

Effect of competition on a threatened species

Centaurea Corymbosa

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Study species

Centaurea corymbosa is an endemic plant species of La Clape, a region in Southern France.

It is closely related to other *Centaurea* species found in the region, but unlike *C. corymbosa*, these are very abundant.



C. corymbosa

Our question

Is *Centaurea corymbosa* threatened because it is not as competitive as other *Centaurea* species?

The experiment (1/2)

- Seeds of two *Centaurea* species were collected from **four** populations, **two** with only *C. corymbosa* present and **two** with only *C. maculosa* present.
- Seeds were sown one per pot.
- Competition was induced by growing *Brachypodium ramosum* in the pots, but at different densities:
 - Control: no *B. ramosum*
 - Not dense: *B. ramosum* covers **10%** of the surface area of the pot
 - Dense: *B. ramosum* covers **between 10 and 50%** of the surface area of the pot
 - Very dense: *B. ramosum* covers **more than 50%** of the surface area of the pot

The experiment (2/2)

For each treatment, **50 replicates** were seeded for **each population** and **each species**, for a **total of 800 seeds** monitored at different time intervals: each week for 3 weeks, and then once per month*.

	C.c. (Pop1)	C.c. (Pop2)	C.m. (Pop3)	C.m. (Pop4)
Control	C.c. (Pop1)/Control	C.c. (Pop2)/Control	C.m. (Pop3)/Control	C.m. (Pop4)/Control
Not Dense	C.c. (Pop1)/Not Dense	C.c. (Pop2)/Not Dense	C.m. (Pop3)/Not Dense	C.m. (Pop4)/Not Dense
Dense	C.c. (Pop1)/Dense	C.c. (Pop2)/Dense	C.m. (Pop3)/Dense	C.m. (Pop4)/Dense
Very Dense	C.c. (Pop1)/Very Dense	C.c. (Pop2)/Very Dense	C.m. (Pop3)/Very Dense	C.m. (Pop4)/Very Dense

The dataset (1/2)

- *Plante*: number of the seed/plant (1 to 800)
- *Espece*: species (mac, C. maculosa, cor, C. corymbosa)
- *Pop*: population names
- *Traitement*: treatment factor
- *PAR*: quantity of light received by a pot, which depends on the percentage of soil covers ; it is 100% in control pots
- *Reference*: quantity of light received by a pot where it is not covered. it is 100% in control pots

The dataset (2/2)

- *Date_de_germination*: germination date; missing data if the seed did not germinate
- *Cotyledons*: size of the emerged seedling
- *Taille_Dec_05*: size of the rosette in December 2005
- *Taille_Fev_06*: size of the rosette in February 2006
- *Taille_Mars_06*: size of the rosette in March 2006
- *Taille_Juin_06*: size of the rosette in June 2006
- *Taille_Sept_06*: size of the rosette in September 2006

Data cleaning (1/n)

```
# Format the date of germination correctly
data$Date_de_germination <- as.Date(data$Date_de_germination,
                                       format = "%d/%m/%Y")

head(data[1:3,1:5])

## # A tibble: 3 x 5
##   Plante Date_de_germination Cotyledons Taille_Dec_05 Taille_Fev_06
##   <dbl> <date>           <dbl>           <dbl>           <dbl>
## 1     1 NA                 NA               0               0
## 2     2 NA                 NA               0               0
## 3     3 NA                 NA               0               0
```

1st decision - We are not interested in the rosette size of plants that do not germinate, so set to NA

Data cleaning (2/n)

```
# If plant didn't germinate, it should not have a rosette size
data_nogerm <- data %>%
  filter(is.na(Date_de_germination)) %>%
  mutate(Taille_Dec_05 = NA,
         Taille_Fev_06 = NA,
         Taille_Mars_06 = NA,
         Taille_Juin_06 = NA,
         Taille_Sept_06 = NA)

data_germ <- data %>%
  filter(!is.na(Date_de_germination))

fulldata <- full_join(data_nogerm, data_germ)

## Joining, by = c("Plante", "Date_de_germination", "Cotyledons", "Taille_Dec_05", "Taille_Fev_06", "Taille_Mars_06", "Taille_Juin_06", "Taille_Sept_06")
```

Data cleaning (3/n)

2nd decision: We are interested in the size of the rosette over time, as this will be our indication of how well each plant is coping with the competition.

