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Impacts of climate-related dieback on regeneration in a drought-prone European beech population

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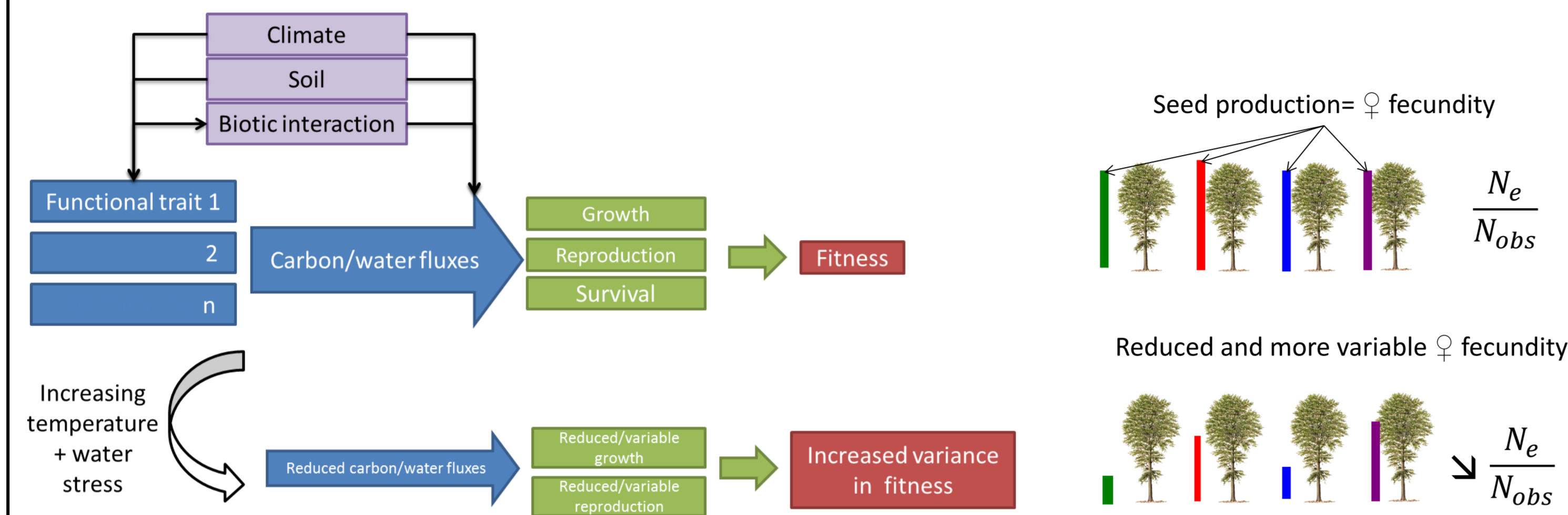
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Impacts of climate-related dieback on regeneration in a drought-prone European beech population

