

Forest structure: collective versus individual growth

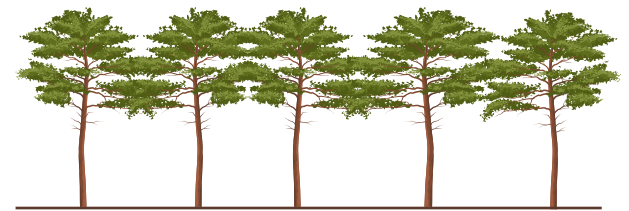
There are two types of highly contrasted forest structures: **even-aged forest** and **uneven-aged forest**. The **even-aged forest** is a **homogeneous forest where the trees are of the same age and have similar competition conditions**. The **uneven-aged forest** is one in which the trees are of **different sizes and different competition conditions**. Each of these forest structures is characterised by a type of tree growth: collective growth in the case of the even-aged forest, and individualised growth in the case of the uneven-aged forest.

■ Forest structure: even-aged and uneven-aged forests

Differentiation is the process by which a tree occupies its neighbour's space to be able to develop its crown. In a forest stand, **if differentiation does not take place, the trees grow without being able to increase its crown**, which becomes unbalanced. The differentiation process can occur naturally or as a result of cutting. The spatial relationship between trees of different ages and sizes defines the structure of the forest. This structure will determine the effect of the natural differentiation of the trees. We can distinguish two types of structures that create very different canopy development conditions: even-aged forest and uneven-aged forest (**Figure 1**).

- **The even-aged forest** is the structure resulting from a disturbance that has removed all the trees. It can be the result of a heavy fire or a clearcutting. It also occurs in reforestations, in which all the trees are of the same age and the preparation of the land gives them similar competition conditions. In these situations, young individuals (seeder species) or sprouts (resprouter species) grow without competition from adult trees. The result is a homogeneous forest, both in terms of structure and species composition.

EVEN-AGED



UNEVEN-AGED



Figure 1. Even-aged and uneven-aged forest structure.

- **The uneven-aged forest** is one in which the trees are of different heights and the growth of each tree depends not only on its height, but also on that of the trees that surround it. Therefore, the rate at which trees move from one size class to the next is different for each class, and it also varies over time, because as trees grows larger, competition decreases.

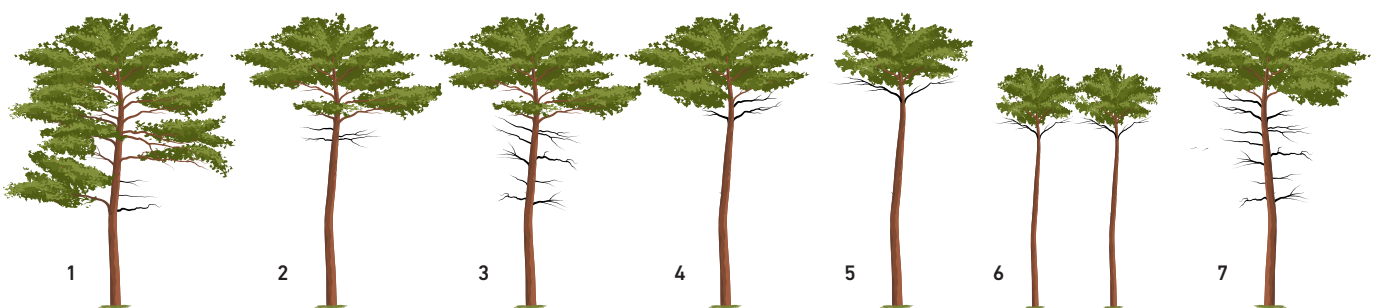


Figure 2. Different situations in an even-aged forest: (1) **forest boundary tree** (the crown develops on the side that has space), (2) **tree with a balanced crown and a well-formed trunk** resulting from the control of the density at throughout forest growth (adequate density throughout growth), (3) **tree with a balanced crown and trunk with large branches** (correct current density but initial too low), (4) **tree with a balanced crown to one side** but greater competition for another that makes the crown small, (5) **tree with a small crown and well-formed trunk** (adequate initial density but without a decrease, leading to a high final density that causes a decrease in diameter growth), (6) **trees with a very small crown that causes a decrease in height growth** (7) **tree with a small crown and very large dead branches** that indicate that the growth of the tree occurred under isolated growth conditions and that the forest subsequently closed (this is a typical situation resulting from the abandonment of wooded pastures).

