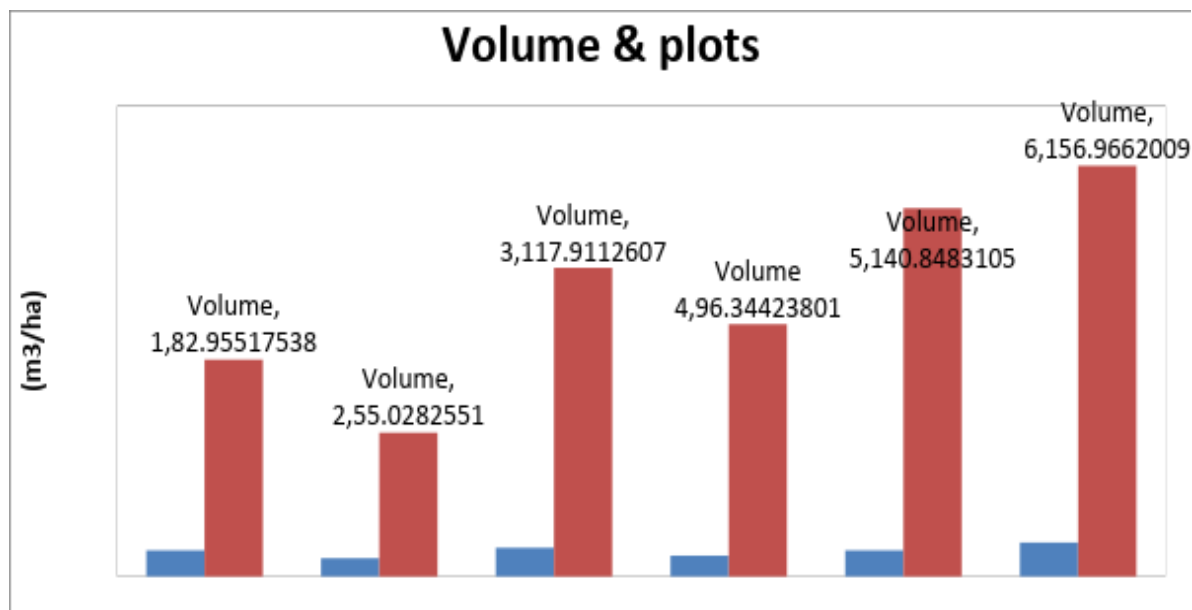


Fig. 4: Trees basal area per plot

**Wood volume per plot of the plantation**



**Fig. 4:** Number of trees and their wood volume

### Discussion

Eucalypts can provide many benefits very quickly, ranging from industrial wood and fibre, poles and posts, through fuelwood and timber for household use, to nectar, oils, tannins and many other products (Davidson, 1993). Tree height is very important parameters in calculating wood volume in plantations and natural forest as it is not affected by any silvicultural operations such as thinning, pruning and many more. The number of trees per plot greatly influences the stand volume of that plot as seen in table 1. The average wood volume of the *Eucalyptus camaldulensis* calculated on Njala campus was 108.3 m<sup>3</sup>/ha. This calculated average volume was far less compared to the wood volume of 191.03m<sup>3</sup>/ha calculated at Kasewe plantation in 2011 by (Fayiah, 2011). However, the sample size, area and trees enumerated in Kasewe plantation were far greater than that of Njala Campus *eucalyptus camaldulensis* plantation. Another reason for the low tree volume recorded in the plantation was due to the age, Dbh size and height of the *Eucalyptus*

*camaldulensis* trees. Be that as it may, the volume of the Eucalyptus recorded was very encouraging for a young plantation of about 9 years. FRA, (2000) Opine that the potential for forest plantations to partially meet demand from natural forests for wood and fibre for industrial uses is increasing. It is believed that if proper silvicultural maintenance would have been adopted the volume reading would be greater.

The average basal area calculated for the trial plots was 11.83m<sup>2</sup>/ha. One possible reason for this basal area value is the age, Dbh size and branching habit of the species. None the less, the basal area reading was not bad for a plantation that often experience wildfire during the dry season. The linear regression function estimated for height and Dbh of the *Eucalyptus camaldulensis* trees was 1.0568Dbh+1.4132 with R<sup>2</sup> of 0.9821 which is statistically good because the higher the R<sup>2</sup> the better the relationship. It shows that the height and Dbh has strong relationship and they are interdependent. Fayiah, (2011) recorded an R<sup>2</sup> of 0.920



from a *Tectona grandis* plantation in Kasewe forest reserve Sierra Leone. The average volume of trees per plots was 9.3m<sup>3</sup>. The spacing (3m× 3m) and size of the plots is one big factor for the number of trees found in each plot. Plots six had the highest number trees per plots as well as volume. Other plots however, recorded fewer trees due to animal grazing, wildfire, and the absence of constant beat up practices by the department of Forestry. Besides beautification, the plantation is expected among other uses to serve as timber and raw material for industries in the near future. Another quality of this plantation is the soil nutrient enrichment through litter falls. Tree cover has value in sustaining and improving beneficial physical and chemical properties of the soil. The improvement of soil conditions under all tree species is due to the presence of a litter layer (Davidson, 1993). A substantial proportion of the nutrients in a tree crop is held in the foliage which is returned periodically to the soil (Davidson 1985). In developing countries about one-third of the total plantation estate grown is primarily for wood fuel with only Uruguay being an interesting exception (FAO 2001). Another quality of Eucalyptus plantation is the ability to provide a good relaxation facility with fresh air from all angles. Davidson, (1993) Opine that shaded areas average air temperatures are lower, extremes of air and surface soil temperatures are reduced and there is a higher surface air humidity compared to areas with no trees

### Conclusion

Though this plantation is situated within the campus and experiences lots of disturbance, yet still it has shown resilience and proven to cope well as

compare to other exotic species. If plantation development is targeted at the most appropriate ecological zones and if sustainable forest management principles are applied, forest plantations can provide a critical substitute for natural forest raw material supply (FRA 2000). Forest plantations may help reduce logging pressure on natural forests in areas in which unsustainable harvesting of wood is a major cause of forest degradation and where logging roads facilitate access that may lead to deforestation. It was concluded that the *Eucalyptus camaldulensis* trial plantation on Njala campus has good growth potentials and has proven that the species can grow well in the area. The average volume of the plantation was low but the relationship between Dbh and height was very strong. However, there is need to do a thorough soil analysis, volume and height estimation on a yearly basis for further understanding.

### Recommendations

- Proper Silvicultural practices and maintenance should be carried out for quality production of *Eucalyptus camaldulensis* species
- Fire belt are recommended to be constructed around the plantation site because the site is prone to fire every dry season.
- Since the *Eucalyptus camaldulensis* species is a valuable species and it has proven to be doing well on Njala soil, it is recommended that more of the specie be established.

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## Vegetation: A sink for atmospheric pollutants

Ajeet J. Williams

B.T.C. College of Agriculture & Research Station, IGKV,  
Sarkanda, Bilaspur (Chhattisgarh) 495 001  
Email: ajeetwilliams@gmail.com

With the continuous growth in technology and unmindful industrial activities we are today experiencing various environmental hazards. Owing to all round continuous deterioration in environment the human beings are today reeling in distress because of his own indiscriminate act. Besides air, water and soil pollution the cultural, spiritual and social environments are also gravely polluted. The people are also extremely distressed due to pollution in cultural, social and political environments. Economical backwardness and poverty are worst of all pollutions.

### **Reliable support of plants and trees for life on earth**

It is a great blessing that greenery and vegetation have befitting answer to control the hazards of environmental pollution. Plants and trees not only absorb environmental pollutants but, also release life saving oxygen. They provide us economical prosperity, mental peace and satisfaction and happiness and help in awakening of spiritual thoughts. Soil and water conservation is also possible due to flora world.

Plant and trees play an important role on earth. They are the source of various advantages to the human beings. They also play a crucial role in reducing the carbon dioxide from the atmosphere. In this context forest eco-system is of immense value. They absorb the poisonous gases and act as a carbon sink. Plants and trees on the one hand by Photosynthesis process provide us oxygen and on the other

convert the carbons into wood which are of multifarious utility. They also reduce the injurious effects of gases like Sulphur dioxide, Oxides of Nitrogen (Nitrogen dioxide, Nitric oxide), Fluorine, Chlorine etc., by releasing oxygen in the atmosphere.

Plants and trees also protect and bind the soil from silting and erosion from winds, floods and heavy rain, with their root conservation system. They also provide us with various kinds of food, fruits, medicinal herbs, various items of day to day use, construction materials, bread, cloth, housing and many articles of basic needs. The prime factors of pollution are importantly disproportion between source of pollutants and the area occupied by plants and trees.

### **Development without destruction**

Scientifically it is proved that environmental balance fully depends on ecological factors. The correct proportion of forest area should be at least 50% of the rest of the area. The proportion in the mountainous area should be at least twice. Unfortunately, in our country the dense forest area is 1/10<sup>th</sup> of the population area. In Madhya Pradesh it is only 1/5<sup>th</sup>.

So, the position revealed this quite tragic and disastrous. Consequently, the quantity of oxygen in the atmosphere is gradually reducing and the carbon dioxide and other harmful gases are increasing in quantity. The hole in the Ozone layer and serious damage to 'Green House' is a matter of great concern. It is true that the human



race cannot survive without the all-round technological and industrial developments, it is therefore essential to adopt development without the environment distribution. To achieve this, it is utmost to plant trees on a massive scale and dense forests to be developed keeping in view the climate of the particular area, soil, natural and geographical conditions. It is also necessary to rear fauna, which is a must for our prosperity and survival. All the necessary strategies to fight effectively against environmental pollution is to be adopted.

#### **Hazards of noise, smoke and dust pollution**

Noise, smoke and dust are the worst type of pollutants and hazards which effect the environment to a great extent. The problems are generated by heavy industries and factories, which emit smokes and harmful gases, polluted effluents and deafening noise. These pollutants are destroying the human sensitivity and making the life miserable and ugly. To counter this hazard it is important to plant large numbers of such species of plants and trees which have the capacity to absorb the poisonous effects of these gases effectively.

#### **Noise abatement**

Plants attenuate sound is now well established. Plants with fleshy and thick leaves such as *Acacia auriculiformis* (Australian Babool), *Aegle marmelos* (Bel), *Agave sisalana* (Sisal), *Aloe vera* (Gheekumari), *Careya arborea* (Khumbi), *Citrus* sp., *Diospyros melanoxylon* (Tendu), *Euphorbia neriifolia* (Sehund), *E. royaleana* (Sullu spurge), *Ficus bengalensis* (Bargad), *F. elastica* (Rubber tree), *F. lacor* (Pakar), *Ixora javanica* (Jungle flame), *Madhuca indica* (Mahua),

*Murraya exotica* (Kamini), *Musa paradisiaca* (Banana), *Nerium oleander* (Kaner), *Pandanus amaryllifolius* (Pandanus), *Plumeria* sp. (Lei flower), *Pongamia pinnata* (Karanj), *Salvadora persica* (Meswak), *Syzygium cumini* (Jamun), *Terminalia bellirica* (Bahera), *Yucca* sp., etc. reduce sound transmission. These are useful in combating the adverse effects of noise and dust pollution. Trees having thick and cushion type leaves are more appropriate.

#### **Neutralizers of smoke and dust**

Industrial atmosphere to make the dust ineffective trees belonging to small and tiny leaves species are more useful and effective. Specially *Azadirachta indica* (Neem), *Butea monosperma* (Palash), *Cassia fistula* (Amaltas), *Ficus religiosa* (Peepal), *Mangifera indica* (Mango), *Pithecellobium dulce* (Jungle jalebi), *Terminalia arjuna* (Arjun) and *Tamarindus indica* (Imli) are extremely useful to neutralize the harmful effects of smoke and filters the dust particles.

#### **Trees act as absorbers of poisonous gases**

Gases which dilute effectively and quickly in water are absorbed equally quickly and speedily by the trees. Trees having damp and wet leaves are 10 times more efficient in absorbing the pollutants of poisonous gases. Soil of dense forest area is competent enough to absorb carbon monoxide.

It is scientifically established during Bhopal gas tragedy that killing effect of MIC gas had no effect on trees like *Callistemon* (Bottlebrush), *Cassia siamea* (Kassod), *Ficus bengalensis* (Bargad), *Ficus religiosa* (Peepal), *Mangifera indica* (Mango), *Saraca asoca* (Ashok), *Syzygium cumini* (Jamun) and its kind.

### Useful species of tree in the vicinity of factories and heavy plants

*Acacia nilotica* (Desi Babool), *Aegle marmelos* (Bel), *Albizia lebbeck* (Kala Siris), *Albizia procera* (Safed Siris), *Artocarpus heterophyllus* (Kathal), *Azadirachta indica* (Neem), *Bauhinia variegata* (Kachnar), *Cassia fistula* (Amaltas), *Cordia dichotoma* (Lasoda), *Embllica officinalis* (Aonla), *Ficus bengalensis* (Bargad), *Ficus religiosa* (Peepal), *Grevellia robusta* (Silver Oak), *Mangifera indica* (Mango), *Pongamia pinnata* (Karanj), *Saraca asoca* (Ashok), *Syzygium cumini* (Jamun), *Tamarindus indica* (Imli), *Terminalia arjuna* (Arjun) are very useful for plantation near and around refineries.