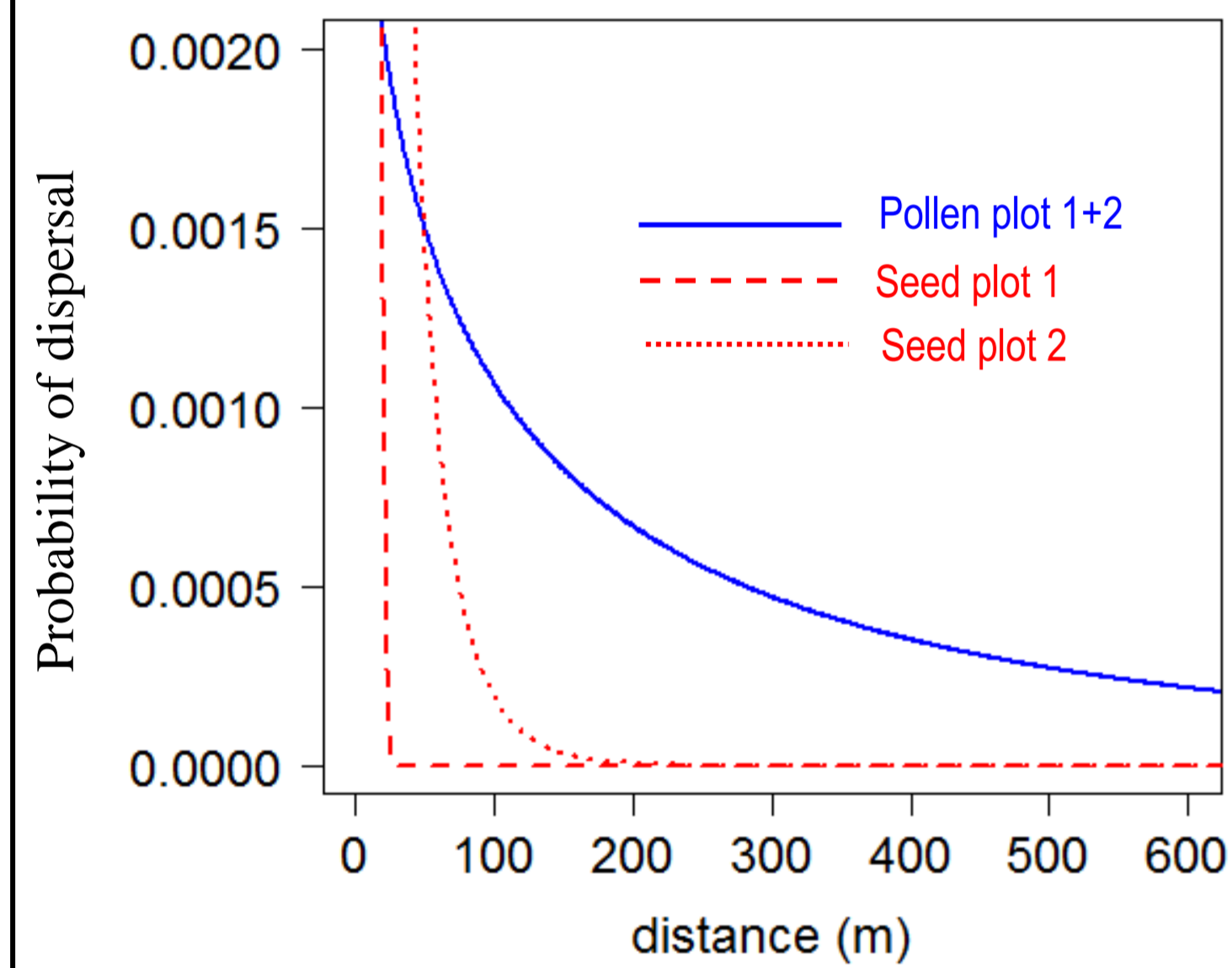
The issue: does climate-driven individual tree dieback reduce effective seed output and population size (N_e) ?

Interactions between biotic and abiotic environment and tree functional traits determine carbohydrate and water fluxes at tree-level, which in turn affect demographic rates and fitness at tree- and population-level. The total number of reproductive trees (N_{obs}) and the among-trees variations of seed production determine the effective population size (N_e).



Climate-induced tree dieback may result in a reduced quantity and/or quality of seed output at population level, even without or before tree mortality. We investigate the relationship between individual tree dieback and fecundity in the forest tree *Fagus sylvatica* (the European beech) in Southern France (La Massane, Pyrénées Orientales). *Fagus sylvatica* is known to be sensitive to summer drought, but shows so far limited mortality; for instance at the study site the mortality rate is 1.75%/year (between 2003 and 2005) while the rate of tree dieback (measured through foliar mortality) is 10.5%.

