



FORESTS OF KARNATAKA A PANAROMIC VIEW

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Chapter 1

FOREST

What is a forest? It is both easy and difficult to define a forest. The simplest definition perhaps is the one adopted by the Forest department, i.e., any land notified as 'forest' is a forest. This definition is helpful from the point of protecting the lands which the department is mandated to protect and manage. However, what conceptually constitutes a forest is missed out in such a sweeping definition. A simple definition of forest as per Oxford dictionary is: 'A large area covered chiefly with trees and undergrowth.' According to Cambridge dictionary, forest is 'a large area of land with trees and plants, usually larger than a wood, or the trees and plants themselves.' As per Merriam-Webster dictionary, forest is 'a dense growth of trees and underbrush covering a large tract'. The common elements in these definitions are: large area, trees, plants and undergrowth.

Ideally, a normal forest has the following attributes: it has many trees belonging to different genera and species; the trees are of different ages, i.e. each species is represented by seedlings, saplings, poles and trees. In addition to trees, there are other plants such as herbs, shrubs, climbers, lianas, palms, ferns, orchids, grasses, mosses, etc. The trees and other plants along with their root systems occupy different layers of the space above as well as below the ground. A distinct feature of an ideal forest is the forest-floor which is a layer of organic matter just above the soil surface. This layer is made up of fallen or shed vegetative parts like leaves, branches, twigs, bark, stems, flowers, fruits, etc. and left-over body parts of dead animals. These are in different stages of decomposition brought about by the soil fauna and soil flora present in the soil. Soil fauna includes mice, moles, earthworms, ants, beetles, termites, spiders, nematodes, mites, centipedes, springtails, mollusks, protozoa, etc. Soil flora includes bacteria, archae, fungi, algae, etc. The ultimate product of decomposition of the organic matter is called humus, a protective cushion over the soil surface - a very important component that provides sustainability to a forest ecosystem. A forest is not complete without its terrestrial as well as arboreal inhabitants including mammals, reptiles, amphibians, birds and a very large variety of insects such as bees, beetles, butterflies, cicadas, crickets, dragonflies, grasshoppers, moths, etc.

The type of forest occurring naturally in a given tract of land is dictated primarily by the general climate and soil in the tract. The treatment to which the forest was subjected in the past also influences its present composition as well as status. A number of factors such as temperature, rainfall, humidity, incident radiation, wind, altitude, topography, aspect, etc. determine the overall climate of a place. The soil conditions of a locality depend upon a set of factors such as geology, soil formation (*in situ* or *ex situ*), soil maturity, soil classification, soil moisture, etc. Soil-related factors are commonly known as edaphic factors. Past treatment of the forest includes past forest management practices as well as other biotic factors such as shifting cultivation, withdrawals, recurring fires, over-grazing, etc. All these climatic, edaphic and biotic factors are collectively known as locality factors. The relative dominance of the locality factors varies from place to place. Depending

upon the interplay of the prevailing locality factors, different types of forests occur in different areas.

The formation and development of a particular type of forest in a given landscape is however the result of a dynamic evolutionary process called succession (see Box) in which the composition of the plant community keeps on changing until it attains a stage of stable equilibrium for that specific locality with given climatic and soil conditions. This stage of equilibrium is known as climax stage. In a **climax forest**, trees growing within a particular geographic region essentially remain unchanged in terms of species composition for as long as the site remains undisturbed. When a climax forest is disturbed by external/biotic factors such as shifting cultivation, repeated fires, over grazing, excessive felling, etc., the composition of the forest undergoes change. The resultant forest is known as **secondary forest**. When the composition of a forest is determined mainly by the soil factors or soil conditions, such forest is known as **edaphic forest**. Bamboo brakes (wet soils), Cane brakes (very wet soils), lateritic semi-evergreen forest (lateritic soils), *Hardwickia* forests (shallow hard gravelly soils), *Terminalia tomentosa* forests (heavy soils), etc. are examples of edaphic forests.