Near tanneries and like factories releasing contaminated effluents trees like *Acacia nilotica* (Desi Babool), *Azadirachta indica* (Neem), *Ficus religiosa* (Peepal), *Pongamia pinnata* (Karanj), *Terminalia arjuna* (Arjun) have been found extremely helpful.

Trees like *Aegle marmelos* (Bel), *Ailanthus excelsa* (Maharuk), *Albizia procera* (Safed Siris), *Alstonia scholaris* (Chatian), *Anthocephalus cadamba* (Kadamb), *Artocarpus heterophyllus* (Kathal), *Azadirachta indica* (Neem), *Bougainvillea glabra* (Paper flower), *Butea monosperma* (Palash), *Bombax ceiba* (Semal), *Calotropis gigantea* (Madar), *Cassia fistula* (Amaltas), *Cassia siamea* (Kassod), *Casuarina equisetifolia* (Jhau), *Dalbergia latifolia* (Shisham), *Dalbergia sissoo* (Sissu), *Diospyros melanoxylon* (Tendu), *Eucalyptus globulus* (Safeda), *Ficus bengalensis* (Bargad), *Ficus religiosa* (Peepal), *Ficus virens* (Pakar), *Grevellia robusta* (Silver Oak), *Ipomoea carnea* (Behaya), *Nerium*

*indicum* (Kaner), *Pongamia pinnata* (Karanj), *Psidium guajava* (Guava), *Samanea saman* (Raintree), *Syzygium cumini* (Jamun), *Tamarindus indica* (Imli), *Terminalia arjuna* (Arjun), *Terminalia tomentosa* (Saja), *Ziziphus mauritiana* (Ber) were found very effective in combating pollution created by Thermal Power Station and these are to be planted in the vicinity of these plants.

### Value of trees

According to Prof. Tarak Mohandas, of Calcutta University, the value of 50 year old tree in terms of pollution control service to mankind as a cleaner of air from pollution is assumed as Rs. 5 lakhs and Rs. 2.5 lakhs for producing 50,000 kg of Oxygen.

### Controlling temperature

A tree on an average transpires 4500 litres of water per day, which is equivalent to five room air conditioners. The plants also intercept solar radiation and thus the areas below a tree may be cooler by 14° C on a still summer day than the surrounding open areas. In the night, the temperature is higher by 5 to 8° C because tree canopy allows the loss of heat from the surface. Deciduous trees are of more utility in India, for they intercept solar radiation and bring about coolness in summer, while they allow welcome sunrays to warm up during the winter by their leaf-fall.

### Decorative plants and cripers a beauty of nature

Owing to expansion of national highways and cities the need for shadow and beautification of townships and road sides are being increasingly felt. These can be achieved only by plantation of shadowed and flowering trees and cripers.

### Glare control

A myriad of shining surfaces like steel, glass, concrete and even water all capable of reflecting light surrounding us. Glare along highways sometimes causes accidents especially in the morning and late afternoon. Plants can be used to screen or soften the glare. Accidents on highways can be checked by planting of avenue on either side of the highway and the median strip. Similarly, the plants can be kept in terraces, windows or even along streets so as to protect driver's vision.

### **Frigorific**

In the treeless desert climate due to shortage of oxygen the human nature and behavior gets irritated. It is also an established fact that on tree full of shadow is equal to 5 air conditioners in providing coolness and soothing effects.

### **Harmful effect of mining**

The importance of mines, in the context of modern day development is quite well known to everybody. For obtaining coal, iron ore, aluminium, lime, rock-phosphate, dolomite, copper, magazine ore, gold etc. every year thousands of hectares of land are dug and made barren and deserted. Disastrous consequence to the environment of this act is well known to all and sundry. If these areas are left as it is and uncared for in course of time they will pose lot of problems, like leprosy disease inflicts to its sufferer.

Efforts and various experiments are being carried out to cover the barren lands with the spread of greeneries and plantation of trees in a massive scale. Only by these efforts the salvation of these lands can be effectively achieved. Initially, they cannot be brought to the original levels as they were before the mining operations.

To counter these challenge planting of *Acacia nilotica* (Desi Babool), *Acacia*

*auriculiformis* (Australian Babool), *Aegle marmelos* (Bel), *Ailanthus excelsa* (Maharuk), *Albizia lebbek* (Kala Siris), *Albizia procera* (Safed Siris), *Anthocephalus cadamba* (Kadamb), *Azadirachta indica* (Neem), *Cassia fistula* (Amaltas), *Cassia siamea* (Kassod), *Casuarina equisetifolia* (Jhau), *Dalbergia latifolia* (Shisham), *Dalbergia sissoo* (Sissu), *Delonix regia* (Gulmohar), *Dendrocalamus strictus* (Male Bamboo), *Emblica officinalis* (Aonla), *Eucalyptus camaldulensis* (Red Gum), *Eucalyptus citriodora* (Lemon Scented Gum), *Eucalyptus globulus* (Blue Gum), *Gmelina arborea* (Khamar), *Grevillia robusta* (Silver Oak), *Nyctanthes arbor-tristis* (Harsingar), *Parkinsonia aculeate* (Parkinsonia), *Peltophorum ferrugineum* (Peltophorum), *Pithecellobium dulce* (Jungle jalebi), *Pongamia pinnata* (Karanj), *Prosopis juliflora* (Vilayati Kikar), *Samanea saman* (Raintree), *Tamarindus indica* (Imli), etc. has proved extremely successful. Similarly, experiments of planting of trees at coal mines, iron-ore and dolomite mines have also been carried out.

In the mine areas top layer of fertile land is removed and due to digging operation infertile soil erupts on top as a result percentage of moisture and equilibrium of minerals are disturbed. Basically, in such areas, plantations of 'pioneer' species are ideal and more effective.

### **Forestry culture and tree plantation**

Since ancient times trees play a vital role in providing pleasure and joy and filling the human heart with enthusiasm. A single tree is enough to break the dry and gloomy atmosphere of a desert and appear so lively that the living creatures on earth have a sign of relief from heat and fatigue.

Building of places of entertainment, zoo, gardens, parks etc. having greenish out look in the township give a lot of pleasure and peace to the human mind. Decent, decorative, evergreen trees, with beautiful flowers are soothing to the eyes and mind both. The ugliness of environment degradation and monotony of loneliness of mind can be banished. For the purpose of plantation in townships and colonies trees like *Anthocephalus cadamba* (Kadamb), *Bauhinia variegata* (Kachnar), *Callistemon* (Bottlebrush), *Cassia fistula* (Amaltas), *Cassia javanica* (Java cassia), *Cassia siamea* (Kassod), *Delonix regia* (Gulmohar), *Grevillia robusta* (Silver Oak), *Jacaranda mimosifolia* (Jacaranda), *Lagerstroemia speciosa* (Jarul or Pride of India), *Lagerstroemia indica* (Sawani), *Melia azedarach* (Baken), *Murray exotica* (Madhu Kamini), *Peltophorum ferrugineum* (Peltophorum), *Pterospermum acerifolium* (Kanak Champa), *Putranjiva roxburghii* (Child life tree), *Samanea saman* (Raintree), *Saraca asoca* (Ashok), *Liriodendron tulipifera* (Tulip) etc. are most ideal.

### **Effective control of pollution**

Meaning of tree plantation does not merely signify the plantation of a few big trees. In fact massive scale afforestation is required. Plantation of cripplers, bushes and other plants are also to be given equal importance, as they are equally useful or saving the environment from degradation. As for the financial and economic prosperity is concerned several plants having medicinal and oily contents and fragrance are of great value and importance. They are quite capable of checking the erosion of soil. The manner in which Cheed and Neelgiri trees keep the atmosphere healthy and clean in the

similar way several shrubs with their medicinal value leave lasting impression and effects.

To control the environment pollution massive plantation of trees have its own importance and value. For this awakening in the common man is very important because today it is a social and scientific necessity on earth. There is no alternative to this 'do and die situation'.

It would thus be seen that the plants by holding up mountains, regulating springs, controlling floods, decreasing silt lead in dams, checking famines, reducing severity of storms, preserving soil fertility, provide bio fertilizers, fostering agriculture, supplying raw material to industries, protecting wild life, catering to cattle needs, yielding edible forest products perform service no less valuable and more expressible by the Defense Services of nation. Plants are really our air conditioners, pollution managers, colony decorators, landscape designers, economy boosters and above all pleasing and dynamic object to beautify our surroundings. It is amazing as to how many ways tree are saving mankind. It is high time that man should save trees. The older belief that man is supreme and nature exists for his convenience is no longer valid. The superiority of man is an illusion. Let us cherish the whole life we belong to save the world from eco-disaster.



## Genetic tools for timber forensics

Tresa Hamalton

Tree Improvement and Genetics Division,  
Institute of Wood Science and Technology,  
Bangalore-560003

Forensic timber identification tools are essential for identification and prosecution of illegal logging crimes in particular, apart from supporting the legal timber trade, and for prosecution of other crimes by associating a wood sample with the convict, victim or scene of crime. Various techniques are available for determining the taxonomic, geographic and individual source of timber material. They include *visual approaches* (morphological & anatomical characters, and dendrochronology), *chemical approaches* (mass spectrometry, near infrared spectroscopy, stable isotope ratio analysis, biochemical analysis and radiocarbon dating) and *genetic approaches* (karyotyping, DNA profiling etc.). When the wood sample is degraded and lacks physical features, visual approaches cannot be used. Also, in the case of contaminated samples, chemical approaches may lead to false interpretation. In such situations, genetic approaches can be relied upon, because neither degradation nor contamination can alter the genetic material of the sample under investigation.

The most common identification question that needs to be addressed during crime investigation is the taxonomic identity (family/genus/species) of the wood sample. Identification of the geographic origin (provenance) of a sample is required in the case of illegal trade of species which are trade-restricted from certain areas.

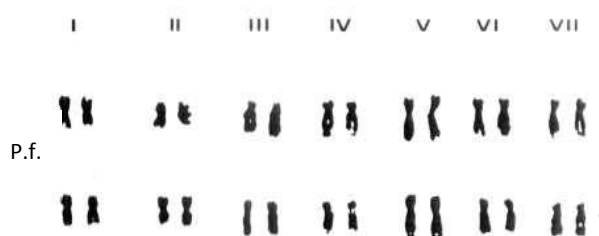
Individual identification is essential during verification process of the supply chain during regular/legal trade, or to identify theft. Genetic analyses can address all these questions by determining the taxonomic, geographic and individual sources of timber material. By taking advantage of a universal barcode system, DNA sequencing and other bio-molecular techniques, DNA markers can be designed and used for forensic timber identification. The various genetic approaches available for use in timber forensics include: karyotyping, phylogeography, DNA profiling and DNA barcoding. The use of karyotyping & phylogenetic analysis is explained now, and DNA profiling & barcoding will be described later.

### **Karyotyping**

A karyotype is the number, size and morphology of chromosomes in the nucleus of a plant cell, and it denotes the complete set of chromosomes in a species, or individual. Karyotyping is the analysis of metaphase chromosomes which have been banded using trypsin followed by Giemsa, Leishmanns, or a mixture of the two. This creates unique banding patterns on the chromosomes and these chromosomal banding patterns can be used for species identification. Chromosomes are morphologically characterised by their length, position of centromere and presence or absence of secondary constrictions.

Several chromosome-banding techniques are used in cytogenetics. The major banding techniques that have been used for plant chromosomes are C-, N-, Q-, F-, Hy-, G-, RE- and Ag-NOR-banding.

As a standard procedure, the root tips are treated with colchicine and fixed in slides, followed by a series of chemical treatments, and then stained. The banded karyotype is then analysed traditionally under the microscope, or recently using image analysis systems. Precise chromosome identification can be undertaken only in those species where differences in size and morphology of chromosomes could be resolved either at mitotic metaphase or at pachytene of meiosis. Karyotyping is not feasible when the individual chromosomes of the species do not differ significantly in size and morphology. This method is used extensively in the study of human genetic disorders caused by chromosomal abnormalities. It is not commonly used for



plants, as mitotic phase chromosomes are short and cannot be easily distinguished. However, karyotype analysis has played an important role in the identification and designation of chromosomes in many plant species. But the technique may not be particularly useful for timber samples, as it requires the presence of cells in the metaphase stage of cell division for accurate identification.