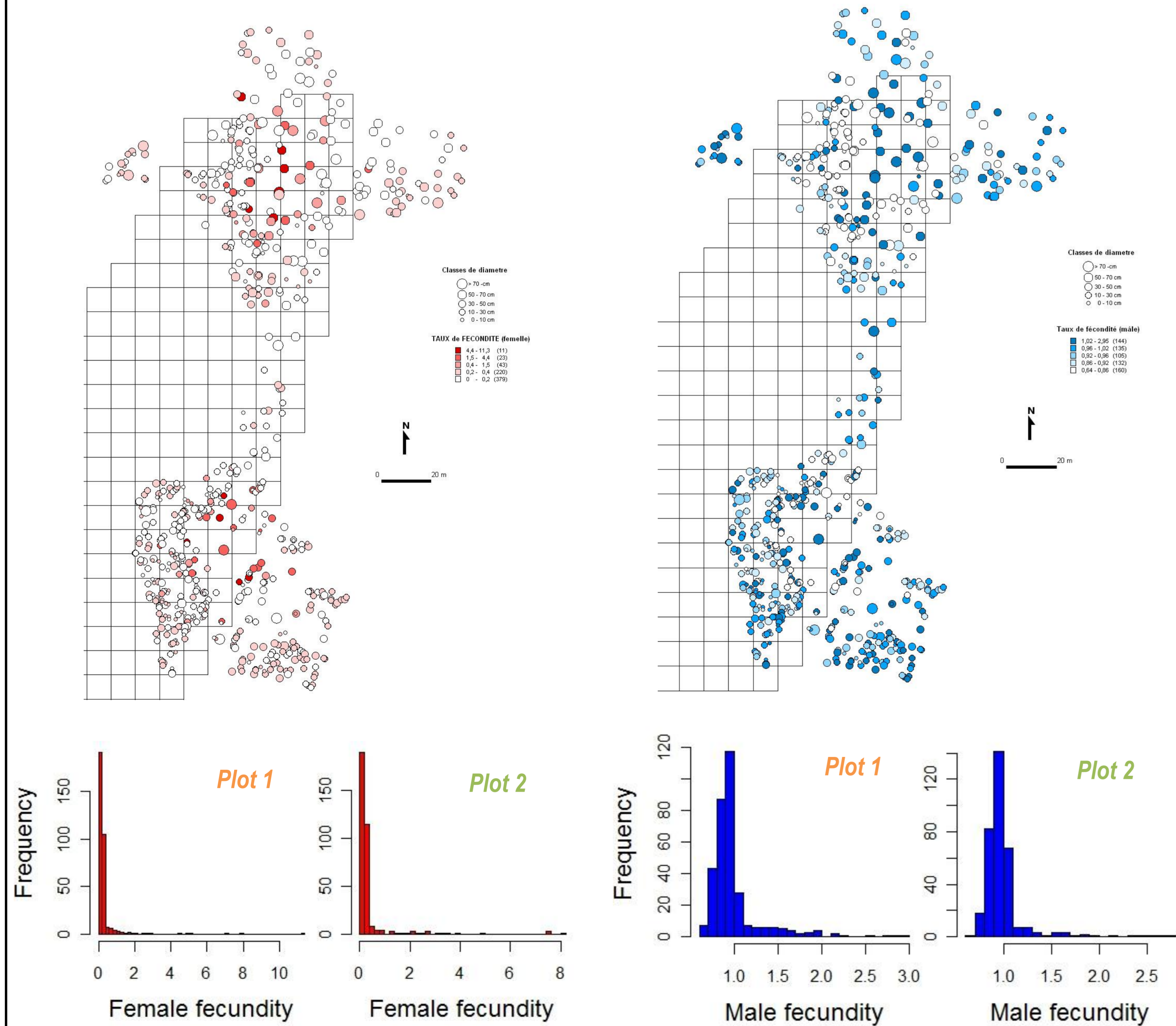
Results: estimated dispersal and fecundity parameters



