**Modelling Forest Ecosystems**

**Homework 3**

**2024-2025**

## *Eucalyptus globulus* even-aged stands are commonly managed considering 3 consecutive rotations (Plantation+coppice1+coppice2). Plantations are usually carried out with 1250 trees ha-1. The table below describes the calendar of operations considering business as usual (BAU) management commonly recommended.

## The **FMA** consists of the calendar of operations from regeneration until final harvest. In the case of tree species managed as coppice systems (such as eucalypt) the user must chose to describe the operations for “Plant. + Coppice”. This is also the case when the stand is already under a coppice cycle and you apparently would not need to define the plantation operations. You must guarantee you have a “number of years in the calendar” ≥ t\_cut (the intended final harvest age). The simulator assumes that:

## All coppice cycles are managed according to the description of operations in the coppice FMA

## The plantation and the coppice will have the same length

* When defining operations the description must always start at age 1 (even if the stand is older)
* Is not compulsory to have operations described every year
* Final harvest is an operation that does not exist and its occurrance is define in the **Prescription**

The most common tree per stool numbers vary between 1.2 and 1.6, although higher values can be practiced in order to compensate low density of stools. Please note the model was fitted with coppice data for which n\_sprouts hardly ever exceed 3 sprouts per stool). Define the FMA for a maximum age of 14 years considering the BAU calendar of opertaions for managed stands as described in table 1.

**ECONOMICS:** All operations have a cost defined by the CAOF default set of values that can be changed and saved if the user does not agree with the amount. Likewise, harvested wood (from either thinnings and final cut) sells at a user-defined price that can be depending on the assortment. Eucalytus has 2 assortments: pulp (35€ m3) and energy (15€ m3). The top diameter (di or dui) ie the threshold separating the two assortments is usually set at 6.5 cm. An economic analysis is prucediced everytime a simulation runs, but if the objective is not carrying out such an analysis defult information can be used and the user just has to guarantee that the the number of assortments and their prices as well as the top diameter are defined.

**STANDS**: For an existing stands some charactiristics have to be provided, namely the location of the stand (to search for the closest meteo station), stand id, stand rotation, stand age, number of stools (Nst) and number of trees/sprouts (Nsp) (these take the same value when in the presence of a rot=1/plantation/1st cycle), and finally, dominant height. If available the user can also provide information about basal area and volumes.

**Prescription**: represents the sequence of consecutive FMAs along the planning horizon ie the sequence of cycles for which the FMA to be assigned per cycle needs to be added, the rotation specified as well as the age for final harvest:

* Rotation=1 identifies the first cycle between planting took place and the stand is harvested (final cut),
* Rotations>1 represent the subsequent cycles benefitting of eucalyptus resprouting ability.

If all prescription cycles have rot=1 it means the user is not benefiting from the species resprouting ability and is replanting in every cycle.

Table 1. Calendar of operations characterizing the BAU for managed stands.

|  |  |  |
| --- | --- | --- |
| **Ages** | **Operations** | **Details** |
| Plantation: |  |  |
| 1 | Stump destruction |  |
| 1 | Harrowing low cover of spontaneous vegetation and Ripping - depth 3m / single shank >=60cm |   |
| 1 | Plantation - evergreen or deciduous trees in containers | 1250 trees per ha |
| 1 | Fertilizing at planting |  |
| 1 | Beating up - evergreen or deciduous trees in containers | 10% of the plants |
| 2, 4, 7, 12 | Weeding - harrow brushcutter |  |
| 2, 4 | Fertilization in line - wheels tractor |  |
| 12 | Final harvest |  |
| Coppice: |
| 3, 5 | Fertilization in line - wheels tractor |  |
| 3 | Shoot selection | 1.6 shoots per stool |
| 12 | Final harvest |  |

In most of the cases, the lot of plots you’ve been assigned doen’t fall under the management described above, because forest managers are absent and/or have no money to invest. The management described in Table 1 is meant to be applied after the stands are converted to BAU managed stands. Before that follow the mangement as indicated in the description of the scenarios.

Run a simulation for 60 years considering the following scenarios for each of the 3 stands in your EXCEL sheet. The scenarios try to reflect the low profitability of forest management and its consequence of postponing the replantation of the stand (one of the most expensive operations) to minimize costs throught the simulation.

**Scenario A:** *forests owner with no money to invest in management – convertion to BAU delayed up to the 5th coppice (max 6 cycles before converting to BAU management)*

No money to invest in reforesting and manageing according to the FMA in table 1. For this reason, he decides to postpone reforestation for after the 5th coppice cycle (ie 1 plantation + 5 coppices), applying a similar as that refleted by the 3 stands you were provided as input. Minimize the opetations to the ones described in the bullets below:

* number of shoots per stool (n\_sprouts)
	+ if rot >1, it should be the same as presented in the current coppice stand
	+ if rot=1, n\_sprouts =2.4
* number of coppice cycles before converting to BAU management=5
* harvest age=12yr

**Scenario B:** *forest owner has little money to invest in management – convertion to BAU after the 2nd coppice is harvested (max 3 cycles before converting to BAU management)*

The forest manager decides to postpone reforestation according to BAU for after the 2nd coppice cycle (ie to manage according to the FMA described in the table), before reforestation, management will follow a similar line as indicated by the current plots:

* number of shoots per stool (n\_sprouts)
	+ if rot >1, it should be the same as presented in the current coppice stand
	+ if rot=1, n\_sprouts =2.4
* harvest age (12yr)

**Scenario C** *forest owner wishes to convert to BAU as soon as possible and is only willing to wait untik he reaches age 12 of its current rotation to convert to BAU management*

* number of shoots per stool (n\_sprouts)
	+ if rot >1, it should be the same as presented in the current coppice stand
	+ if rot=1, n\_sprouts =2.4
* harvest age (12yr)

Stands for which the age is >= 12yr are immediately harvested regardless of the rotation

Suggestion:

Run each of the stands one at a time under the 3 scenarios; use the “<-input data option “ to go back and edit data previously defined

Once you figure you’ve completed a final version of the simulations required, archive the final runs under the following name: “student\_nr-stand\_id”.

You should only require 2 FMAs per plot to run the 3 scenarios: one corresponding to “current management” and the othe to “proper management”.

Take the following situation as an example:

Stand in 2nd rotation and 5 yrs, apply the 3 scenarios assuming you are asked to simulate for 45 yrs, a harvest age of 12 years in all cycled regardless of the management intensification level. Consider that “poor” management exceeds the 2nd coppice up to the 4th coppice (ie only after 4 coppices the stand gets to be converted to BAU management)



Whe you complete the work you should have 9 archives: “student\_nr-1”,… “student\_nr-9”.

If you feel the need , you can send an email with a word document “student\_nr\_HW3.docx” with any comment you’ll find relevant to my **email:** smb@isa.ulisboa.pt