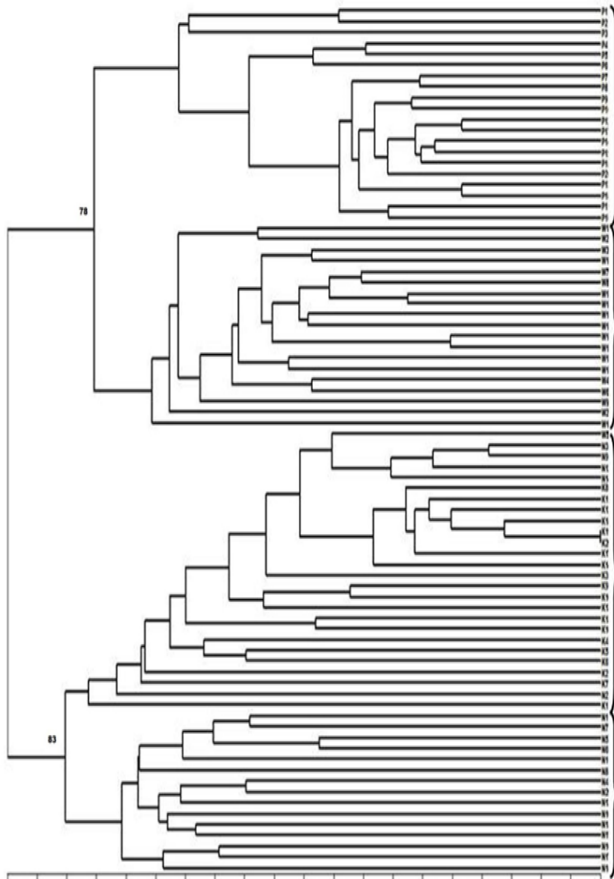
Karyotype of *Pisum sativum* and *P. fulvum* showing difference in the arm ratios of some chromosome pairs (Courtesy: Errico and Conicella, 1989).

### Phylogenetic analysis

Phylogenetics is the science of the evolutionary relationships among individuals, or groups of organisms such as species or populations. These relationships are discovered through methods that evaluate observed heritable traits, such as DNA or protein sequences under a model of evolution of these traits. The result of these analyses is a phylogeny or a phylogenetic tree, which is a diagrammatic hypothesis about the history of the evolutionary relationships of a group of organisms. Evolutionary relationships can be unraveled by identifying the most recent common ancestor shared by the species. A phylogenetic tree can be reconstructed by looking at the nucleotide sequences and combining this with the understanding of sequence evolution, which is described using an evolutionary model.

Phylogenetic tree of genetic relationships of 80 genotypes of teak, showing trees from the same seed production area clustered together (Courtesy: Sreekanth and Balasundaran, 2017).

The study of genetic differences within and between populations is a part of evolutionary biology. Statistical inference is drawn from DNA sequence data using population genetic models. The nucleotide diversity between DNA sequences of different individuals is a measure of the degree of polymorphism within a population. This statistic may be used to monitor diversity within or between



ecological populations, to examine the genetic variation between related species, or to determine evolutionary relationships. The nucleotide diversity is calculated by examining the DNA sequences directly, or may be estimated from molecular marker data, such as RAPD data and AFLP data. Phylogenetic analyses have become central to understanding biodiversity, evolution, ecology and genomes, and can be used for taxonomic identification as well. Though not particularly useful for individual identification, phylogenetic analysis can be used in forensics for identification of the population (provenance) from which the sample was taken. In other words, it throws light on the geographical origin of a sample and answers the question: 'where did the sample come from?'

### DNA Profiling

DNA profiling/fingerprinting is based on the principle that, wherever a PCR primer has sequence homology with the DNA sample in question, it will bind and a PCR product will be formed. As a result, PCR products of variable size are produced which form a unique DNA profile during gel electrophoresis. Thus, they are DNA fragment markers and samples are distinguished by their banding pattern. The different DNA profiling techniques used in forensics include: randomly amplified polymorphic DNA (RAPD), restriction fragment length polymorphism (RFLP), amplified fragment length polymorphism (AFLP), microsatellite markers (STR/SSR) and PCR-RFLP. These techniques can be used for discriminating individuals at the population or individual level, as well as differentiate between wild and cultivated trees. It is most commonly used to answer the question 'from which individual?'

### DNA Barcoding

DNA barcoding is based on the difference between DNA sequences of different species at specified locations in the genome. A short genetic marker or barcode in an organism's DNA is used to identify it as belonging to a particular species. In plants, regions in the chloroplast genome such as *trnH-psbA* intergenic spacer and, *rbcL* and *matK* gene sequences are used for species identification. To determine the geographical origin, these regions are analysed in combination with regions in the nuclear genome. Thus, DNA barcoding is a method for differentiating at species level or to determine the geographic origin of a sample, and answers the questions 'what species' and 'from where?'

## Conclusion

Various techniques are available for determining the taxonomic, geographic and individual source of timber material. Among them, genetic approaches are the most reliable as DNA information cannot be altered and remains the same throughout the sample. Also, minute quantities are sufficient for analysis, and even physically degraded or contaminated samples can be identified i.e., even saw dust or powdered wood samples can be identified using genetic tools. Thus, they are superior to other identification/screening methods available.

The different circumstances where genetic tools can be used for timber identification include: investigation of illegal felling of trees (timber theft / trafficking), authentication of wood and its products (timber certification and detecting adulterants), for regulating timber trade by keeping track of supply during legal timber trading, and for tracing substitution or mixing during supply chain verification from stump to shop. On the other hand, genetic tools cannot be used to answer questions such as: what was the time of/period after felling, age of the tree from which sample was taken and, which part of the tree was the sample taken from, as the genetic material will be same throughout the tree, irrespective of its age or time of felling. Though identification using genetic tools does not require complementing with other scientific tools, it can be used synergistically with other tools to answer questions that genetic approaches do not address.

Laws have been enacted to curb illegal logging crimes in many countries. However, their enforcement is limited by the lack of means to identify timber up to a level of certainty which is acceptable in a court of law. There are some prerequisites to the use of any method for wood identification. Generation of reference data and its statistical validation is the most important among them. This needs to be addressed before the results can be presented as valid evidence during an investigation in a court.

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## Trees – The most precious gift of nature

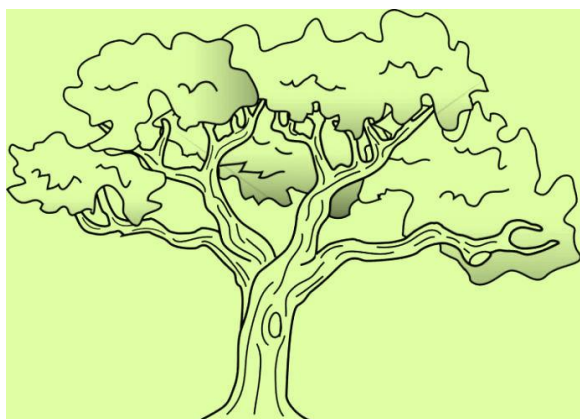
**Rajesh Kumar Mishra**

Computer and Information Technology Section

<sup>1</sup>Tropical Forest Research Institute

(Indian Council of Forestry Research and Education, Ministry of Environment, Forest and Climate Change)

Jabalpur -482 021, Madhya Pradesh



Trees are the most valuable and important means of life on earth. It's a lot of work for health and business communities on Earth. With all these direct and indirect methods, all these creatures benefit animals on earth. Everything on the earth is connected to each other and runs through the balance of nature, if there is any disturbance with it, the entire environment can be disrupted and can damage life on earth. The tree protects us from many natural disasters and in many ways it fosters our lives. It keeps our environment clean and green to the earth, therefore, we are also responsible for them and have to do our best to save them. Long and mature trees are more profitable than small trees because they absorb more carbon, greenhouse gases filter at very high rates, adopts storm water, provides big shade and opposes urban heat, energy Reduces the use of etc.

Since from Vedic times India is known for its rich nature resources, it was covered with thick forest where our civilization was born and acquired its distinct character. Our people instinctively used natural resources in a way that was favorable to the long term survival of man.

The people were free from desire to extend their domain and participated with other creations that gave purpose and joy to living. In constant contact with Nature's renewing growth, the Indian mind was free from the desire to extend its dominion by erecting boundary walls around its acquisitions. Absolute isolation from other living forms was not acceptable. It was not power over but participation with other creations that gave purpose and joy to living. A series of invasions altered the pattern of our existence. We adopted unnatural norms. Everything was subordinated to the specious ideal of making money, and yet more money. This approach filled heavy burden on Mother Nature.

Wild life was destroyed; forests uprooted, hill-sides stripped of their thick supply of trees. Warning signals in the form of frequent floods, shortage of timber and famine of forest products are being constantly given by Nature. Deprived of its natural purifiers, the trees, the atmosphere



around our cities is polluted and endangers the very life of man, but he cheerfully proceeds to accumulate more and more goods, and to multiply himself. The primitive man had a great relation with trees he worshiped trees. Recent chipko movement can illustrate the great affinity of man to trees when men and women wrapped themselves around trees rather than allow them to be destroyed. The trees are remarkable living things stabilizing environment. We cannot use such resources at a pace that does not allow Nature to rejuvenate itself.

When lord made this beautiful Earth he obviously had a very good plan of how each part of nature should fit together so it would work like a well-kept machine. Dodo was a large flightless bird which once lived on the island of Mauritius and Reunion in the Indian Ocean near the coast of Africa. Because of man it became extinct. 300 years ago, when ships anchored near these islands, the sailors would land, and while exploring would find the poor clumsy Dodos. Because they were large and couldn't escape, the sailors killed them for fun. After a very short time they ceased to exist anywhere in the world. This was senseless cruelty since even the flesh of the bird was not particularly pleasant to eat. But this bird had a purpose on earth which has been realized only recently. This was to help the seeds of a tree called the Calvaria Major to grow into plants and then full-grown trees. The Dodo ate the seeds. While passing through its digestive system the hard outer covering of the seed was dissolved. When at last it was passed out of the bird's body it was ready to grow. Since the disappearance of the Dodo so

many hundred years ago, no more Calvaria trees have grown. The trees that remain are very old and are now dying. Scientists have been working hard to find another bird to do the job that the Dodo once did. It is now thought that the turkey is a possible substitute, as it has the same kind of digestive system. Let us hope that although the Dodo cannot be restored to earth, at least the Calvaria tree will not be lost. There are many trees whose seeds need the help of the digestive systems of birds or animals to grow. The above example gives inference very clearly how everything on earth is connected directly or indirectly to every other thing and how man can interfere in this relationship. Destroy one thing and everything else will be affected in one way or another. This balance is called the ecological balance and is very important for the wellbeing of the entire world. If, for instance, all the trees in one forest were cut down for some reason and another kind of tree not usually grown in that area were planted, it would completely change the balance of nature. Insects, birds and animals would either die or move elsewhere to find their normal food, and other insects, birds and animals may or may not replace them. Similarly, the small plants normally growing beneath the trees would change: for the same reasons. People living in the forest might find that the trees from which they got their fruit were no longer there.

In Bhagwad Gita Krishna says that our world is like banyan tree which has its roots upward and its branches down and whose leaves are the Vedic hymns. One who knows this tree is the knower of the Vedas. The importance of trees is also been described in

Ramayana and Mahabharata. This indicates that Indians from Vedic time had a great bonding for trees. The Hindu tradition describes three different categories of forest. The first among them is shrivan, the forest that gives prosperity. The second is tapovan, the forest where one can meditate like the sages who contemplate to seek truth. The third type is mahavan; it is the place where all species seek out shelter. The importance of trees, its scientific evolution such as absorption and assimilation of food from soil by the roots, distinction between fertile and sterile soil, knowledge of trees, methods of planting, grafting and transplanting, various types of manures, rotation of crops, pollination of seeds etc were all mentioned in taittiriya, Brihatsamhita, purans and other texts written by great scholars like varahamihira, shankara Mishra, gunaratna and others.

The Taittiriya upanishad describes about “Aranyakas” means belonging to wilderness from where one cannot see the roofs of the settlement. Where knowledge can be gained and learned in the wilderness. In Vedic literature the most important tree described is about “Asvattham” which is called as Arasa Maram” (Ficus religiosa). One call it as palm tree, another call it as pipal (ficus religiosa-pagoda fig-tree) and yet another call it as Banyan tree (ficus bhengalensis) with adventitious aerial roots. It is a cosmic tree, the berries of the tree are sweet, and Soma (intoxicant) is prepared from its juice according to some accounts. Asvattham is said to be a “body-tree.” “A” is no; “THA” is existence; “Shva” means “after tomorrow.” No existence after tomorrow. It tells us that life is precarious. The body tree

itself is imperishable (HAM), because God pervades it. The Buddha attained enlightenment under the Bo tree; Bo is short for bo-gaha, tree of wisdom; Bo tree is Pipal or Banyan tree; Bo is wisdom, Bodhi is enlightenment, Buddhi is knowledge and the Buddha is he who attained enlightenment.