1. Pollen and seed dispersal abilities

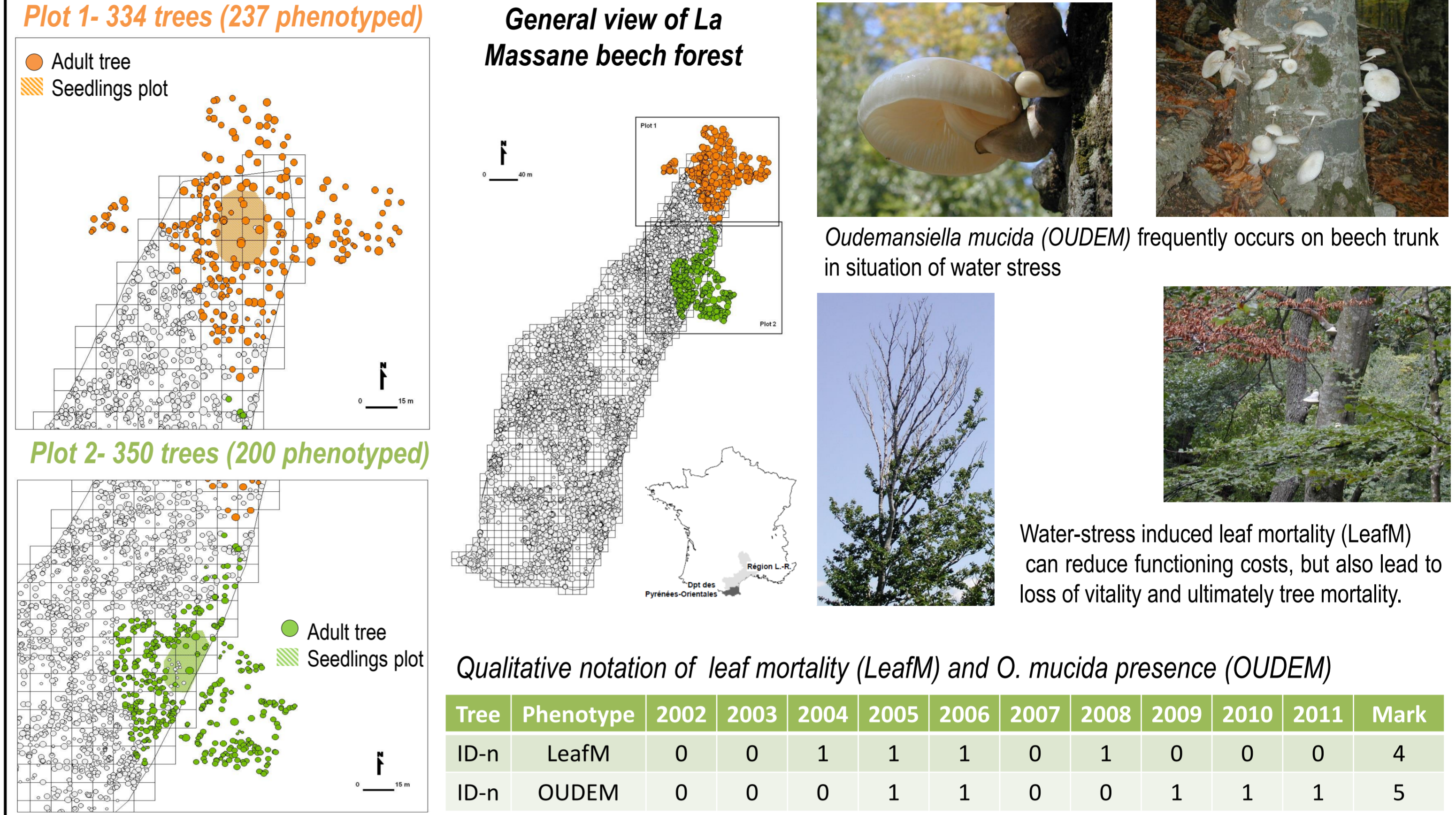
- Pollen and seed dispersal kernel were modeled with exponential power distribution with parameters (δ_p, b_p) and (δ_s, b_s).
- Pollen is dispersed on average at $\delta_p = 62$ m, with non negligible events of long distance dispersal ($b_p = 0.46$)
- Seeds are dispersed on average at $\delta_s = 12$ m, with fewer long distance dispersal events than for pollen ($b_p = 0.83$)
- 13% of the seedlings have their mother-tree out of the plot, and 67% of the offspring with local mother have their father-tree out of the plot.

