**Vegetation Stratification**

Forests are vertically divided into several layers, each with their own unique ecological significance, combining to create an integrated and biologically complex living space.

The number of layers of a forest varies, and these layers are as important to every forests distinctive characteristic as the species that make them up. Each forest has a horizontal organization as well as a vertical structure depending on the maximum height of the different trees and other plants. The term layering in forests is used to divide the vertical structure into many sections, and is also called stratification.

**Many Layers to Every Forest:**

The number of layers a forest has depends most on its climatic conditions, especially light and temperature, as well as soil type and rainfall. Above-ground starting from the outside is the emergent layer, then the forest canopy, the understory, shrub layer, soil layer, and then underground there is the rhizosphere.

**Emergent Layer:**

The emergent layer is the topmost layer, composed of trees, woody climbers, and epiphytes. This strata can have trees reaching 70 to 80 meters high, and is found only in tropical forests. This layer is absent in temperate forests.

**Forest Canopy:**

The forest canopy is continuous in a forest and is made of tree crowns. This can be undulating, as not all species, or even all individuals of the same species, have the same height. The forest canopy is always exposed to sunlight. However trees have to tolerate high humidity and winds as well . Trees grow tall in their competition to reach light. This layer is found in both tropical and temperate forests. The maximum height in tropical forests can be 60 meters high, though average heights are only 10 to 25 meters. In temperate forests this strata can reach 90 meters.

**Understory:**

The forest canopy blocks much of the light from penetrating through it, and consequently the understory is dimly-lit, and calm without much wind due to the overhead shield. So trees found in this layer are those that need less light and this layer is not as densely packed as the canopy, and reaches up to 5 to 10 meters.

**Shrub Layer:**

There is even less light here than in the understory. The shrub layer is 1 to 5 meters and is made of very short trees, and seedlings of bigger trees. Shrubs are rarely found in untouched forests, as they usually need a great deal of sunlight, in tropical forests. Some deciduous temperate forests have a rich shrub layer.

**Non-Woody Herbaceous Ground Cover:**

Here there are herbaceous plants and some grasses. There are usually few species in this layer compared to the other higher layers in tropical forests. While the tree species can run into a few hundreds, there can be less than 50 species of herbs. In untouched tropical forests this strata is rarely more than 10% of the forest area. In contrast, the temperate forest floor can have more species and covers a larger area.

**Moss, Cryptogam, and Shallow Soil Layer:**

This is the zone of the forest with the fallen logs of trees, and the decomposing litter of fallen leaves and twigs. This layer of decomposing organic matter, and cool temperatures are ideal for cryptogams, which are species that use spores and not seeds to propagate, including ferns, mosses, lichens, fungi and algae.

**Rhizosphere: Realm of the Roots:**

The rhizosphere is underground, and is made up of roots. Most of the roots are found in shallow soil, which is the first 5 centimeters in tropical forests, and as the soil depth increases the amount of roots decreases.

**Animals Living in Each Layer:**

In tropical forests, most of the organisms, including insects, birds, and mammals such as squirrels, primates, and the Australian Ring-Tail Possum pictured hanging out above, are found in the forest canopy. There, they are attracted by the ample supply of flowers, fruits, leaves, and other food sources. Insects and micro-organisms are also found in the soil and litter. In temperate forests most of the animal life is found in the cryptogam and herb layer, with a few of them, such as squirrels, also being found living all the way up to the canopy as.

However, the unique niches created in each strata can support different animal life. The climate and soil of a region can determine the number of layers, which in turn can influence the environmental conditions and characteristic biodiversity of each of the layers. Many tropical species need this interactions, as they can germinate only in the dark, and need shade as seedlings and saplings. Without the stratification, primary forests cannot exist, and would be replaced by secondary common species. In the deciduous nature of temperate forests wild flowers are common and bloom in spring before the trees grow leaves.

* **Field Data Collection, Management, and Analysis:**

Field data collection will be completed to classify, and fully describe all vegetation types across the park. The polygons of different vegetation types will be delineated through the interpretation of aerial photography across the pilot study areas. Standard photo interpretation rules will be employed that depend on the identification of homogeneous patches of color, texture, and pattern. New boundaries to the original imagery polygons will be added as the field teams identify additional polygons in the field.