Trees work very hard to keep the air we breathe clean and healthy. Their leaves breathe in much of the poisonous unwanted carbon dioxide in the air, and replace it with the oxygen, which we need for healthy living. Tree roots dig deep into the earth and hold the soil together so that the rain and wind cannot wash or blow it away hence avoiding soil erosion. Scientists, all over the world are trying to find ways to prevent it. But one of the most significant ways is by planting more trees. They prevent floods. The roots keep river banks firm and do not let them crumble. Water is thus prevented from pouring out onto the fields and spoiling the farmers’ crops, or entering villages and destroying houses and drowning people and animals. The trees in forest attract rain. Trees send up water vapour into the atmosphere through their leaves. When this vapour meets the cool air above it turns into drops of water, which then fall as rain. They give us beauty, Colour and greenery. This is something, which we often forget and fail to appreciate. They are the homes of many birds, animals and insects. Each of these is important in keeping up a balance in nature. Trees are vital. As the biggest plants on the planet, they give us oxygen, store carbon, stabilise the soil and give life to the world’s wildlife. They also provide us with the materials for tools and shelter.

Not only are trees essential for life, but as the longest living species on earth, they give us a link between the past, present and future. It's critical that woodlands, rainforests and trees in urban settings, such as parks, are preserved and sustainably managed across the world.

The canopies of trees act as a physical filter, trapping dust and absorbing pollutants from the air. Each individual tree removes up to 1.7 kilos every year. They also provide shade from solar radiation and reduce noise.

Over 20 species of British trees and shrubs are known to have medicinal properties. The oil from birch bark, for example, has antiseptic properties. Research shows that within minutes of being surrounded by trees and green space, your blood pressure drops, your heart rate slows and your stress levels come down.

Trees absorb carbon dioxide as they grow and the carbon that they store in their wood helps slow the rate of global warming. They reduce wind speeds and cool the air as they lose moisture and reflect heat upwards from their leaves. It's estimated that trees can reduce the temperature in a city by up to 7°C. Trees also help prevent flooding and soil erosion, absorbing thousands of litres of storm water.

Trees host complex microhabitats. When young, they offer habitation and food to

amazing communities of birds, insects, lichen and fungi. When ancient, their trunks also provide the hollow cover needed by species such as bats, wood boring beetles, tawny owls and woodpeckers.

One mature oak can be home to as many as 500 different species. Richmond Park is full of such trees, which is one of the reasons it has been designated a National Nature Reserve and Site of Special Scientific Interest.

Trees strengthen the distinctive character of a place and encourage local pride. Urban woodland can be used as an educational resource and to bring groups together for activities like walking and bird-watching. Trees are also invaluable for children to play in and discover their sense of adventure.

People are attracted to live, work and invest in green surroundings. Research shows that average house prices are 5-18% higher when properties are close to mature trees. Companies benefit from a healthier, happier workforce if there are parks and trees nearby.

The greatest challenge of our times is to try and re-establish the vital link with Nature in the face of modern urban pressures. While the West is well on its way to rectifying its errors, we are still following a dangerous path. In our ignorance, we are not even being selfish.

## पेंगोलिन: एक असहाय प्राणी विलुप्ति की राह पर

योगेश पारधी, अंकुर दहायत, नसीर मोहम्मद एवं फातिमा शीरीन

आनुवांशिकी एवं पादप प्रजनन प्रभाग

उष्णकटिबंधीय वन अनुसंधान संस्थान

जबलपुर - 482021 (म.प्र.)

E-mail: yogeshpardhi1911@gmail.com

पेंगोलिन एक शल्कधारी चीटीखोर स्तनधारी प्राणी है जो कि Pholidota order के अन्तर्गत आता है। Midae Family में तीन Genera है। जिसमें पहला Manis है। इसकी चार प्रजातियां एशिया में पाई जाती हैं। भारत में मुख्यतः Manis crassicaudata पाई जाती हैं। पेंगोलिन मुख्यतः एशिया एवं अफ्रीका के उष्ण कटिबंधीय वन में पाया जाता है। IUCN ने पेंगोलिन को गम्भीर रूप से संकटग्रस्त (A3d+4d) प्रजातियों की सूची में डाला है। TRAFFIC (Conservation programme) ने पेंगोलिन को बढ़ते शिकार व अवैध व्यापार के कारण लुप्तप्राय की श्रेणी में शामिल किया है। इसके बढ़ते शिकार की मुख्य वजह इसका स्वादिष्ट मांस व स्केल है। इसके स्केल व मांस की अन्तराष्ट्रीय बाजार में बहुत मांग है, अब तक उपलब्ध साक्ष्य के आधार पर कहा जा सकता है कि पूर्व मध्य एशिया इसके व्यापार का मुख्य केन्द्र है। यहां पर इसके स्केल से दवाईयां व अन्य कीमती सामान जैसे कोट, बैग व सौन्दर्य प्रसाधन की सामग्री बनाई जाती है। यह प्रजाति दक्षिण एशिया में मुख्यतः पायी जाती है। दक्षिण एशिया में पाकिस्तान, दक्षिण नेपाल, हिमालय पर्वत की श्रेणियां, बांग्लादेश, श्रीलंका, दक्षिण पूर्व चीन में पायी जाती है। पाकिस्तान में विशेष तौरपर सिंध प्रांत तथा पाक अधिकृत कश्मीर में पाया जाता है। भारत में यह प्रजाति निचले व समतल हिमालय क्षेत्र में फैली हुई है तथा कर्नाटक, केरल, तमिलनाडू, मध्यप्रदेश, पश्चिम

बंगाल, गोवा, गुजरात में पायी जाती है। एशियन पेंगोलिन की वास्तविक जनसंख्या की कोई जानकारी उपलब्ध नहीं है। पेंगोलिन को बांग्लादेश में 1980 में लुप्तप्राय घोषित किया जा चुका है। पेंगोलिन की पारिस्थितिकी से सम्बन्धित, अनुसंधान में यह पाया गया कि इसके स्केल की बढ़ती मांग की वजह से इसकी संख्या में भारी कमी आई है। नेपाल में कुछ वर्षों से इसके संरक्षण व सुरक्षा प्रबन्धन पर ध्यान दिया जा रहा है परन्तु इसकी निश्चित संख्या के बारे में वहां भी कोई अधिकारिक रिकार्ड उपलब्ध नहीं है।

CITES (Convention on international trade in endangered species of wild fauna and flora) के अनुसार भारतीय पेंगोलिन (*Manis Crassicaudata*) अपनी स्केल की वजह से पृथ्वी का सबसे अधिक शिकार किया जाने वाला प्राणी है। पेंगोलिन किसी भी तरह से अपने बचाव के दौरान सामने वाले प्राणी को कोई नुकसान नहीं पहुंचाता है और गेंदनुमा गोल रूप धारण कर यह अपनी सुरक्षा स्केल के माध्यम से करता है। यही वजह है कि इसका शिकार आसानी पूर्वक शिकारी कर लेते हैं। विश्व में बहुत सारे कार्यक्रम पेंगोलिन के बचाव के लिए चलाए जा रहे हैं जो नाकाम साबित हुए हैं। पेंगोलिन में कुछ विशेष खासियत होती है जो इसकी उपयोगिता को बढ़ाती है तथा यही खासियत उसके सबसे अधिक शिकार प्रिय जानवर की श्रेणी में लाती है इसकी जीभ करीब 40 सेंमी लम्बी होती है जोकि इसके शरीर से भी लम्बी है। इसके जबड़ों में दांत नहीं होते हैं।

इस वजह से इसका शिकार करना आसान होता है इसके पूरे शरीर में स्केल होते हैं यह अकेला स्तनधारी है जो पूरी तरह से स्केल से ढका है। यह केरेटिन स्केल से बना होता है जैसे मनुष्य का नाखून, राइनों का सींग, मोर पक्षी की चेंच बनी होती है यह स्केल बहुत कड़े होते हैं जो शिकारियों से इसका बचाव करते हैं। चीन में इससे दवाईयां बनाई जाती हैं और खाने में इस्तेमाल किया जाता है।

अन्तर्राष्ट्रीय बाजार में इसके स्केल की कालाबाजारी होती है, जहां इसकी कीमत 3000 डालर आंकी गयी है यहां तक कि इसका उपयोग कोट बनाने में किया जाता है। एशिया में बैग बनाने में भी इसका इस्तेमाल होता है। सौन्दर्य प्रसाधन से लेकर कैंसर जैसी घातक बीमारी के लिए दवा बनाने में भी इस स्केल का उपयोग होता है जब ये गोल रूप धारण कर लेता है तब इसका शिकार करना मनुष्य के लिए असम्भव हो जाता है यहां तक कि इसका शिकार करना शेर के लिए भी सम्भव नहीं होता है।

**चीन की भूमिका-विश्व का प्रमुख व्यापारिक केन्द्र**

विगत कुछ वर्षों में पेंगोलिन के शिकार की घटना तेजी से बढ़ी है इसका अवैध व्यापार चीन व भारत ही नहीं, अपितु सम्पूर्ण दक्षिण एशिया में होता है। जिसके कारण इसकी संख्या में तेजी से कमी आई है TRAFFIC के अनुसार 2015 में पेंगोलिन सबसे ज्यादा शिकार किया जानेवाला वन्यप्राणी था। TRAFFIC एक अन्तर्राष्ट्रीय संस्था है जो वन्य अपराध का पता लगाती है और वन्य अपराध को सूचीबद्ध करती है। TRAFFIC के अनुसार अंतिम पांच वर्ष में पेंगोलिन के 4300 किग्रा0 स्केल का विश्व में व्यापार किया गया। यह व्यापार न केवल भारत में अपितु पूरे विश्व में हुआ है। Dr. Tikadar की रिपोर्ट के अनुसार (1983) भारतीय एवं चीनी पेंगोलिन की संख्या में शिकार की वजह से भारी गिरावट आ रही

है। पेंगोलिन का शिकार कर भारत से विदेशों में भेजा जा रहा है। चीन में इसके शरीर के विभिन्न अवयव का दवाई बनाने में उपयोग होता है। चीन पेंगोलिन का विश्व में सबसे बड़ा उपभोक्ता देश है। इस प्रकार पूरे विश्व में से अवैध रूप से इकट्ठा कर पेंगोलिन चीन को भेजा जाता है।

इस प्रकार चीन पेंगोलिन के अवैध व्यापार को पूरे विश्व में प्रोत्साहित कर रहा है। भारत में शिकारी पेंगोलिन को पकड़ने के बाद इसका मांस स्थानीय बाजारों में बेच देते हैं। पेंगोलिन से प्राप्त स्केल को ये शिकारी, मध्यस्थ व्यापारी को बेच देते हैं। ये मध्यस्थ व्यापारी कोलकाता, चेन्नई के रास्ते से चीन के सीमावर्ती जिलों तक पहुंचाते हैं जैसे पश्चिम बंगाल में सिलीगुडी मोरेल, चांदल जिलों में, मणिपुर में, मेघालय में सिलोंग यहां से होता हुआ यह चीन के बाजार में जाता है, स्थानीय स्तर पर पेंगोलिन का शिकार स्थानीय शिकारी या किसान, मजदूर आदिवासी करते हैं। जिन्हें एक पेंगोलिन की कीमत 2500 से 4000 तक दी जाती है। वहीं इस पेंगोलिन की कीमत विदेशी बाजार में पहुंचते ही 30 गुना करीब बढ़ जाती है। चीन के अलावा यह नेपाल व मयनमार के बाजारों में भी बेचा जाता है। कुछ भारतीय नागरिक जो इसका अवैध व्यापार करते हैं उनके पास नेपाली व मयनमार चीनी करेन्सी पाई गई है जो इस व्यापार मार्ग की पुष्टि करता है कि पेंगोलिन चीन के अलावा नेपाल व मयनमार में भी बेचा जाता है। विश्व में सबसे अधिक पेंगोलिन की मांग चीन में है। चीन के व्यापारी विभिन्न देशों में अपना अवैध व्यापार का जाल बिछाये हुये हैं, अवैध व्यापार का यहां मजबूत तंत्र आसानी से पेंगोलिन को पूरे विश्व से चीन तक पहुंचाने में मदद करता है।





चित्र-1 : भारत से चीन की ओर जाता पैंगोलिन का अवैध व्यापारिक मार्ग

संरक्षण के लिए विभिन्न देशों द्वारा किए गए वैधानिक प्रयास

पेंगोलिन के भविष्य पर आ रहे गम्भीर खतरे व तेजी से घटती संख्या के बाद भी भारत, श्रीलंका, मयानमार, पाकिस्तान में सामान्य कानून के तहत ही इसे प्रोटेक्ट किया जा रहा है। चूंकि यह सम्पूर्ण दक्षिण एशिया में पाया जाता है और संरक्षित क्षेत्र में ही बचा रह गया है। अतः इस पर शोध व पेंगोलिन की वर्तमान जनसंख्या की गणना करने की आवश्यकता है ताकि यह पता चल सके कि वर्तमान में पेंगोलिन की संख्या कितनी है। साथ ही इसकी वर्तमान स्थिति की जैविक व प्राकृतिक आवास के अध्ययन की आवश्यकता है। ताकि भविष्य में इसके प्राकृतिक आवास के संरक्षण व प्रबन्धन के लिए विस्तृत कार्ययोजना का निर्माण किया जा सके तथा इस कार्ययोजना के प्रभावी क्रियान्वयन में वनविभाग व सहायता समूह को किसी प्रकार की समस्या न हो और पेंगोलिन का संरक्षण व प्रबन्धन समुचित तरह से हो सके ताकि यह जीव भी प्रकृति में अपना अस्तित्व बनाए रख सके।