In the following chapters we will discuss about the various types of forests that occur in Karnataka. India's tropical region, of which Karnataka is a part, harbors two major types of forest: **Deciduous forest** and **Evergreen forest**. Before discussing further about these two types of forest, it is necessary to know about the characteristics of deciduous trees and evergreen trees, which respectively constitute the major components of these forests.

Deciduous trees:

The word 'deciduous' means 'falling off at maturity' or 'tending to fall off', and it is typically used in order to refer to trees or shrubs that lose their leaves seasonally. In forestry, deciduous trees are those that lose all of their leaves for part of the year. This process is called 'abscission'. Abscission is the shedding of various parts of an organism, such as a plant dropping a leaf, fruit, flower, or seed. It is a natural

SUCCESSION

Forest is a dynamic ecosystem which undergoes constant change as the trees/plants compete with one another for sunlight, water and nutrients. As a result of such competition, one type of plant is replaced by others, and the process continues. This process of replacement of one type of plant by another is called succession. Each stage of succession creates a set of environmental conditions which make it ideal for the establishment of the next stage, and so on. During succession, with the progress of time and change in the environmental conditions, different species of trees/plants become dominant.

Natural succession of forest in the earth, known as primary succession, began after the ice age ended, when ice began to melt in certain parts of the planet and conditions there became warmer. Primary succession usually begins on bare soil or sand where no plants grew before. When the sunlight, moisture and air temperature are just adequate, seeds begin to germinate and grow. The plants which appear first are often made up of mosses, grasses and herbs. They continue to grow and eventually form grasslands. Over time, and as environmental conditions change and become favorable, other plants such as shrubs and trees begin to grow. These plants become dominant and replace or take over where mosses, grasses or herbs originally grew.

As primary succession continues, pioneer trees begin to thrive. The pioneer trees are light demanding or sun-loving and are intolerant of shade. They quickly take over the grasslands. They change the environment by providing shade. This allows trees with broader leaves that prefer some protection from the sun to take root and establish. These are also called shade-tolerant trees as they tolerate some shade. If conditions are favorable, a mixed forest of light-demanding and shade-tolerant trees may continue for many years before more changes occur.

Climax forest

Seedlings from pioneer trees do not grow well in shade; therefore, new pioneer trees do not grow. As the mature trees start dying and falling from old age, disease and other causes, the broad leaved shade-tolerant trees become dominant. The shade from these broadleaved trees can also be too dense for their own seedlings. As a result, seedlings from trees which are more and more tolerant of shade begin to thrive and dominate the forest. These trees produce such deep shade that only those trees or plants that can survive in complete shade will succeed. When this happens, the result is a climax forest - one in which certain species of trees characteristic of the ecological conditions of the area are dominant.

Few true climax forests actually exist because forests are dynamic ecosystems and changes take place that interfere with a forest's stability. A climax forest may get destroyed or damaged because of natural or man-made causes such as glacier movements, floods, high winds, volcanic activities, fires, excessive grazing, shifting cultivation, heavy felling, etc. Then the process of succession starts all over again. Such succession is called secondary succession.

Secondary succession

If a climax forest destroyed or damaged due to natural or man-made causes as mentioned above is left alone, it will eventually be covered with trees again. This is called secondary succession. Secondary succession normally takes place more quickly than primary succession. Seeds from neighboring forests are carried to the site due to wind or rain, or through animals. Soon, the seeds take root and seedlings sprout, and the process begins again.

process of detachment of parts of a plant, typically dead leaves and ripe fruit. In some cases, such as in temperate or polar climates, leaf fall coincides with autumn or winter season. In other parts of the world, including tropical, subtropical and arid regions, plants lose their leaves during dry seasons or other seasons, depending on variations in rainfall. Deciduous trees are predominantly broad-leaved trees. The act of shedding leaves by deciduous trees is usually an adaptation to a cold or dry season. Trees shed leaves in order to conserve water and energy. The period of leaflessness is dependent on the period and degree of dryness in the soil; it also varies from species to species. Certain species shed leaves early whereas in certain species the leaves hold on to trees much longer. Under drought conditions, trees tend to shed leaves earlier than usual.