The field work will be stratified to sample all vegetation types on all biophysical classes across the pilot area. Field teams will collect standardized plot data on approximately 10 samples of all vegetation classes across the pilot area. The exact number of samples per class will be determined by total coverage and number of polygons of each type, and will be flexible to account for the degree of biological and environmental variability.

Complete vegetation descriptions for all types found in the park based on the broader knowledge of this type across its entire range will be developed. In addition, field keys will be completed along with photo interpretation keys to detail the characteristics, environmental correlates and distribution of this type within the park.

1. **Photointerpretation and Mapping:**

The methodology and experience from the pilot areas will be then be extended across the park. The vegetation classification, description, environmental "position" and photointerpretation decision rules will be applied to continue the vegetation mapping across the rest of the park. Photo signatures that do not match existing keys and descriptions will be "flagged" as unknown.

1. **Map Validation:**

After the preliminary vegetation map has been completed for the park, an assessment of class accuracy will be carried out. The vegetation class accuracy will be determined through the stratification of sample points by class throughout the park. The methods will be refined to address any problems that are documented from the map validation phase and the preliminary map will be corrected to produce the final vegetation map.

* **Data Collection and Review of Existing Information:**

To ensure the full application of existing data and other information on the park, information on the park's resources will be reviewed and fully evaluated for their quality and utility to this project. In addition, an attempt will be made to identify and contact all individuals who have expertise concerning the biology and ecology of the park.

1. **Biodiversity Information:**

All information concerning the biological diversity of the park will be collected and evaluated for use in the vegetation mapping program. Types of information that will be collected include

**•** Vegetation classifications and other information

**•** Vegetation type distributions

**•** Species inventories

**•** Species range maps

**•** Species and community distribution in relation to environmental variables

**•** Species and community distribution in relation to disturbance events

**•** Biological collections derived from the park

* **Establishing the plot sizes:**

1. One hundred-by-one hundred metre (1-ha) permanent canopy tree biodiversity monitoring plot.
2. Twenty-by-twenty metre permanent stand-alone canopy tree biodiversity monitoring plot.
3. Five-by-five metre permanent small tree and shrub biodiversity monitoring plot.
4. One-by-one metre permanent ground vegetation biodiversity monitoring plot.
5. Permanent transects organized as contiguous five-by-five metre plots.
6. Permanent transects organized as contiguous one-by-one metre plots.

* **How to survey a permanent monitoring plot:**

**Equipment:**

1. Stand chart and list of the randomly selected plot coordinates
2. Theodolite and tripod
3. Two steel survey tapes (minimum length 30 m)
4. One 2-m telescoping surveying rod (with levelling bubble) that extends to 4 m
5. Flagging tape
6. Survey stakes (preferably metal-core plastic), in at least two colours for the 1-ha plot (four of one colour and 32 of the other)
7. Two heavy mallets
8. GPS (global positioning system) instrument with data differentially corrected
9. Waterproof record book and pencils

**How to measure tree height**

It is important to record the heights of individual trees in immature forests because they are measures of the rate of tree growth. The height of an individual tree in mature deciduous forests is often difficult to obtain. For this reason, at least the average tree height and canopy depth of a mature stand should be determined.

Measure the length, diameter and orientation of all tagged trees that fall down between measurement periods.

**Equipment:**

1. Theodometer
2. 30-m steel survey tape
3. Compass
4. One 2-m surveying rod (with levelling bubble)
5. Data sheets and pencils

**Method:**

From a measured distance (such as 20 m) from the base of a tagged tree, record the readings for the top and base of the tree, and the horizontal line from the eye-level of the observer to the tree stem, or equivalent below the base of the tree. Record the eye-level height of the observer and whether the base of the tree is above, the same, or below the eye-level of the observer. In addition, take the reading for the lowest live branch. Calculate the height and canopy depth of each tree.

To measure the average canopy height of a stand, from a convenient location and from a measured distance, take the readings for determining the average height and depth of the stand canopy. Record the heights of emergent species, but exclude them when calculating the average height of the stand canopy.