**3.3. Monitoring plant biodiversity: example of forest ecosystems**

Monitoring plants that are considered as PA values, and is often key to understanding the ecosystem and making the right decisions, especially when it comes to ensuring the sustainable development of certain woody plants. If the goal is to monitor the long-term changes of plant biodiversity in different ecosystems, it is key to use samples in permanently marked-off areas. The intensity of ecological factors can change based on geological or topographic gradients, which then causes changes in the structure and in the floristic composition along these gradients.

Regarding the monitoring of plant communities that do not have strong gradients, it is recommended to use permanent plots. But when the gradients are strong, it is better to use permanent transects. We won’t be developing this specific case here, as this unit focuses on monitoring trees of the forest canopy in stands where there are no strong gradients.

Monitoring trees of a permanent forest plot in the long run, provides important information on the forest structure and composition, on its condition, the growth pace and longevity of tree species inside the forest, on the progressive variation of the species composition and the size of the population, on the impacts environmental changes have on mature trees, etc.

This ongoing form of monitoring helps to assess the impacts of the decisions affecting forest vegetation. In this case, permanent plots can ground-truth the measurements obtained via satellite images. Square shaped plots are generally the norm.

In the case of forest ecosystems, two sizes of square shaped plots are recommended: 100 by 100 metres (1 hectare or 2.5 acres) and 20 by 20 metre plots. These two formats are interchangeable or can be used together.

Ideally, you should be able to use at least two plots of 2.5 acres per selected type of forest or “stand”. And, whatever the stand, use at least five independent quadrats of 20 by 20 metres. Plotting the species accumulation curve determines if this number is sufficient for the given forest stand. To avoid bias, the plots should be scattered randomly throughout the chosen stands. Likewise, the location of a plot in each settlement should be set at random.

Some basic principles ought to be followed:

1. The equivalent of three times the height of the forest cover should separate the plot from the edge of a non-forest stand to prevent an “edge effect”.
2. Plots of 2.5 acres should be separated by at least 250 metre, and 20 by 20 metre quadrats by at least 50 m.
3. In small or uneven forest stands where the previously stated conditions cannot be respected, only independent 20 by 20 metre quadrats (and not 1 ha plots) should be established.
4. Avoid establishing plots where there are strong and unusual plant variations or in the presence of important ecological disruptions, such as a small lake, a field or a river.
5. Avoid places where roads or paths run through the plots, unless the study is about the impact of the use of said paths. In this case, the decision should be justified.

It is vital to collect and take note of the following data:

* The tag number and species of all standing trees with a diameter at breast height (dbh) equal to or higher than 10 cm (4 cm or higher where forest growth is poor)
* The location of all numbered trees (located on a map)
* The dbh of all numbered trees (the dbh measurement follows strict rules)
* The general state of all numbered trees

The following data should also be collected and recorded:

* The height of all numbered trees
* The height of the lowest living branch of all numbered trees
* The canopy age
* Photos taken from given places at set times and dates
* The degree of canopy closure (per quadrat)

The forest stand should be assessed every five years or whenever needed. If the quadrats suffer from terrible weather conditions, fires or other catastrophic events, the quadrats should be measured again and the new information should be recorded as soon as possible after the catastrophe, when the conditions have improved.

To analyse the data:

* Draw up a list of standing species found for all selected trees.
* Take note of all the species found in the plots or in the permanent independent quadrats
* For each species (of living trees only), calculate separately: the abundance, the basal area, the density and the dominance, the frequency, the relative density, the relative dominance, the relative frequency and the value of importance
* Calculate the total basal surface of all standing dead trees and the ones leaning.

If carried out well on representative samples of the studied stand, monitoring plants will help making the right management decisions, be they in terms of forest conservation or of its sustainable use when compatible with the PA’s conservation targets.