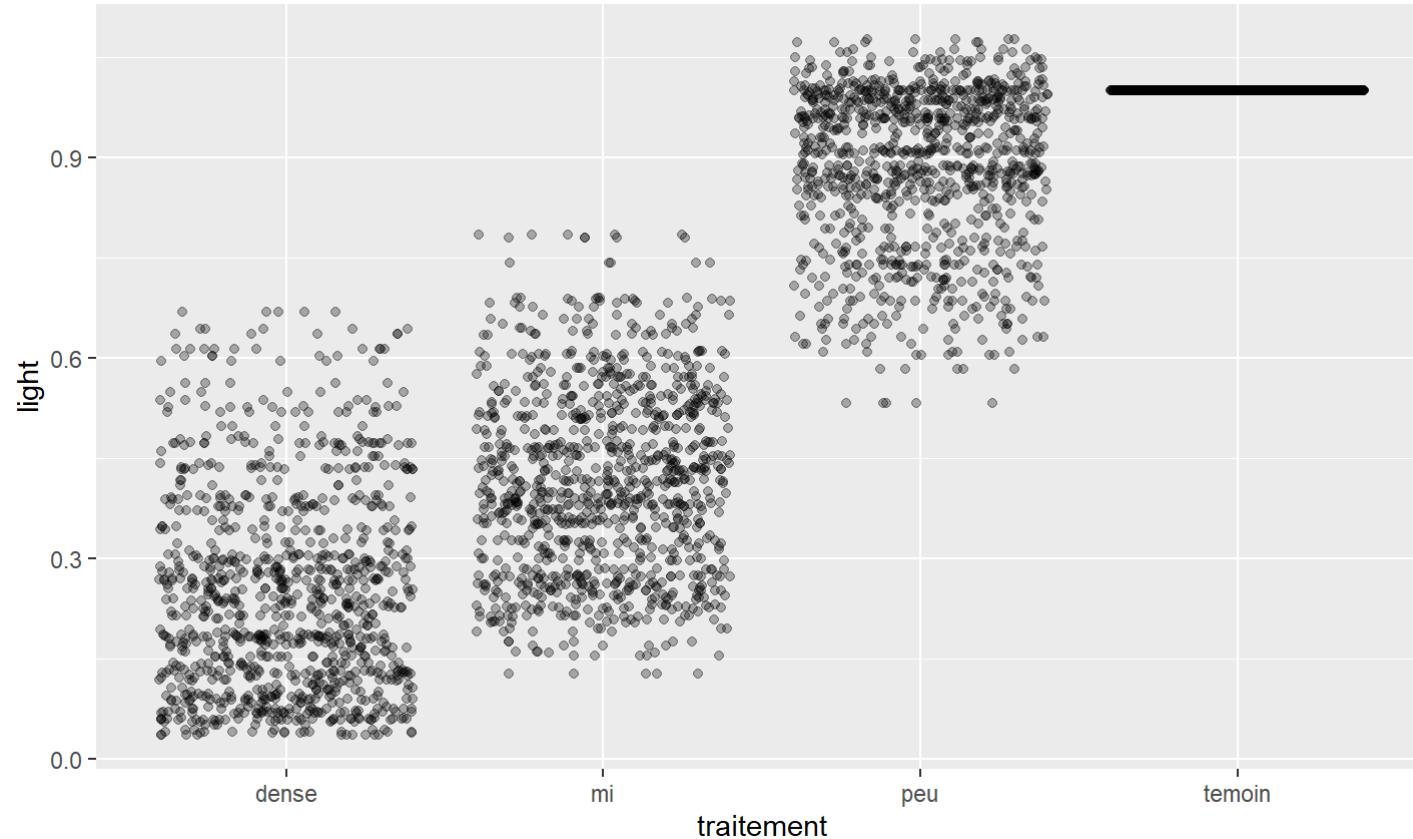
```
gathered_data <- fulldata %>%  
  rename("2005-12-01" = "Taille_Dec_05",  
         "2006-02-01" = "Taille_Fev_06",  
         "2006-03-01" = "Taille_Mars_06",  
         "2006-06-01" = "Taille_Juin_06",  
         "2006-09-01" = "Taille_Sept_06") %>%  
  gather(key = "Date",  
         value = "Rosette_size",  
         "2005-12-01": "2006-09-01")  
  
gathered_data$Date <- as.Date(gathered_data$Date, format = "%Y-%m-%d")
```

Data cleaning (4/n)

3rd decision: To make sense of the light data, we divide the PAR received by the plant through the *Brachypodium* by the max PAR that pot was receiving (actual/max possible). As the max values were taken for areas within the greenhouse (presumed), not each pot, some values of actual/max are slightly above 1.