Evergreen trees:

Evergreen trees or plants have leaves throughout the year, and therefore they always remain green. This contrasts with deciduous plants, which completely lose their foliage during the winter or dry season. It however does not mean that evergreen trees do not shed their leaves at all. Evergreen trees do lose leaves, but each tree sheds its leaves gradually and not all at once. In other words, unlike deciduous trees, evergreen trees do not have a distinct period of leaflessness. Evergreens include most species of conifers, most angiosperms from frost-free climates, such as eucalyptus and rain forest trees.

As the names suggest, deciduous forests have preponderance of deciduous trees and evergreen forests are dominated by evergreen trees. However, it is not necessary that all the trees of an evergreen forest are evergreen trees. There are a number of deciduous tree species which are found in evergreen forests. These include *Ailanthus malabarica* (halmaddi), *Cedrela toona* (gandhagarige), *Acrocarpus fraxinifolius* (balanji), *Antiaris toxicaria* (ajjanapatte/karvat), *Xanthoxylum rhetsa* (jumminakai), *Spondias acuminata* (amtekai), *Tetrameles nudiflora* (jarmal), *Bischofia javanica* (neelimara), *Trewia nudiflora* (kat-kumbala/petari), etc. Similarly, there are a number of evergreen trees which are found in deciduous forests. *Santalum album* (sandal/shrigandha) is a typical example of an evergreen tree found in deciduous forests. Evergreen tree species such as *Azadirachta indica* (neem/bevu), *Tamarindus indica* (hunase), *Ixora arborea* (lokhandi), *Pithecellobium dulce* (vilayati hunase), *Thespesia populnea* (bugari/hoovarasi), *Morinda tinctoria* (maddi), *Erythroxylon monogynum* (devadari/jivadali/jeemthali), *Mangifera indica* (mavu), *Prosopis juliflora* (Ballari jali), *Trema orientalis* (charcoal tree/kiruhale), *Salvadora persica* (khakhin/karigoni mara), *Mallotus philippensis* (kumkuma/sinduri), *Syzigium cumini* (neral), *Ficus* species (atthi, ala, goni and others), etc. are quite common in deciduous forests. *Pongamia pinnata* (honge) is an almost evergreen tree found in streambanks of both evergreen and deciduous forests. It is a deciduous tree with a very short period of leaflessness, sometimes just a day or two. Among the *Artocarpus* species which are common in evergreen forests, *Artocarpus lakucha/gomezianus* (watehuli) is deciduous, whereas the other species such as *Artocarpus hirsutus* (hebbalsu) and *Artocarpus heterophyllus* (halasu) are evergreen. In the *Sterculiaceae* family, *Pterygota alata* (kolugida/anathondi/poola) and *Sterculia guttata* (happu savage/kuhimdar) are evergreen species, whereas *Sterculia villosa* (bilidale/savaya/anenar) and *Sterculia foetida* (patala mara/peenari) are deciduous, although all these four species mostly occur in the semi-evergreen and evergreen forests in Karnataka. There are certain species such as *Chukrasia tabularis* (kalgarike/kempudevadar), *Strychnos nux-vomica* (kajra/kaasarka), etc. which are deciduous or evergreen depending upon the environment in which they grow. Some common tree species of deciduous forests such as *Dalbergia latifolia* (beete/sissum), *Saccopetalum tomentosum* (omb), *Acacia nilotica* (jali), *Terminalia arjuna* (holematti), *Buchanania lanzan* (char/nurkal), *Madhuca longifolia* (sanna ippe/hal-tumri), etc. exhibit characteristics of nearly evergreen trees with a very short, or almost negligible, period of leaflessness. Many

herbs and shrubs of deciduous forests are evergreen in nature. Similarly, deciduous shrubs are found in evergreen forest also.

