Forest harvesting

The main characteristic that determines forest exploitation is the **quality of the forest** (shape and size of the trees), linked to the site **quality of the stand**. The cutting criteria differ according to the site quality of the stand. **In low-quality forests**, the intervention on the forest is of low intensity, with the aim of achieving a **decrease in density**. **In high-quality forests**, intervention on the forest is done by identifying the **trees of the future** and intervening to improve their growing conditions.

Harvesting of Mediterranean forests

In managed forests, the main disturbance is logging. **Unlike natural disturbance**, where wood always remains in place, generating a return of carbon and protection of the soil, in forest exploitation **there is a significant extraction from the system** (**Figure 1**). The manager must control the effects of this extraction while promoting trees that allow them to obtain the most suitable product for their needs in the shortest time possible. This is achieved by favouring the differentiation of the trees, in order to have the most suitable canopies at each moment of the tree's life, and by controlling the return of carbon and the environmental conditions for its incorporation into the soil.

Cuttings in high quality and low-quality forests

The main characteristic that intervenes in the planning of forest exploitation is **the quality of the forest** (shape and size of the trees), linked to the site **quality of the stand** (productive potential of the stand). For Mediterranean forests, average height can be used as a good indicator of site quality. Although there is a gradient of situations, we will analyse the cuttings in two site qualities and contrasted situations:

(i) **Low quality**, in which the height of the trees does not exceed 8 m, which is linked to high densities and small diameters.

(ii) **High quality**, with heights exceeding 12 m, which allows proposing a management to obtain trees with a better conformation and larger diameters.

Figure 1. Cut logs in a forest use exploitation.

Site **quality conditions**, combined with the **management history of the stand**, determine the current state of the forest and its ability to reach a certain structure over time in response to felling. **Figure 2** shows the combined effect of site quality and the management applied to the structure of a Holm-oak forests.

- **Intense felling** generates a structure with **many sprouts** for both high and low qualities. As the cuttings are of less intensity, crown closing generates a natural selection of sprouts, decreasing their density. This effect is more important in high qualities where greater growth allows greater closure of the crowns.

- **In low intensity felling** (i.e. uneven-age management) this selection effect means that in **high qualities** the resulting structure presents **individuals mostly with only one tree** (from resprouting). On the other hand, for **low site qualities**, where the lower growth does not allow a complete closure of the crowns (or this occurs very slowly), the effect of the natural selection of sprouts is less, and we find structures that maintain a **high number of sprouts per individual**.

The way to apply the cuts will be different depending on the site quality of the stand:

- **In low-quality forests**, the intervention on the stand is done with a spatial criterion, with the aim of achieving a **decrease in density**. Due to the main character of forest improvement of this intervention, the intensity of felling is low, not exceeding 30% of the basal area.

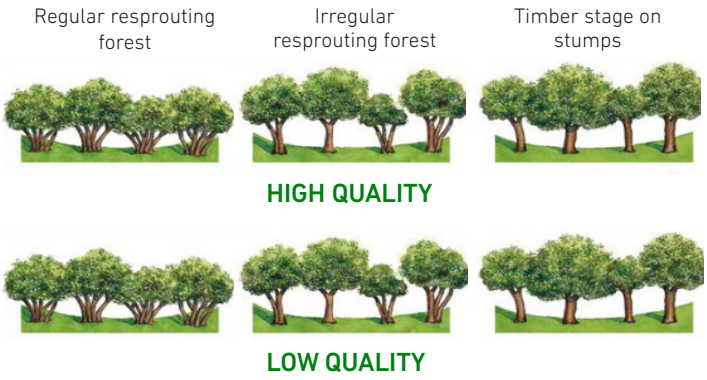

Figure 2. Holm oak structures according to the management model applied (regular resprouting forest, irregular resprouting forest and timber stage on stumps) and the site quality of the stand (high and low). Source: Manuals de gestió d'hàbitats. Els alzinars. Illustrator: Agnés Perelló

Figure 3. The bark of the tree as an indicator of the responsiveness of the tree: the image on the left shows a tree with greater responsiveness than the one on the right. Photo: MJ Broncano.

- **In high-quality forests**, the intervention on the stand is done by identifying the trees of the future and intervening to improve their growing conditions (i.e. cutting their biggest competitors). The goal is to **produce well-shaped and large trees**.

This **sprout selection process** that has just been described will be more or less rapid depending on the **speed response forest of the individuals**, i.e. the time it takes the individual to react and begin to occupy the new available space. This responsiveness depends on the conditions in which the individual has grown and on the characteristics of the species. The reaction of an individual will be faster the younger and more vigorous it is. This vigour of the individual is determined above all by the **size of its crown**, which can be assessed by the % of the height of the tree that the living crown occupies. The vigour is maximum when its height is more than 30% of the live crown. This % will depend on **the degree of competition** to which the individual has grown (related to past management of the plot), the **time** during which it is subjected to this competition and the **shade tolerance** characteristics of each species, which decrease with the **individual's age**. Under very shaded conditions (i.e. strong competition), **shade-tolerant species**, such as holm oak, have a greater ability to keep canopies alive for longer than **non-shade-tolerant species**, such as pines, and therefore they maintain the ability to respond to the release of competition for longer.

Carrying out forest harvesting

Once the trees to be cut have been decided, they are **cut and limbed with a chainsaw** (**Figure 4**). **Harvesting** is usually carried out by **dragging the logs with an adapted agricultural tractor from** the tracks. Skidding is carried out upwards at maximum distances of 60-80 m, so the track system must be designed to prevent the skidding being longer. This implies that the **distances between tracks cannot exceed 200 m**. When it is for firewood, the trees can be chopped in the forest, although this process is usually done once they reach the track. They are then cut into 2-2.20 m pieces (measured for trucking) and stacked for transport.

At the end of the harvest, **the remains of branches should be stacked** to facilitate access to the area and reduce the risk of fire.

Cutting criteria

The cutting criteria differ according to site quality of the stand. In each case the criteria are:

- LOW SITE QUALITY

• Short low-intensity cuts are made.

• The trees to be cut are chosen mainly by a criterion of homogeneous distribution in space.

• The felling does not require marking on the ground of the trees to be cut, it can be done directly during the harvest.

- HIGH SITE QUALITY

• More intense cuts are made.

• The selection of the trees for cutting is based on the selection of the trees that are left uncut, the 'trees of the future'.

• To favour the trees that we are interested in growing, we first study what they are in the field. Once chosen, the trees that affect their development are cut.

• The characteristics of the trees of the future, in order of priority, are: (1) **well-developed crowns**, (2) **smooth bark**, (3) **large diameter** (in relation to the average of the plot), and (4) **well-formed trunk**. One of these characteristics, type of bark, is illustrated in **Figure 3.**

• If there are **trees of interest to the fauna** (trees with cavities and large standing dead trees), **they will not be cut.**

Figure 4. Forest worker limbing an oak tree on the Planeses farm. Photo: AV Video.