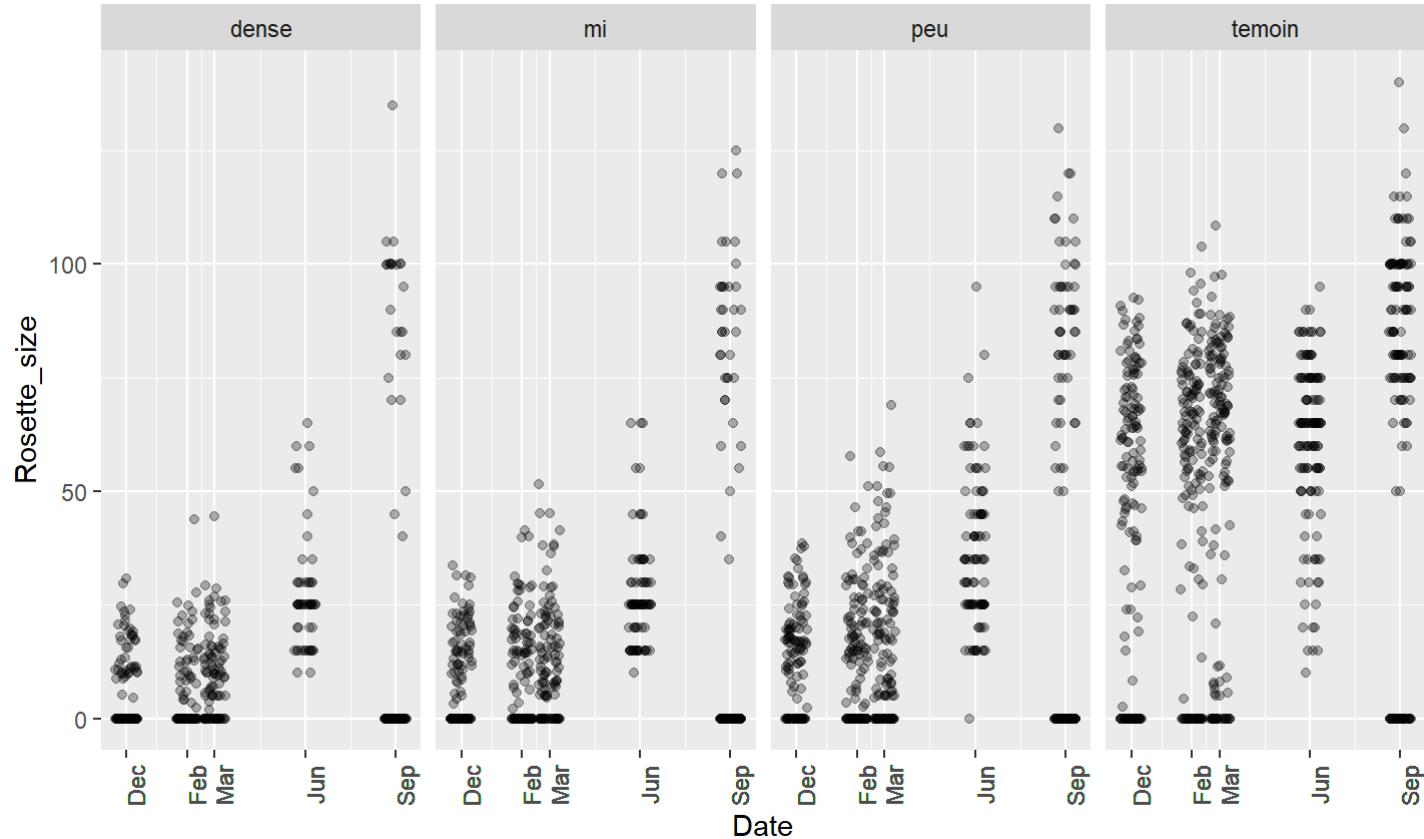
```
gathered_data <- gathered_data %>%
  mutate(light = PAR/reference)
```

Data exploration (1/n)



Is light received (actual PAR / Max PAR) perhaps a better measure of competition than the visual sorting of % soil covered?

Data exploration (2/n)



Something is weird: lack of 0s in the June measurements

Data exploration (3/n)