Being evergreen or deciduous is an intrinsic quality of a species. However, the natural occurrence of a tree species either in an evergreen forest or in a deciduous forest is not very rigid; it is determined by the interplay of various factors such as rainfall intensity, rainfall distribution, temperature, soil profile, etc. Depending upon these factors, the distribution pattern may change from region to region. It is quite often found that a number of tree species generally associated with evergreen forest in peninsular India are commonly found in the deciduous forests of the North East. *Sterculia villosa*, *Alstonia scholaris*, *Tetrameles nudiflora*, *Aphanamixis polystachya* (*Amoora rohituka*), *Cedrela toona*, *Chukrasia tabularis*, etc. are examples of such tree species.

Availability of soil moisture (mostly through rainfall) is the primary factor deciding the evergreen or deciduous character of tropical forests. As we move from moister areas to drier areas, evergreen forests give way to deciduous forests. In deciduous forests too, marked change in composition is noticed as we move from dry to drier areas; the proportion of trees with thorny elements (thorns, spines and prickles) increases. They provide protection from herbivorous intruders thereby ensuring survival and prolonged life of the trees and the forests. They help in conservation of water and energy by reducing evapo-transpiration from trees. **Thorn forests** are important forests in the arid region (*bailuseeme/maidan*) of Karnataka. Many of these forests are remnants of erstwhile deciduous forests which in the past had been subjected to maltreatment due to heavy felling, over-grazing and recurring fires. Such forests in defence tend to throw up more and more thorny species during the secondary succession. These forests have preponderance of species such as *Acacia nilotica* (babul/karijali/gobli), *Acacia catechu* (khair/cutch/kaggli), *Acacia latronum* (hottejali), *Acacia leucophloea* (bilijali), *Acacia ferruginea* (banni), *Acacia chundra* (kempujali), *Zizyphus jujuba* (bore), *Zizyphus xylopyrus* (gotte), *Randia dumetorum* (kare), *Dichrostachys cinerea* (wadu), *Capparis divaricata* (thottala/mullippi), *Capparis decidua* (karina), *Pterolobium hexapetalum* (baadu bakka/kabala mullu), *Gymnosporia spinosa* (tandrasi), *Euphorbia* species (kalli), etc. *Opuntia* species (cacti) has naturalized in some of the highly degraded sites.

In forestry, the terms 'light demander' and 'shade tolerant' or 'shade bearer' are often used to indicate the preferences of trees/plants in terms of their light requirement. As sunlight is the principal source of energy for growth, trees/plants necessarily need sunlight. However, during the initial stage of their lives, certain species may show preference for sheltered light or tolerance to shade. By and large, most of the evergreen tree species prefer sheltered light or tolerate partial shade in their younger stage. As a matter of fact, these species exhibit extremely high degree of shade tolerance. In the evergreen zone, the density of seedlings or saplings is quite high. As and when an opening is created in the forest due to tree fall, snapping of a branch, or the neighboring deciduous tree shedding its leaves, there is intense competition among the seedlings/saplings growing underneath, and some of them gain height to occupy the vacant vertical space. The unsuccessful ones wait for another opportunity. In this way, the dynamic growth process of the forest is continued. In deciduous forest, most of the tree species are usually strong or moderate light demanders, although there are some species which in the seedling or sapling stage prefer sheltered light or tolerate partial shade. *Dalbergia latifolia* (beete/sissum/rosewood), *Lagerstroemia lanceolata* (nandi/nana), *Xylia xylocarpa* (jamba), *Terminalia paniculata* (kindal/hunal), *Santalum album* (shrigandha/sandal), etc. are examples of tree species of the deciduous zone which show some degree of preference for, or tolerance to, partial shade during their initial phase of growth. However, they generally require full overhead light

Thorns, Spines and Prickles

Thorn is a sharp pointed modified stem;

Spine is a sharp pointed structure that is a modified leaf or a stipule;

Prickle is a sharp outgrowth from the epidermis or bark.