2. Distribution of female and male fecundities on each plot

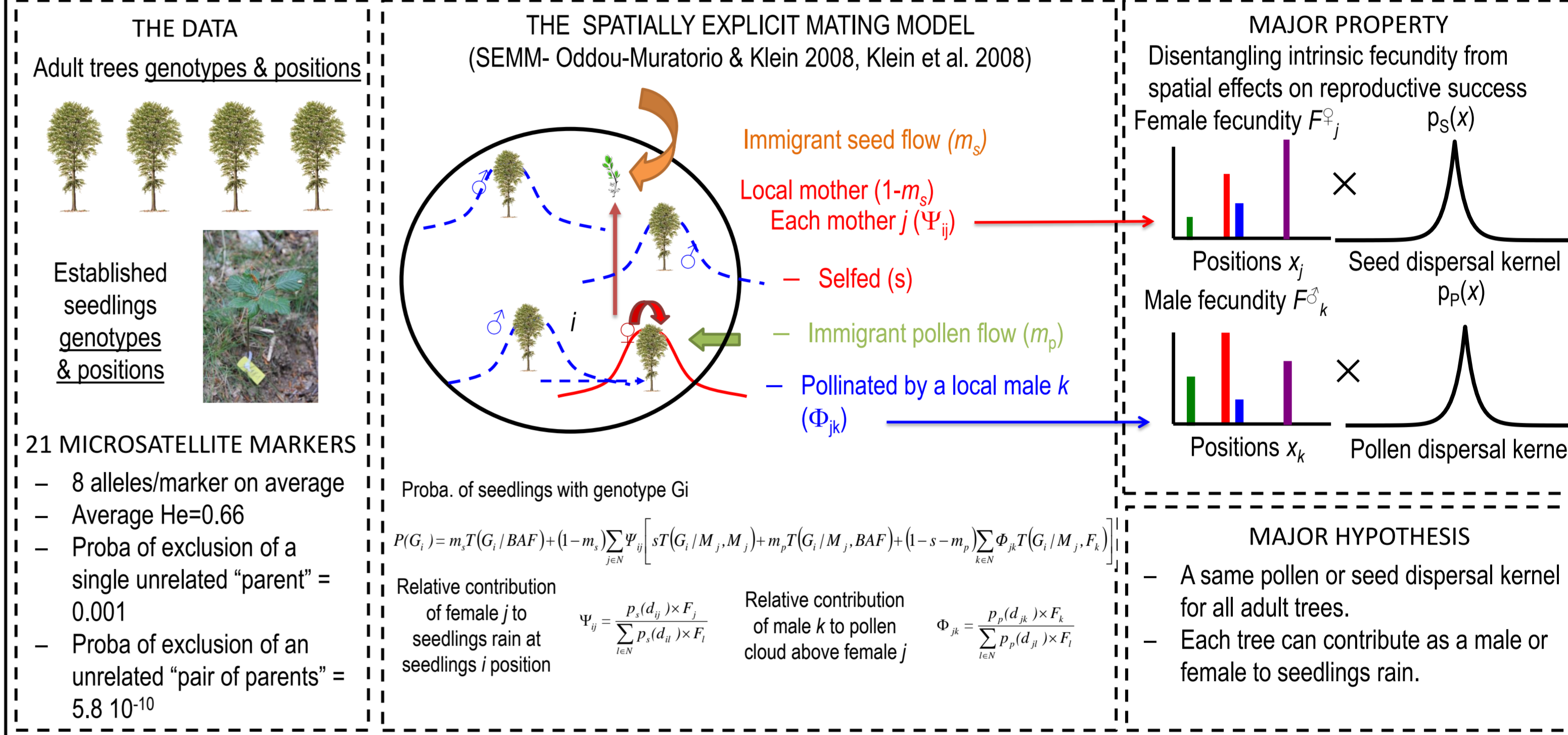


Methods

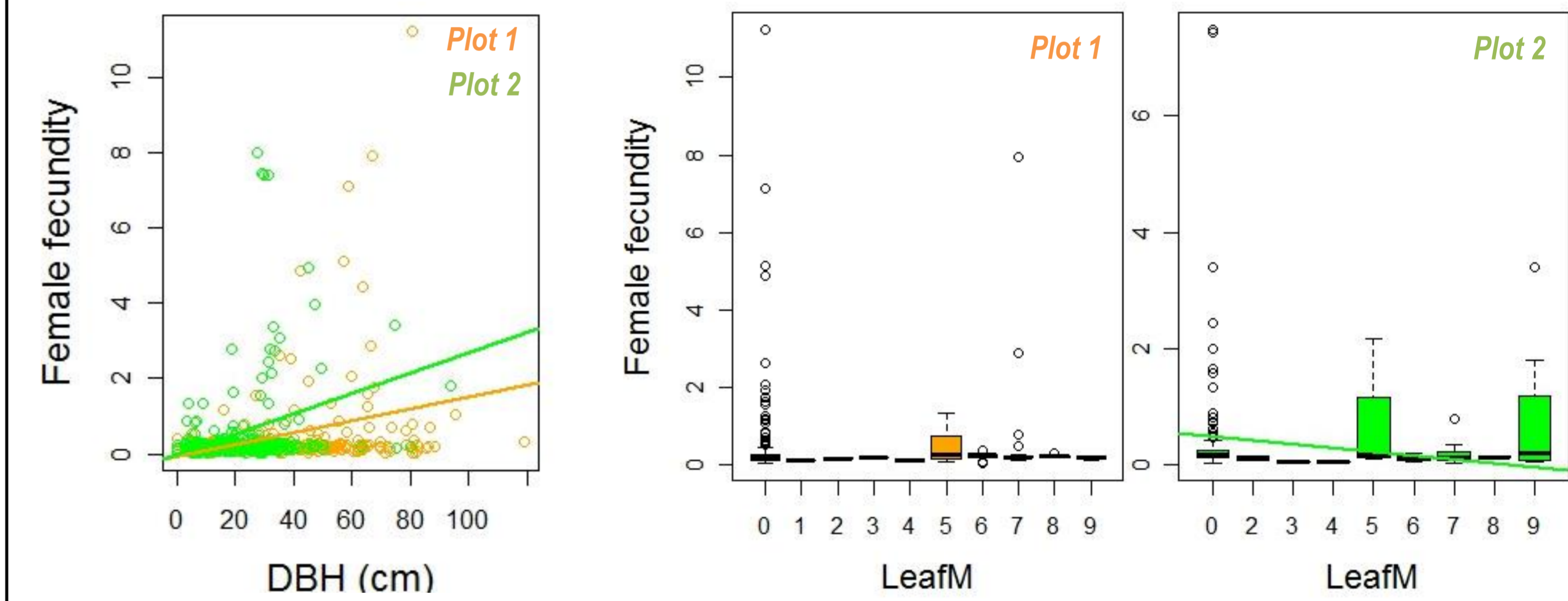
1- Long-term survey of *Fagus sylvatica* dieback in La Massane integral reserve