बांग्लादेश ने इस दिशा में प्रयास किए हैं वहां पर पेंगोलिन का वाइल्ड लाईफ संरक्षण व सुरक्षा कानून 2012 के तहत बचाव किया जा रहा है। भारत में इस प्रजाति को वन्यजीव सुरक्षा अधिनियम 1972 के तहत शयडूल एक में रखा गया है।

पाकिस्तान में इस प्रजाति को इस्लामाबाद वन्यजीवन बचाव संरक्षण आरक्षित और प्रबन्धन अधिनियम 1979 के तहत शयडूल तीन और पूर्व पश्चिम फ्रटियर प्रोविसंस वन्यजीवन अधिनियम 1975 के तहत संरक्षण पर ध्यान दिया जा रहा है। नेपाल में पेंगोलिन को राष्ट्रीय पार्क व वन्यजीव संरक्षण अधिनियम 1973 के तहत रखा गया है। श्रीलंका में सख्त रूप से संरक्षित करने योग्य की श्रेणी के तहत रखा गया है।

भारत के वन्यजीव संरक्षण अधिनियम 1972 की वर्तमान समय में प्रासांगिकता सम्पूर्ण दक्षिण एशियाई देशों में अपने स्तर पर कानून का निर्माण करके पेंगोलिन संरक्षण की दिशा में प्रयास किए हैं इसके बावजूद भी पेंगोलिन का शिकार पूरे दक्षिण एशिया में हो रहा है और अपराधी बेखौफ घूम

रहे हैं। भारत, पाकिस्तान, म्यान्मार, नेपाल, श्रीलंका ने वन्यजीव संरक्षण के लिए कानून बनाए हैं परन्तु ये कानून अत्यंत ही लचीले व कम सजा के प्रावधान वाले हैं। जिनसे अपराधी पर अपराध सिद्ध भी हो जाए तो सजा नाम मात्र की होती है और वह सजा काट कर पुनः इसी काम में लग जाते हैं। वन्यजीव अपराध को कम करने के लिए भारत सरकार ने वन्यजीव अपराध संरक्षण अधिनियम 1972 का प्रावधान किया था। परन्तु वर्तमान परिदृश्य में यह 1972 का एक्ट भी नाकाम साबित हो रहा है। अतः जरूरत है कि 1972 के वन्यजीव संरक्षण अधिनियम को कानूनी रूप से कठोर बनाया जाए क्योंकि वर्तमान परिदृश्य में इस एक्ट की प्रासंगिकता समाप्त सी हो गयी है। इस एक्ट को प्रभावी बनाकर ही हम वन्य जन्तुओं के प्रति संवेदनशील हो सकेंगे, क्योंकि मानव पर हो रहे अपराध व अत्याचार के लिए कानून पर्याप्त रूप से कठोर है परन्तु वन्य जन्तुओं के लिए बना कानून अत्यंत ही लचीला व कम सजा के प्रावधान वाला है। इसी का लाभ शिकारी व वन माफिया उठाते हैं और मनमाने तरीके से जंगली जानवरों को मारकर उनका व्यापार करते हैं, S चूंकि 1972 वन्यजीव संरक्षण अधिनियम के अनुसार एक या दो साल की सजा दी जाती है और मामूली सा जुर्माना होता है, जोकि वन्यजीव प्राणियों के अवैध व्यापार से प्राप्त धन की तुलना में यह सजा बहुत ही कम होती है। यही वजह है कि 1972 अधिनियम के सजा का भय शिकारियों व इनके अवैध व्यापार में संलग्न माफियाओं को बिल्कुल भी नहीं है। वर्तमान परिदृश्य को देखकर लगता है कि मनुष्य ने यह तय कर लिया है कि कुछ वर्षों में पूरी पृथ्वी पर एक ही प्रजाति बची रहेगी जिसका नाम Homo sapience होगा तब तक काफी देर हो चुकी होगी और वह भी कुछ ही वर्षों में खत्म हो जाएगी। अतः अब चुनौती हमारे सामने यह है कि अगर अपना

अस्तित्व बचाना है तो वन्य जीव व वन का संरक्षण करना नितान्त आवश्यक है।

पेंगोलिन प्रोजेक्ट की नितान्त आवश्यकता आखिर क्यों है ?

जिस मनुष्य के अन्दर भय एवं संवेदनशीलता समाप्त हो जाये। वह मनुष्य निश्चित ही धन लोलुपता व निजी स्वार्थ के लिए सारे नियमों व कानूनों को ताक में रखकर विनाश के कार्यों को अंजाम देने लगता है। यही कारण है कि वन्य प्राणी की संख्या में निरन्तर कमी आ रही है। हाल ही कुछ बीते वर्षों में भारत व राज्य सरकारों ने टाईगर प्रोजेक्ट पर पूरा ध्यान लगा दिया है। बाघ संरक्षण वन विभाग की प्राथमिकता सूची में सबसे उपर है अन्य वन्यप्राणी के संरक्षण पर टाईगर प्रोजेक्ट की तुलना में सरकार अत्यन्त कम मात्रा में धन व्यय करती है। बाघ शिकार की सूचना मिलते ही वन विभाग का सारा अमला तेजी से सक्रियता दिखाता है नीचे से उपर तक के कर्मचारी व अधिकारी हरकत में आ जाते हैं जबकि अन्य वन्यजीव के शिकार की घटना की जानकारी मिलने पर भी वन विभाग के कान में जू तक नहीं रेंगती। यही कारण है कि अन्य वन्य प्राणी की संख्या तेजी से घट रही है। इस प्रकार हम देखते हैं कि हमने बहुत सारा धन और संसाधन टाईगर प्रोजेक्ट पर ही लगा दिया है हालांकि इसके अच्छे परिणाम भी हमारे सामने हैं। हर वर्ष बाघों की संख्या बढ़ रही है। परन्तु हमने अन्य वन्यजीव के संरक्षण से अपना मुंह मोड़ लिया है। हर वर्ष उन जीवों की संख्या में कमी आ रही है जो विलुप्ति की कगार पर खड़े हैं या संरक्षित घोषित नहीं किए गए हैं। यह एक कारण भी हो सकता है कि अब वन्यप्राणी के अवैध व्यापार करने वालों का ध्यान टाईगर के शिकार से हटकर अन्य दुर्लभ प्राणियों की ओर चला गया है। जिनकी विश्व बाजार में भारी मांग है और जिनकी उच्च कीमत बाजार में प्राप्त होती है। चूंकि टाईगर का शिकार करना मुश्किल व जोखिम भरा होता है साथ ही सजा भी सख्त होती है। वही पेंगोलिन जैसे वन्यप्राणी का शिकार करना आसान होता है साथ ही सजा भी कम होती है। यही कारण है कि विगत कुछ वर्षों में पेंगोलिन

के शिकार की घटनाएँ ज्यादा हुई हैं। जिस तरह से पेंगोलिन का शिकार हो रहा है तथा वन में इनकी संख्या में कमी आ रही है तब यह जरूरी हो गया है कि पेंगोलिन को संरक्षित जीव घोषित किया जाए और बृहद रूप से इसके बचाव के लिए एक कार्ययोजना बनाई जाए। जिससे कि यह जंगली जीव वन में बचा रह सके इसके लिए बृहद पेंगोलिन प्रोजेक्ट की आवश्यकता है तथा जिन वन क्षेत्रों में इनकी पर्याप्त संख्या है वहां पर पेंगोलिन प्रोजेक्ट प्रारम्भ कर उस क्षेत्र को और इनके प्राकृति वास को बचाया जाये, साथ ही इसके आवास स्थान में शोध व अध्ययन को बढ़ावा दिया जाए और बेहतर व प्रभावी कार्ययोजना का निर्माण किया जाये क्योंकि अब तक इस जीव के बारे में प्राप्त जानकारी पर्याप्त नहीं है। इस जीव के बारे में भ्रांतियाँ ज्यादा हैं तथा वैज्ञानिक व सैद्धान्तिक ज्ञान का अभाव है।

इस जीव के बचाव का एक मात्र उपाय पेंगोलिन प्रोजेक्ट ही हो सकता है। साथ ही पेंगोलिन प्रोजेक्ट तहत कड़े कानून का निर्माण करना होगा। इस जीव के शिकारी या शिकार को प्रोत्साहित करने वाले व व्यापार में शामिल लोगों को मृत्युदंड या आजीवन कारावास की सजा दी जानी चाहिए जिससे इसके अवैध व्यापार में लिप्त लोगों में भय का वातावरण व्याप्त हो और इसका अवैध व्यापार समाप्त हो सके।

पेंगोलिन के अवैध शिकार/व्यापार के केन्द्र के रूप में उभरता मध्य प्रदेश

वन व वन्यजीव सम्पदा के दृष्टिकोण से म0प्र0 भारत के एक अति महत्वपूर्ण राज्य की श्रेणी में आता है। राज्य के वनक्षेत्र वन्यजीवों से समृद्ध है। यहां के वनों में बाघ, तेंदुआ, कृष्णमृग, चीतल, सांभर, भालू, जंगली भैंसे आदि पाए जाते हैं। कान्हा, बान्धवगढ़, पेंच में बाघ परियोजना सफलतापूर्वक संचालित हो रही है जो कि सम्पूर्ण देश में एक मिसाल है। वन व वन्यजीव के संरक्षण में म0प्र0 के वन विभाग के अधिकारियों व कर्मचारियों का महत्वपूर्ण योगदान है परन्तु समाज की

भागीदारी को भी नजरअंदाज नहीं किया जा सकता है। वन्यजीव व वन की सुरक्षा में प्रशासन व समाज का भी बराबर सक्रिय योगदान रहा है जोकि न केवल भारत अपितु विश्वभर के समाज के लिए एक अनुकरणीय उदाहरण है। राजस्थान में विश्वोई समाज पशुप्रेम का जीवंत उदाहरण है परन्तु वर्तमान परिस्थितियों के बदलते सामाजिक दायरे व संकीर्ण मानसिकता ने जरूर बदलाव किए हैं साथ ही बढ़ती निर्धनता व धन की लालसा की वजह से प्राकृतिक धरोहर पर दबाव बढ़ता जा रहा है। इसके फलस्वरूप वनक्षेत्र के साथ साथ वन्यजीवों की संख्या में भी लगातार कमी आती जा रही है। यह वन्यजीवों के अनैतिक शिकार के रूप में सामने आ रही है। वर्तमान में म0प्र0 बाघ, चिंकारा, मृग, भालू का शिकार हो रहा है। इन्हीं में से एक पेंगोलिन भी वन्यजीव है, जंगलों में कीड़े मकोड़े खाकर अपनी जिंदगी बिताने वाले पेंगोलिन पर शिकारियों की बुरी नजर पडी है। शिकारियों की निगाहें इन पर हमेशा बनी रहती है, क्योंकि पेंगोलिन से सेक्सुअल पावर बढ़ाने वाली दवाईयां बनाने का कारोबार किया जा रहा है। यही नहीं इन्हे शिकार के बाद पड़ोसी देशों में सप्लाई किया जा रहा है जिनमें, चीन, जापान, थाईलैण्ड जैसे देश शामिल हैं। म0प्र. में जबलपुर, बालाघाट, सिवनी, होशंगाबाद, वैतूल, छिंदवाडा, पेंच, कान्हा भोपाल के जंगलों में पेंगोलिन प्राणी आसानी से पाया जाता है यहां पर यह चीटी, कीड़े खाकर रहता है इसके अंगों में ऐसे रसायन पाए जाते हैं जिनसे नपुंसकता दूर करने वाली दवाईयां बनाई जाती है इसी कारण म0प्र0 में इस जीव का शिकार बड़े पैमाने पर किया जा रहा है।

पेंगोलिन की कीमत बाजार में (प्रति किलो)

पेंगोलिन की कीमत के विभिन्न स्तर पर अनुमानित आकड़े (दशाई गई कीमत डॉलर में आंकलन की गई है)

शिकार से	22.5\$
निम्न स्तर व्यापारी तक	45\$

मध्य स्तर व्यापारी तक	80\$
उच्च स्तर व्यापारी तक	265\$
विदेशी बाजार में कीमत	350\$
वन्यजीव की प्रतिवर्ष शिकार की जाने वाली अनुमानित संख्या	
वन्यजीव की प्रतिवर्ष शिकार की जानेवाली अनुमानित संख्या	
बाघ	200
गेंडा	1000
पेंगोलिन	10,000

(स्रोत: TRAFFIC, South Africa and IUCN, Note: Rhino Numbers are for South Africa only)