Thorns and Spines emerge at the nodes of a plant whereas Prickles arise in locations other than the nodes. Prickles can also grow on surface of leaves or fruits.

beyond sapling or pole stage. The tree species occurring in the thorn forests are usually strong light demanders.

Most of the evergreen tree species regenerate from seeds. The seeds usually remain viable for shorter periods. For effective germination and initial growth, the seeds prefer a forest floor which is rich in humus. As already mentioned, seedlings and saplings in the evergreen forest either prefer sheltered light or tolerate partial shade, and they have tremendous patience and tenacity to wait for their turn to grow up. These conditions are generally met with in a normal evergreen forest thereby ensuring regeneration and growth of the existing forest in perpetuity. The moment such a forest is opened up and exposed to biotic disturbances, the local conditions of the opened-up area change drastically due to over-exposure to light and heat; the soil surface rich in humus soon gets drained and impoverished as a result of heavy rainfall, which is common in these areas. Removal of forest cover is soon followed by permanent drop in fertility. The conditions obtaining in such exposed and disturbed areas are not conducive to regeneration of the existing tree species. Such areas are quickly invaded by light demanding weeds and shrubs. Colonizing tree species such as *Macaranga peltata* (uptige/chandoda), *Macaranga indica* (bettadavare/holenekki), *Trema orientalis* (kiruhale/home/charcoal tree), *Mallotus philippensis* (kumkuma), *Mallotus tetracoccus* (kukbuta), *Debregeasia longifoila* (kurigele), *Callicarpa tomentosa* (towdatti/mardi/kanphulia), etc. often appear in such cleared and disturbed evergreen forests.

A large number of tree species from the deciduous zone coppice well, some of them very vigorously. Coppicing refers to the phenomenon of production of new shoots from the stump of a tree after the tree is felled. In the deciduous zone, coppicing is an additional means of propagation of many tree species, notably the hardwood species. Besides, seeds of the deciduous species remain viable for a relatively longer period compared to the seeds of evergreen species. As a result, in a deciduous forest the tenacity of the trees to perpetuate is higher. On the other hand, most of the evergreen species do not coppice at all, or they coppice poorly. Besides, as already mentioned, seeds of evergreen species remain viable for short periods and they have difficulty in germinating and growing up in sunny positions and exposed/disturbed environment. These adverse conditions make the evergreen forest extremely vulnerable to human intervention and interference. Once an evergreen forest is disturbed or opened up, it is very difficult, at times almost impossible, to restore its original status.

Although deciduous forests have the tenacity and resilience to perpetuate on account of a number of favorable factors such as coppicing vigor of many of their constituent species, relatively longer viability of their seeds, and light demanding nature of the species, these forests face challenges of a different kind. They are subjected to higher degree of intervention and interference because of their proximity to habitations, and economic importance of their constituent trees as source of valuable timber, including teak and rosewood, and fuel wood. More often than not, these forests are subjected to heavy withdrawals; they also suffer from excessive grazing and recurring fires. As we will see in the following chapters, repeated onslaughts on our deciduous forests for many years have resulted in formation of vast expanses of scrub forests with a large proportion of thorny species.

In the following chapter, we will briefly discuss the classification of forests as per the revised system of classification adopted by Sir Harry G. Champion and Mr. S.K. Seth (popularly known as Champion and Seth classification).