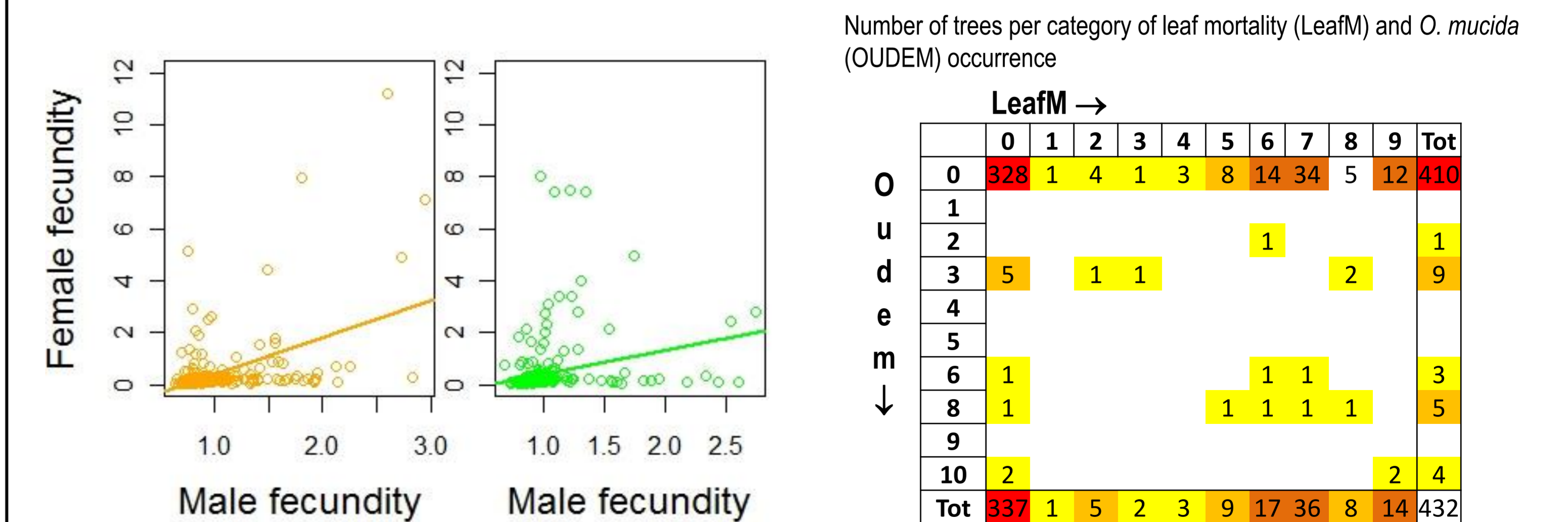
2- Estimation of realized fecundities and dispersal with the SEMM



Results: relationship between dieback and fecundity



- Significant increasing female and male fecundity with increasing DBH (Plot1: effect=0.016; Plot 2 : effect=0.027; pval<0.001).
- Significant decreasing female (but not male) fecundity with increasing cumulated leaf mortality (DEFECUM) when correcting for DBH effects (Plot 2 only; effect=-0.067; pval<0.001).
- However, intermediate leaf mortality (LeafM=5) associated with variable (and high) female fecundity.
- No significant relationship between *O. mucida* (OUDEM) occurrence and male or female fecundity, but few records of *O. mucida* presence.



- Significant correlation between male and female fecundities
- Trend for a correlation between foliar mortality (DEFECUM) and *O. mucida* (OUDEM) occurrence.

Conclusions

- Individual tree dieback (through foliar mortality) is associated to lower relative female fecundity, consistently with costly nut-seeds in *Fagus sylvatica*.
- Non negligible female fecundity can however be achieved for intermediate leaf mortality, suggesting adaptive plastic response aiming at reducing functioning costs.
- Perspective : investigating whether there is a change in allocation to reproduction versus growth for trees showing evidence of dieback.