विगत वर्ष में राज्य वन अनुसंधान संस्थान जबलपुर में वन्यजीवों पर मंथन करने देश के विभिन्न कोनों से आए वन्यजीव विशेषज्ञों ने भी पेंगोलिन के शिकार की बात स्वीकार की थी। उन्होंने माना था कि पेंगोलिन के अंगों का कारोबार करने वाले बड़े पैमाने पर इसका शिकार करवा रहे हैं जिनमें स्थानीय लोगों को पैसो का लालच दिया जाता है। वन्यजीव अपराध नियंत्रण ब्यूरो जबलपुर के आरक्षक श्री देवेश शर्मा कहते हैं कि शिकार करने के बाद शिकारी जंगल में ही पेंगोलिन के आवश्यक अंगों को अलग कर लेता है और इसके बाद वे कोलकाता के रास्ते से चीन व जापान थाईलैण्ड देशों में भिजवा देते हैं।

भारत हाल ही में ग्वालियर से पकड़ाए एक दम्पति ने स्वीकार किया कि वे म0प्र0 व राजस्थान में वन्यजीव के अवैध व्यापार में 20 साल से सक्रिय हैं उन्होंने बहुत सारे बाघ का शिकार कर इसका व्यापार किया है और उन्होंने एक बहुत ही रुचिपूर्ण बात को उजागर किया कि बाघ के व्यापार की तुलना में पेंगोलिन का व्यापार फायदेमंद है और हाल ही के कुछ वर्षों से वे बाघ के व्यापार को छोड़कर पेंगोलिन के व्यापार में सक्रिय हैं साथ ही उन्होंने अपने साथ मुरैना व भिंड में कुछ लोगों के शामिल होने की बात स्वीकारी। म0प्र0 पेंगोलिन के

व्यापार का गढ़ बन चुका है पूरे भारत में सबसे अधिक पेंगोलिन का शिकार म0प्र0 के जंगलों से होता है अगर उपरोक्त माफिया व गिरोहो की बातों को सही माने तो यह सहज ही अंदाजा लगाया जा सकता है कि जो गिरोह पुलिस व वन विभाग की नजर से बचे हुए हैं, उन्होंने न जाने कितने पेंगोलिन का शिकार किया होगा और कितने उच्च स्तर पर इनको नुकसान पहुंचाया होगा, इसका अनुमान लगाना कठिन है।

इन सभी घटनाओं को देखकर म0 प्र0 की वन्य विभाग ने इससे निपटने के लिए (Special Task Force) एस0टी0एफ का निर्माण किया है जो पेंगोलिन के शिकार में सक्रिय लोगों को पकड़ रही है। एस0टी0एफ के प्रयास से बालाघाट, जबलपुर, ग्वालियर में बहुत से गिरोह का खुलासा हुआ है और (Special Task Force) एस0टी0एफ के प्रयास से ही बहुत सारे अपराधी पकड़ में आए हैं। एस0टी0एफ के अनुसार 50 हजार पेंगोलिन अंतिम पांच साल में भारत से विदेशों को निर्यात किया गया है। एस0टी0एफ के अनुसार यह आंकड़ा बढ़ भी सकता है। इसी बात से यह अंदाजा लगाया जा सकता है कि म0प्र0 में पेंगोलिन का अवैध व्यापार किस तरह से फलफूल रहा है। असम के एक व्यापारी ने एस0टी0एफ के सामने यह स्वीकार किया है कि इसके गिरोह ने 1 वर्ष के अन्दर म0प्र0 से 100 पेंगोलिन का निर्यात चीन को किया है। एक गिरोह ने छिंदवाडा से पेंगोलिन खरीदने की बात स्वीकार की है। यहां पर हम इस पूरे अवैध व्यापार को एक सरसरी नजर से देखें तो यह बात सामने आती है कि पूर्व भारत जैसे असम, पश्चिम बंगाल के बड़े व्यापारी म0प्र0 के निर्धन व निरक्षर वनवासी ग्रामीण को शिकार के लिए उकसाते हैं तथा उन्हें 2500 से 5000 रूपये तक एक पेंगोलिन की कीमत देकर उसे असम व पश्चिम बंगाल के रास्ते नेपाल

व बांगलादेश में उच्च कीमत पर बेच देते हैं। इसके बाद यह नेपाल के रास्ते चीन में उच्च कीमत पर बेच दिया जाता है। चीन पेंगोलिन के व्यापार का मुख्य केन्द्र है यह चीन से विदेशों में वियतनाम व थाईलैण्ड, सिंगापुर, मयानमार भेजा जाता है। म0प्र0 के स्थानीय शिकारी को एक पेंगोलिन अंगों की कीमत जहां 2 हजार मिलती है वहीं अन्तर्राष्ट्रीय स्तर पर इसकी कीमत 2 से 25 लाख रुपये तक होती है।

म0प्र0 में पेंगोलिन के शिकार में चीन व मयानमार के व्यापारी गिरोह अधिक सक्रिय है ये व्यापारी गिरोह स्थानीय शिकारी से गहरा तालमेल स्थापित कर इस पूरे काम को अंजाम देते हैं। म0प्र0 वन विभाग का पूरा ध्यान बाघ प्रोजेक्ट पर केंद्रित है इस वजह से पेंगोलिन की शिकार की घटनाएँ प्रकाश में नहीं आ पाती हैं तथा शिकारी वन विभाग की निष्क्रियता का लाभ उठाकर बिना किसी डर के जंगलों से पेंगोलिन का शिकार कर लेते हैं। पेंगोलिन का म0प्र0 में अवैध शिकार की बढ़ती घटनाओं की वजह इस जीव का अहिंसक होना है जिससे इसको मारना आसान होता है। तथा इसे बाजार में आसानी से बेचा भी जा सकता है। क्योंकि इस जीव का परिवहन आसान व सुगम होता है इस वजह से म0प्र0 में वन्यजीव शिकारी इस जीव का अधिक शिकार कर रहे हैं।

**पेंगोलिन का प्राकृतिक आवास बालाघाट जिला**

म.प्र. का बालाघाट जिला वन व वन्यजीव से परिपूर्ण जिला है यहां का बांस पूरे भारत में प्रसिद्ध है बालाघाट जिले में अभी कुछ वर्षों में पेंगोलिन के शिकार की घटनाएँ बढ़ी हैं बालाघाट के लांजी तहसील में पेंगोलिन की संख्या बहुत अधिक है। लांजी के बगडी, चोरिया, सीतापाला, माताघाट, थरीरुमूरुम, देवरवेली, चोरिया, बेलगांव, थानेगांव, खाडाफरी, शेरपार में पेंगोलिन बहुतायत में पाए जाते हैं यह क्षेत्र उनका प्राकृतिक

आवास है। यहां की जलवायु व वनस्पति इन्हे अपने वृद्धि व विकास के लिए अनुकूलन प्रदान करती है परन्तु अभी के कुछ वर्षों में यहां पर भी शिकारियों की नजर पडने की वजह से पेंगोलिन के शिकार की घटनाएँ प्रकाश में आई हैं। यहां के कुछ स्थानीय लोगों ने पेंगोलिन का अवैध शिकार कर विदेशों को पेंगोलिन अंगों का निर्यात किया है। कुछ पुलिस व वन विभाग की सक्रियता की वजह से पकड़े जा चुके हैं परन्तु कुछ लोग अभी भी इस अवैध व्यापार में संलिप्त हैं। इन शिकारियों की वजह से पेंगोलिन की संख्या में इस क्षेत्र में भारी कमी आयी है साथ ही अन्य वन्यप्राणी के शिकार की भी घटनाएँ बढ़ रही हैं। समय रहते वन विभाग ने इस ओर ध्यान नहीं दिया तो वह दिन दूर नहीं जब इस क्षेत्र से यह वन्यप्राणी विलुप्त हो जायेगा

भारत में जितने भी वन्य जीव संरक्षण की परियोजनाएँ चल रही हैं, उन परियोजना के तहत शामिल जैसे हाथी, बाघ, हिम तेंदुआ, डॉल्फिन सभी जीवों के हत्या व अवैध व्यापार व शिकार में संलिप्त पाए गए संदिग्ध व्यक्ति पर Fast track court की तर्ज पर कानूनी प्रक्रिया चलाई जानी चाहिए ताकि ऐसे मामले का त्वरित न्याय हो तथा अपराधी को सजा हो। जिससे वन्यजीव अपराध नियंत्रण ब्यूरो व वन विभाग में कार्य करने वाले अधिकारी व कर्मचारी के उत्साह में वृद्धि आएगी जिससे वन्य अपराध में कमी आएगी तथा हमें आशातीत परिणाम समय पर प्राप्त होंगे।

वर्तमान में पेंगोलिन दिवस (फरवरी माह का तृतीय शनिवार) को मनाकर सरकार मात्र अपनी जिम्मेदारी की खानापूर्ति कर रही है। एक दिन पेंगोलिन दिवस मनाकर हम साल भर की कसर पूरी कर लेते हैं। पेंगोलिन प्रोजेक्ट के माध्यम से उन वन्य क्षेत्रों में जहां पर वर्तमान में इनकी पर्याप्त संख्या में उपलब्धता है उन क्षेत्रों में स्थापित की जाए ताकि उनके संरक्षण के लिए पर्याप्त कदम उठाने में आसानी हो। समाज में इसके बचाव के लिए जन जागरूकता के लिए प्रचार प्रसार



किया जाए क्योंकि कोई भी परियोजना जनता की भागीदारी के बिना सफल होना संभव नहीं है। पेंगोलिन प्रोजेक्ट के लिए पहले पूरे देश में सर्वे करके इनकी संख्या का पता लगाया जाए क्योंकि वर्तमान में ऐसे कोई सरकारी आंकड़े नहीं हैं जिससे कि इनकी संख्या का निश्चित अनुमान लगाया जा सके। साथ ही में वन्य जीव संरक्षण अधिनियम 1972 में संशोधन कर इसे कानूनी तौर पर सख्त किया जाए ताकि वन्यजीव अपराध में शामिल होनेवाले लोगों में भय का वातावरण व्याप्त हो और वन्यजीव अपराध में कमी आये।

## Documentation of lichens diversity

P. Shivakumar Singh\*<sup>1</sup> D.S.R. Rajender Singh<sup>2</sup> and GM Vidyasagar<sup>3</sup>

<sup>1</sup> Department of Botany, Palamuru University, Mahabubnagar, Telangana -509001, India

\*<sup>2</sup> Sri Venkateshwara Government UG & PG College, Palem, Nagarkarnol, Telangana, India

<sup>3</sup> Medicinal plants and microbiology Research Laboratory, Department of Post Graduate Studies and Research in Botany, Gulbarga University, Gulbarga - 585 106, Karnataka, India

### Abstract

In the present article the rudiments, importance of lichens and documented lichens Palamuru university campus have been discussed. Palamuru university campus comprises huge biodiversity with 156 acres land area located with latitude 16.720, longitude 77.981. The average temperature in campus is 27.0 °C. The average annual rainfall is 882 mm. Lichens are mutual associations of a fungus and an alga or cyanobacterium and occur as crusty patches or bushy growths on trees, rocks and bare ground. The names given to lichens strictly refer to the fungal partner; the algae have separate names. Lichens are very sensitive to sulphur dioxide pollution in the air. Since industrialization, many lichen species have become extinct in large areas of lowland Britain. The effect of Sulphur dioxide in the growth of lichens, the interaction, and mode of action

of lichens against Sulphur dioxide mentioned. In the present report the maximum of Foliose and Crustose group of lichens have been documented.

### Introduction

Lichen is a supplementary organism: two very different beings, an alga and a fungus, live together in a qualified symbiotic association, producing a new body, or lichen thallus. Much of the lichen body is a tangle of fungal filaments called hyphae; these filaments clasp alga, sometimes in a mat, or sometimes wrapped as single cells. The fungus collects water and provides structure and protection for the alga, and may in certain species extract minerals for both organisms from the substrate. The alga possesses chloroplasts and can photosynthesize, thus providing carbohydrates for both itself and its fungal partner.



**Figure 1: Foliose and Crustose group of lichens documented from Palamuru University campus.**

When a fungus joins with an alga, it is said to be "lichenized." Many scientists, consulting a family tree of DNA, now believe that different forms of lichens evolved in independent strands of fungi development. They do not agree on the number of strands.

Lichens have special adaptations which permit them to withstand extremes of moisture and temperature. When moisture is available, it is taken up by the fungus leading to a mechanical change which allows lighter to get through, triggering algal photosynthesis; new food and new tissue are then made. When the atmosphere is dry, however, the lichen is dormant and does not grow.

Because lichens are hardy, love light, live a long time, and grow slowly, they can be pioneers in many inhospitable environments such as tundra, exposed rock surfaces, asbestos, mortar, tropical leaf surfaces, and even in water. When they

decay, their nutrients nourish new settlers such as moss.

Bio indicators are living organisms that retort in an especially clear way to a change in the environment. The hardy lichens are useful bio indicators for air pollution, especially sulfur dioxide pollution, since they derive their water and essential nutrients mainly from the atmosphere rather than from the soil. It also helps that they are able to react to air pollutants all year round. Compared with most physical/chemical monitors, they are inexpensive to use in evaluating air pollution.

Lichens can also be used to measure toxic elemental pollutants and radioactive metals because they bind these substances in their fungal threads where they concentrate them over time. Environmental scientists can then evaluate this accumulation to determine the history of the local air.