Each of these forest structures is characterised, as indicated above, by a particular type of tree growth: 1) **collective growth in the case of the even-aged forest**, and 2) **individual growth in the case of the uneven-aged forest**.

■ Collective growth

Collective growth is characterised by the fact that the **conditions are created by trees of similar height** (and usually of similar ages), so that the competition is the same for all individuals growing together. The equality of conditions between all trees makes the natural differentiation between individuals insufficient for a tree to be able to surpass its neighbour and occupy a space that allows it to develop a balanced crown. So, over time, **competition increases** and the crowns become increasingly unbalanced.

This type of growth ends up generating **trees with small crowns, cylindrical trunks and, usually, a reduced individual physical stability** (depending on the size of the crown). Under these conditions, the stability of a tree is determined by the collective support effect between the trees that touch it (collective stability). If this collective effect is lost (for example, by thinning that removes part of the trees), the trees that remain have low individual stability and run the risk of being knocked over by the wind until they regain **a balanced crown (stability individual) or the crowns are closed with their neighbours (collective stability)**.

This structure generates environmental conditions inside the forest (determined by light conditions) that are homogeneous throughout the stand, but that vary significantly over

time (from the moment of regeneration to the maturity of the forest). Within this type of growth, we can find **varied situations according to the space** that the trees have to develop the crown, the degree of natural differentiation that occurs in the mass or differentiation by felling. **Figure 2** shows different situations and how to identify them.

■ Individual growth

In this case, the growing conditions are created by a mixture of trees with different age and height. The heterogeneity of the environmental conditions inside the forest (mainly light) and the age of the trees makes the differentiation processes occur naturally. Small trees thrive in semi-shady conditions with **high initial competition**. As the tree grows, it has increasingly favourable light conditions, i.e. **competition decreases** with growth which allows the development of balanced crowns.

The forest is controlled by large trees, but their crowns do not touch. How tight they are (density of the mass) depends on the climate (the availability of water) and the **tolerance of the species**, variables that often coincide. In these growing conditions, in which adult trees do not touch the crowns, physical stability depends only on the individual and is given by the development of a balanced crown. **Indoor forest (low light) environmental conditions** vary over a short distance, creating different tree growth situations. However, **on a larger scale there is a mosaic of light conditions that remains more or less constant over time**. **Figure 3** shows different situations found in individual growth conditions and how to identify them.

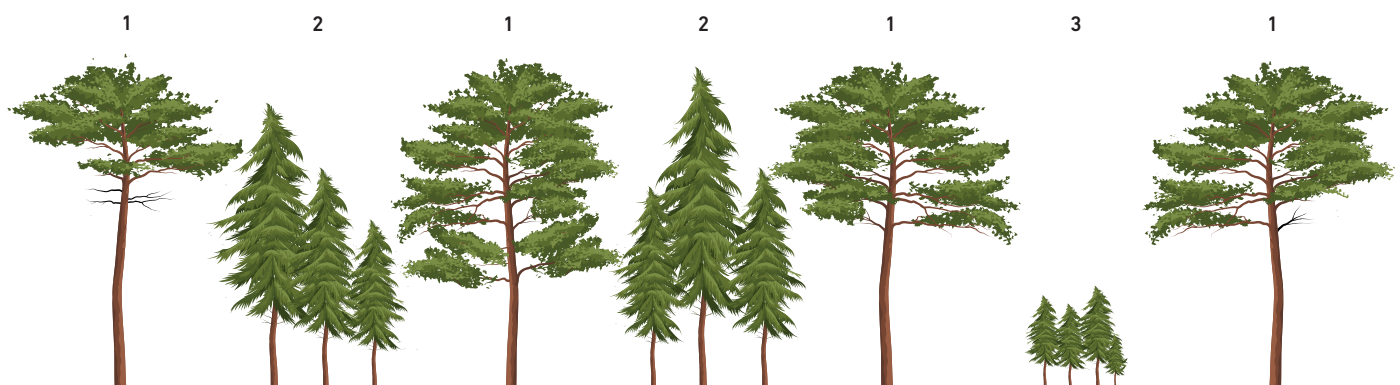


Figure 3. Different situations in an uneven-aged forest: (1) **adult trees that dominate the canopy** (there are four): large crown >1/3 with large branches, well-formed main trunk; (2) **intermediate trees**: small branches, large competition, the conditions of environmental heterogeneity (light) and different ages make one of the trees ends up dominating the others in its environment; (3) **young trees**: conditions of major competition, regeneration that appears when a large tree is cut or dies.