Chapter 2

CLASSIFICATION OF FORESTS

For comprehensive understanding of forestry, it is necessary to classify the forests into various types. With this objective in view, a number of classification systems were developed in the past. The systems developed by Beard (1944), Fosberg (1958) and Webb (1959) were based mainly on vegetation (floristic grouping). The systems developed by Schimper (1898), Mayr (1909), Rubner (1925) and Thornwhite (1933) were based mainly on climatic factors. There were a few classification systems, such as those developed by Burt-Davy (1938), Swain and Gaussen (1938), which were based mainly on eco-system which gave sufficient weightage to both vegetational and climatic factors. 'A Preliminary Survey of the Forest Types of India and Myanmar' authored by Mr. H.G. Champion and published in 1935 also belongs to this classification system. The classification system was further revised by Champion and Seth and published in 1968 in the book entitled 'A Revised Survey of the Forest Types of India'.

In the revised classification by Champion and Seth, the forests of India have been classified into six Major Groups:

- I: Moist Tropical Forests;
- II: Dry Tropical Forests;
- III: Montane Subtropical Forests;
- IV: Montane Temperate Forests;
- V: Sub-Alpine Forests; and
- VI: Alpine Scrub.

The six major groups mentioned above are further divided into 16 groups with serial numbers 1 to 16 as follows: I (1, 2, 3 & 4), II (5, 6 & 7), III (8, 9 & 10), IV (11, 12 & 13), V (14) and VI (15 & 16).

Under the Major Group I (Moist Tropical Forests), we have the following four groups:

- Group 1: Tropical Wet Evergreen Forests;
- Group 2: Tropical Semi-evergreen Forests;
- Group 3: Tropical Moist Deciduous Forests;
- Group 4: Littoral and Swamp Forests.

Under the Major Group II (Dry Tropical Forests), we have the following three groups:

- Group 5: Tropical Dry Deciduous Forests;
- Group 6: Tropical Thorn Forests;
- Group 7: Tropical Dry Evergreen Forests.

Under the Major Group III (Montane Subtropical Forests), we have the following three groups:

- Group 8: Subtropical Broadleaved Hill Forests;
- Group 9: Subtropical Pine Forests;
- Group 10: Subtropical Dry Evergreen Forests.

Under the Major Group IV (Montane Temperate Forests), we have the following three groups:

- Group 11: Montane Wet Temperate Forests;
- Group 12: Himalayan Moist Temperate Forests;
- Group 13: Himalayan Dry Temperate Forests.

Under the Major Group V (Sub-Alpine Forests), we have only one group:

- Group 14: Sub-Alpine Forests.

Under the Major Group VI (Alpine Scrub), we have the following two groups:

- Group 15: Moist Alpine Scrub;
- Group 16: Dry Alpine Scrub.

Each forest group is further divided into sub-groups such as A, B, C, etc. For example, Group 1 (Tropical Wet Evergreen Forests) has two sub-groups:

- Sub-group 1A: Southern tropical wet evergreen forests;
- Sub-group 1B: Northern tropical wet evergreen forests;

Group 2 (Tropical Semi-evergreen Forests) has two sub-groups (2A and 2B), Group 3 (Tropical Moist Deciduous Forests) has three sub-groups (3A, 3B and 3C), Group 4 (Littoral and Swamp Forests) has five sub-groups (4A, 4B, 4C, 4D and 4E), and so on.

Each sub-group is further divided into types such as C1, C2, E1, E2, S1, S2, DS1, DS2, L1, L2, TS1, TS2, FS1, FS2, SS1, SS2, RS1, RS2, etc. depending upon their climax status. Here, C represents climatic climax stage, E represents edaphic climax stage, S represents secondary stage, DS represents degradation stage (scrub, savannah), L represents littoral forest, TS represents tidal swamp (mangrove forest), FS represents freshwater swamp, SS represents seasonal swamp, RS represents riparian swamp, etc. For example, the sub-group 1A (Southern tropical wet evergreen forests) is divided into the following five forest types:

- 1A/C1: Giant evergreen forest;
- 1A/C2: Andamans tropical evergreen forest;
- 1A/E1: Andamans moist deciduous forest;
- 1A/C3: Southern hilltop tropical evergreen forest;
- 1A/C4: West coast tropical evergreen forest.

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