**Fig. 2: Study area, Google map, Palamuru University campus, Mahabubnagar, Telangana State, India.**

### The impacts of Sulphur-di-oxide on Lichen diversity

Lichens are injured by sulfur dioxide (SO<sup>2</sup>). Rose (1975) has calculated that more than one-third of England and Wales has lost nearly all its epiphytic lichens, the most delicate shrubby lichens, largely due to the sulphur-dioxide emissions of coal-burning power plants. In Northern Siberia, an area of the Soviet Union which is much polluted, the number of lichen species has fallen from 50 to about 3, and the lichen production in general stands at about 1 or 2% or normal levels, threatening the reindeer diet; in Alaska there are similar concerns about lichen reduction and the caribou diet. (Tyson, 1990).

Losses in other parts of the world reflect the increasingly poor quality of the earth's air and the need for early warning bio indicators such as lichens.

This pollutant has natural sources, such as volcanic eruptions and sea spray. By far the largest source for it, however, is the combustion of fossil fuels, automobile emissions, and some industrial processes. The pollutant is carried in the atmosphere until rained out or deposited as dry particles or as gas. Sulfur dioxide combines with moisture in the atmosphere to form sulfurous acid (H<sub>2</sub>SO<sub>3</sub>) or sulfuric acid (H<sub>2</sub>SO<sub>4</sub>). When this happens with rainwater, the result is acid rain. All these forms of sulfur are harmful to lichens and plants.

Lichens have also shown sensitivity to some other pollutants, such as heavy metals and ozone, but for the most part lichen damage can be attributed to SO<sub>2</sub>.

The effect of pollution upon lichen depends on the pH of the substrate, the surface on which the lichen grows. In general, an alkaline substrate such as basic bark or limestone counteracts the acidity

of SO<sup>2</sup> pollution. As acid rain falls on a substrate, one kind of lichen growth form will often be replaced by another more tolerant form. In areas of high pollution lichens may be found only on sites such as wounds on trees and on sandstone walls, which have high (basic) pH.

Scientists have found that, with considerable SO<sub>2</sub> pollution in an area:

- The first loss of the same pH-sensitive lichens occurs on birches and conifers (acid bark and low buffering capacity);
- The next loss on oaks and sycamore (intermediate acidity and buffering capacity);
- The last on trees like elm (alkaline bark and high buffering capacity).

### Significances of lichens as Bio-indicators

Lichens are widely used as environmental indicators or bio-indicators. If air is very badly polluted with sulphur dioxide there may be no lichens present, just green algae may be found. If the air is clean, shrubby, hairy and leafy lichens become abundant. A few lichen species can tolerate quite high levels of pollution and are commonly found on pavements, walls and tree bark in urban areas. The most sensitive lichens are shrubby and leafy while the most tolerant lichens are all crusty in appearance. Since industrialisation many of the shrubby and leafy lichens such as *Ramalina*, *Usnea* and *Lobaria* species have very limited ranges, often being confined to the parts of Britain with the purest air such as northern and western Scotland and Devon and Cornwall.

### Impacts of Acid Rain

Acid rain became a recognized international problem during the 1980s resulting from the dispersion of air pollutants via tall chimney stacks. Air pollution and acid deposition has led to problems for lichens on bark, particularly



because the tree bark has often become more acidic. In some areas, although gaseous sulphur dioxide levels have fallen, the bark of older trees is too acidic for recolonisation, and new growth develops on twigs and younger trees. Some species of lichens have become more widely distributed than they were a century ago as they are more tolerant of acid conditions, such as some species of *Bryoria*, *Parmeliopsis*, *Pseudevernia* and *Rinodina*.

#### **Common habitat of Lichens**

A lichen zone pattern may be observed in large towns and cities or around industrial complexes which corresponds to the mean levels of sulphur dioxide experienced. Table 1 shows the lichen zone scale of Hawksworth & Rose (1970). Particular species of lichen present on tree bark can indicate the typical sulphur dioxide levels experienced in that area. For example if there are no lichens present, the air quality is very poor (zone 1), whilst generally only crusty lichens such as *Lecanora conizaeoides* or *Lepraria incana* can tolerate poor air quality (zone 3). In moderate to good air, leafy lichens such as *Parmelia caperata* or *Evernia prunastri* can survive (zone 6) and in areas where the air is very clean, rare species such as 'the string of sausages' *Usnea articulata* or the golden wiry lichen *Teloschistes flavicans* may grow (zone 10).

It is important to note that the zone chart in Table 1 applies to areas where sulphur dioxide levels are increasing. If sulphur dioxide conditions are falling, lichens rarely colonise in exactly the same sequence; lichens are slow growing and may take a year or two to recolonise bark or other substrates following a reduction in air pollution levels, and tiny recolonising

specimens can be difficult to spot and identify.

During the early and mid-twentieth century, air pollution levels were much greater than they are today in towns and cities of the UK. Sulphur dioxide levels were highest in the inner city areas becoming less polluted out towards the edges of the urban areas. At such times, the lichen zone scale would often highlight zone 1 as the inner city area, moving through the zones to the cleaner air at the edge of the city. From the 1970s onwards, sulphur dioxide levels have been falling markedly in the central and outer areas of cities, such that there may be no differentiation between levels in central and outer areas of many cities. The fall in sulphur dioxide levels between the 1970s and the 1990s has led to a number of lichens recolonising in areas from which they had previously been eliminated.

#### **The origin of lichens from fungi**

The plant-like appearance of lichens hides their true identity. Lichen is not a single organism, but the result of a partnership (mutualistic symbiosis) between a fungus and an alga or cyanobacteria. Some lichens are formed of three or more partners. The body of lichen consists of fungal filaments (hyphae) surrounding cells of green algae and/or blue-green cyanobacteria. The basis of the mutualistic symbiosis in lichens is similar to the mycorrhizal partnership between some species of fungi and the roots of most plants. The lichen fungus provides its partner(s) a benefit (protection) and gains nutrients in return. The complexity of lichen partnerships has caused lichens to be described as "small ecosystems". They are classified as members of the Fungus Kingdom by systematists because the fungus partner is always the major partner. After a lichen



symbiosis is established, the fungus has the greatest influence on the final form of the lichen body's shape, and whether it is tough or flexible. The algal and bacterial partner(s) each have their own scientific names, but the lichen symbiosis is known only by the name of its fungus.

The great majority of the 13,500-18,000 species of lichenized fungi are Ascomycetes, the "cup fungi". About 20 species in the tropical and temperate rain forests are Basidiomycetes, the "mushrooms". About 40 genera of algae and cyanobacteria are found in lichen partnerships. The algal and/or cyanobacterial partner(s) possess the green pigment chlorophyll, enabling them to use sunlight's energy to make their own food from water and carbon dioxide through photosynthesis. They also provide vitamins to the fungus. Cyanobacteria can make amino acids directly from the nitrogen gas in the atmosphere, something neither fungi nor algae can do. The fungus, in turn, protects its partners from drying out and shades them from strong sunlight by enclosing the photosynthesizing partners within the body of the lichen. This life habit has allowed lichens to successfully colonize many different

#### Foliose



habitats. Lichens have a truly remarkable resistance to drought. A dry lichen can quickly absorb from 3 to 35 times its weight in water! Lichens can also absorb moisture from dew or fog, even from the air itself if the humidity is very high and the temperature is low. They also dry out slowly, making it possible for the photosynthesizing partner(s) to make food for as long as possible. This ability to quickly absorb and retain water from many sources makes it possible for lichens to live in harsh environments like deserts and Polar Regions, and on exposed surfaces like bare rocks, roofs and tree branches.

#### Types of Lichen

##### Foliose

Flat leaf-like lichens

##### Crustose

Crust-like lichens that may be buried in tree bark, or even between the crystals of rocks.

##### Fruticose

Miniature shrub-like lichens, one of the famous lichens of this type is "reindeer moss" of Lapland.

##### Squamulose

Scaly lichens made of numerous small rounded lobes, intermediate between foliose and crustose lichens.

#### Crustose



Fruticose



Squamulose



Most lichens grow slowly, probably because they live in environments where water is available for only short periods. They tend to live for many years, and lichens hundreds of years old can be used to date the rock surfaces on which they grow.

Lichens spread mostly by small pieces of their body being blown around. All the partners in the original lichen body are present in the fragment, so growth can begin immediately. Some lichens create soredia, balls of tissue made just for dispersal. Although the fungus is the major partner, dispersal by spores is rare.

Supplementary secondary products are used to make everyday life more colorful and pleasant. Some are used to scent soaps and make perfumes. Others were used in the past to dye woolen cloth. Most colors were some shade of brown or yellow, but blue was produced from a few species. The discovery of synthetic dyes ended the demand for lichen dyes. The synthetic dyes provided many more colors, and did not fade. Lichen dyes are still used by some craft weavers who like their soft, quiet colors. Today, the only commercially important lichen dye is used to make litmus paper, to test the acidity of liquids. The litmus dye turns blue in "basic" (low-acid) solutions like ammonia, and red in

acid solutions like vinegar.

Lichens can be an important food source in extreme environments. The Lapp people, who live above the Arctic Circle in Scandinavia and Russia, harvest lichens as winter food for their reindeer, just like farmers in temperate zones stockpile hay.

Lichens are also significant in making soil. Soil is made up of organic matter, such as decayed plants, and minerals. Species that grow on rocks permeate and wedge apart pieces of the rock by both pressure and chemical action. Some of their acidic secondary products dissolve the rock's surface, freeing mineral grains. This is an extremely slow process, but the flexibility and endurance of the lichen fungi puts time on their side.

### Conclusion

They differ in their sensitivity to air pollution, and the presence or absence of different lichens in an area has been used to map concentrations of pollutants. Foliose lichens are used to represent trees in model train layouts. Lichens also make about 400 known "secondary products". It is thought that these chemicals are produced by lichens as defenses against disease and parasites, and, in some cases, to make the lichen taste unpleasant to animals. Some of these compounds are now used as anti-viral and anti-bacterial

medications. In the present report the maximum of Foliose and Crustose group of lichens have been documented. The molecular level of identifications to be carried out with expert and industrial collaborations.

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## Diversity of Macro-fungi in central India-XI: *Trametes lactinea* on *Terminalia arjuna*, a new host record

R.K. Verma<sup>1</sup>, A.J.K. Asaiya<sup>1</sup> and Shailendra Kumar<sup>2</sup>

Forest Pathology Division

<sup>1</sup>Tropical Forest Research Institute

(Indian Council of Forestry Research and Education, Ministry of Environment, Forest and Climate Change)

Jabalpur -482 021, Madhya Pradesh

<sup>2</sup>ICFRE, Dehradun

E-mail: vermaramk@icfre.org

### Abstract

*Trametes lactinea*, characterized with sterile sporophores containing very small pores, trimitic hyphal system and thin whitish azonate pileus. It is widespread in the paleotropics and causes a white rot as all *Trametes* species. The fungus was for the first time collected on woody roots of a living tree of *Terminalia arjuna* from Samardha, Bhopal, Madhya Pradesh. Thus occurrence of *Trametes lactinea* on *Terminalia arjuna* constitute a new host record from India.

### Introduction

The polyporoid genus *Trametes* Fr. was created by Fries (1835) to accommodate coriaceous species with poroid hymenophore characterized by a context continuously descending into the hymenial trama. In addition other genera were created based on other structures of the hymenophore for example lamellate in *Lenzites* Fr., or daedalean in *Daedalea* Fr, etc. Later, Quélet (1886) refined the systematics of the polypores and separated species with regular pores, including stipitate species such as *Caloporus* Quélet., or *Leucoporus* Quélet., and sessile or resupinate species (*Coriolus* Quélet. *Phellinus* Quélet., etc.), from species with alveoloid to daedalean pores, including *Trametes gibbosa*, *T. suaveolens*, *Daedalea* Pers., and *Hexagona* Poll., etc.).

*Trametes lactinea* (Berk.) Sacc., is widely distributed in Australia, Ceylon and Java and it is also widespread in Asia (Pakistan to Phillipines, India and in the paleotropics) (Mohanani, 2011; Quélet, 1886; Ryvarden et al., 2009; Ryvarden and Johansen, 1980; Tiwari et al., 2013; Verma et al., 2008; Vlasák and Kout, 2011).

*Trametes lactinea* (Berk.) Sacc., was earlier recorded on *Anogeissus latifolia*, from CG Odisha (Tiwari et al., 2013). It was also recorded on living branch of *Mangifera indica* from WB (De, 1997). The present article for the first time reports the occurrence of *Trametes lactinea* on root of *Terminalia arjuna* from India.

### *Trametes lactinea* (Berk.) Sacc.

*Leiotrametes lactinea* (Berk.) Welti & Courtec., in Welti, Moreau, Favel, Courtecuisse, Haon, Navarro, Taussac & Lesage-Meessen, *Fungal Diversity* 55(1): 60 (2012)

=*Coriolus lactineus* (Berk.) G. Cunn., *Proc. Linn. Soc. N.S.W.* 75(3-4): 229 (1950)

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=*Trametes levis* Berk., *J. Bot.*, Lond. 6: 507 (1847)

=*Trametes lactinea* (Berk.) Sacc., *Syll. fung.* (Abellini) 6: 343 (1888)

=*Trametes lactinea* (Berk.) Sacc., *Syll.*



fung. (Abellini) 6: 343 (1888) var. *lactinea* = *Trametes lactinea* var. *poris-minoribus* Berk. & Cooke, J. Linn. Soc., Bot. 15: 385 (1876) [1877]

(Polyporaceae, Polyporales, Incertae sedis, Agaricomycetes, Agaricomycotina, Basidiomycota, Fungi)

### Taxonomic Description

Basidiome: annual, solitary, imbricate, sessile, applanate, semicircular, 4060 x 25-42 x 10mm (at the base), 2-5mm (at the margin), corky to woody hard when dry. Pileus: off-white to cream when fresh, soft to velvety to touch, with age become warted or with irregular outgrowth specially near the base, azonate, some time very slightly concentrically sulcate and zone near the margin. Margin entire to weakly lobed, obtuse and relatively thick, concolorous with the pileus. Context: 2-10 m thick cream, ochraceous to pale fulvous. Hymenium: ochraceous to pale fulvous, pore round to angular 2/mm, poretube very thin less than 0.5 mm deep. Hyphal system: trimitic, generative hyphae clamped, hyaline thin-walled, 2.0-2.5  $\mu$ m wide, skeletal hyphae abundant, hyaline to pale yellow, thin walled to almost solid, 3.0-5.0  $\mu$ m wide, binding hyphae abundant hyaline to pale yellow, arboriform to coralloid, 2.0-3.5  $\mu$ m wide. Basidiospores: not seen, hyaline, ellipsoid to cylindric, 4.0-7.5 x 2.0-3.0  $\mu$ m. Specimen on *Terminalia arjuna*: sterile, very characteristic by its small pores, trimitic hyphal system, whitish, soft, usually azonate pileus. It is widespread in the paleotropics. It causes white rot.

### Specimens examined

Tropical Forest Research Institute TF-1590, 1910, 2331, 2473, 2541, 2542, 2571 and 3853. On wood of *Anogeissus latifolia*, Kota, *Shorea robusta*, Kondagaon CG; Viruda, Bhanjnagar (Lal

Singh depot), Korian, Khopriya (Orissa), associated with woody dead roots of a living tree of *Terminalia arjuna*, standing in the water stream side, Samardha, Raisen road, Bhopal, Madhya Pradesh, (N 23° 19' 43.2"; E 77° 36' 23.6") 23.11.2016.

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Fig.1: *Trametes lactinea*, Fruit body upper surface



Fig.2: *Trametes lactinea*, fruit body pore surface



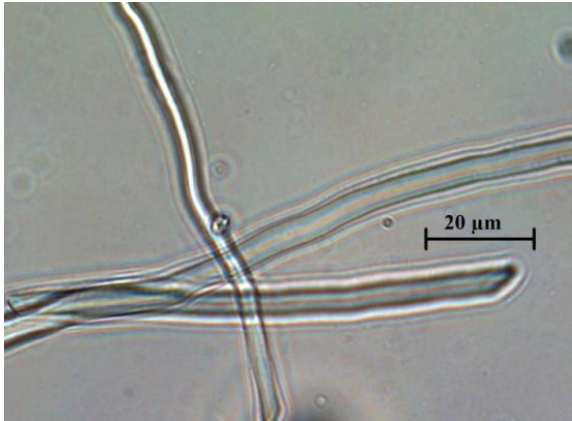


Fig.3: *Trametes lactinea*, binding hyphae

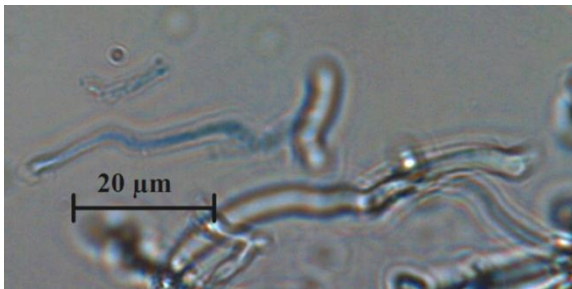


Fig. 4: *Trametes lactinea*, generative hyphae



**Figure 5:** *Trametes lactinea*, associated with woody dead roots of a living tree, *Terminalia arjuna*, standing in the water stream side, Samardha, Raisen road, Bhopal, Madhya Pradesh



**Figs.6-7:** *Trametes lactinea*, fruit bodies associated with *Terminalia arjuna* roots

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## Know your biodiversity

Swaran Lata, Varsha and Isha

Himalayan Forest Research Institute (HFRI)

(Indian Council of Forestry Research and Education, Ministry of Environment Forest and Climate Change)  
Shimla (Himachal Pradesh)

### *Quercus oblongata*



*Quercus oblongata* is an evergreen tree commonly known as Ban oak, Grey oak, Himalayan White oak, Kumaon Oak, and Dyer's Oak. It belongs to order Fagales and Family Fagaceae. *Quercus leucotrichophora* and *Quercus incana* are its synonym. The species name '*leucotrichophora*' means carrying white hairs.

It is a tree of Asia distributed in Northern India, Nepal, Myanmar, Pakistan and Sri Lanka. In India it is found in Himachal Pradesh, Uttarakhand and Jammu & Kashmir at altitude of 1200-2500 m. In Himachal Pradesh it is very common in temperate areas and usually seen in the form of pure or mixed forests in Chamba, Kangra, Kinnaur, Kullu, Mandi, Shimla and Sirmour districts. It is generally found in association with *Rhododendron arboreum*, *Quercus dilatata*, *Cedrus deodara*, *Pinus wallichiana*, *Aesculus indica*, *Lyonia ovalifoila*, *Myrica esculenta*, *Alnus nepalensis* etc. It have

several traits which allow it to dominate in the forest like coppicing power of young trees, longevity of trees, adaptability of wide range of edaphic conditions, heavy shade and wide spreading crowns of mature trees that prevent most other species from invading.

It is a moderate sized to large evergreen tree with massive branches and a rounded crown. Bark dark-grey, rough with cracks and fissures. The leaves are 5-12 cm long, alternate, elongated ovals with sharp teeth on the edges, pinkish in colour when young and later the upper surface of the leaves became deep green while the lower side is silvery grey due to the presence of white hairs. The petiole is 1.2-1.7cm long. The flowers are monoecious and come out in catkins. Male catkins are borne on the tips of the branches they are 3-10 cm long, drooping, usually clustered, softly hairy, while tiny round female flower are borne at the base of the leaves and they are sessile and axillary. Acorns solitary or in pairs usually grow on current year shoot having a cup outside enclosing with 2cm long nut which has brown colour when ripe. Each acorn contains seeds and takes 6-18 month to mature. Flowering and fruiting period is April to October.

*Quercus leucotrichophora* is a multipurpose tree. It provides an excellent fuel wood, fodder and firewood for cooking. The leaves of the ban oak are said to be very nutritious so preferred as cattle feed. The leaves are also used in cowsheds by mixing with dung of the cattle and used as manure in the fields. The wood is used



as firewood and also used to make charcoal. The seeds of the ban oak are used in the treatment of gonorrhoea, indigestion, diarrhoea and asthma also used in the treatment of snake bite. The seeds can be roasted to make a coffee substitute. The galls produced on the tree are strongly astringent and can be used in the treatment of hemorrhages, chronic diarrhoea and dysentery etc. The gum is used for treating cold, stomachache and as an analgesic. Bark of the tree is used to cure toothache and piles and also in the form of gargle in tonsil's (25g bark in 100ml water). It also provides tannins for leather. In addition to fodder, fuel, medicinal benefits it is also important for the conservation of soil, water and native flora fauna by providing ideal habitat to them.

The *Quercus leucotrichophora* is declining with time because of the pressure have increased due to the population explosion and probably global warming and deforestation and urban development. Lopping of tree for fuel wood and leaf fodder is a dominant disturbance particularly in vicinity of villages. Excessive and unmanaged lopping coupled with grazing leading to rapid degradation. Heavy lopping also result in poor acorn production which results low seed fall hence there is no new tree growing in the area of its availability. Expansion of orchards and horticultural fields leading fragmentation of ban oak forests and regular forest fires are also causing threat to this tree. Tree is generally affected by different types of flies of family Cecidomyiidae which cause leaf galls. Beside these two insects *Calandra glandium* and *Curculio sikkimensis* also cause damage to acorns.

This species is very important from the conservation point of view because it is a source of fodder for livestock especially in temperate areas of Western Himalayas and also plays important role in soil, water conservation. Through the sustainable utilization and plantation of this species and other fodder species in the fringe of agriculture, barren fields and degraded ban forest areas can help in conservation of this valuable species. Beside this village level community awareness programmes should be organized to stop the further degradation of Ban oak.

#### *Columba leuconota*



*Columba leuconota* is a species of bird belongs to order Columbiformes and family Columbidae. The common name of *Columba leuconota* is Snow Pigeons. The genus name '*Columba*' comes from the Latin word '*Columba*' means 'a dove'. It is found in hilly regions of Central Asian countries viz. Afghanistan, Bhutan, China, India, Kyrgyzstan, Myanmar, Nepal, Pakistan, Tajikistan, and Turkmenistan. *Columba leuconota* is high altitude bird ranges 2800m to 5000m. In India it is found in Kashmir, Garhwal, Kumaon and Sikkim. These pigeon are altitudinal migrant birds. In winter they move to the warmer climes of lower altitudes range of 1500 m.

It is birds of high Himalayas live in alpine zone (alpine tundra, rock hill sides and sequestered valley) in mountain ecosystem dominated by grasses and low growth

shrubs. They are observed up to the snow line. They forage in the undulating plains and hill sides and roots in the cliffs and rocky ledges. They do not normally occur in forests. They inhabit barren sandy plains near water body. They move in flocks and forage in the morning and afternoon on the undulating treeless semi desert. They feed mostly on grains, seeds of herbs, berries, bulbs, bulbils, bulbs, small roots and shoots.

*Columba leuconota* are 35cm long and 250 to 300 grams in weight. They have black beak and red feet and have blackish head with white neck collar. They are black on lower back. Their wings are pale grey with three brown bands, these characteristics seen at rest and in flight. They are brownish grey with a white patch on the lower back. Their black tails have a clear white band in the middle which narrows and curve forward to reach the tip of outermost tail features. Young birds have narrow pale buff margins to the feathers of the upper parts and wings.

They frequent rocky hill sides and sequestered valleys, seen up to the snow line. They are generally shy and wary. Gatherings of 150 or more occur in winter, often in company of hill pigeon and in some areas with rock pigeon too. In the summer, they descend to lower heights and are found in pairs or small flocks. They breed in colonies. The nests are placed in crevices or caves in the face of cliffs or ledges of rock. Their nests are untidy interlaced structures made of sticks, grass, straw, feathers etc. The nests are generally reused every year with minor repairing.

The breeding season of snow pigeon species is from May to July. They often breed in larger colonies, nesting in crevices, cracks or caves in the face of cliffs or rock ledges. The clutch usually

contains two eggs. Hatching period is 18/19 days and both parents participate in the incubation of eggs. Both parents feed the young with a special 'pigeon milk' that is regurgitated and fed to the squabs. Each squab can double its birth weight in one day but it takes 3 days to starts its heart beating and 4 days for the eyes to open. When squabs are hungry they 'squeak' whilst flapping their wings and as a result they are also commonly known as 'squeakers'. At approximately 2 months of age the young are ready to fledge and leave the nest. This longer-than-average time spent in the nest ensures that the life expectancy of a juvenile pigeon is far greater than that of other fledglings. Their average lifespan is 5.6 years.

Like other pigeons *Columba* has great nutrition in its meat. Its meat contains has high mineral contents and prevent skin diseases like warts and increasing the function of immune system. It also helps in optimizing the function of liver and kidney and also reduces blood pressure and blood sugar level. Expansion of cultivation, illegal logging, overgrazing by livestock, weaknesses in protected area management, hunting and trapping are the some of the threats which affecting its habitat and its populations.

This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (Extent of Occurrence <20,000 km<sup>2</sup> combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation). The population trend appears to be stable, and hence the species does not approach the thresholds for Vulnerable under the population trend criterion (>30% decline over ten years or



three generations). The population size has not been quantified, but it is not believed to approach the thresholds for Vulnerable under the population size criterion (<10,000 mature individuals with a continuing decline estimated to be >10% in ten years or three generations, or with a specified population structure). For these reasons the species is evaluated as Least Concern by IUCN. Although its population seems stable but we need to take care of these species before they come under threatened categories by developing suitable conservation strategies in its zone of occurrence.

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**P.O. RFRC, Mandla Road**

**Jabalpur – 482021 M.P. India**

**Phone: 91-761-2840484**

**Fax: 91-761-2840484**

**E-mail: [vansangyan\\_tfri@icfre.org](mailto:vansangyan_tfri@icfre.org), [vansangyan@gmail.com](mailto:vansangyan@gmail.com)**

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