

# Integrating palaeoecology and genetics to uncover stand-scale glacial beech refugium

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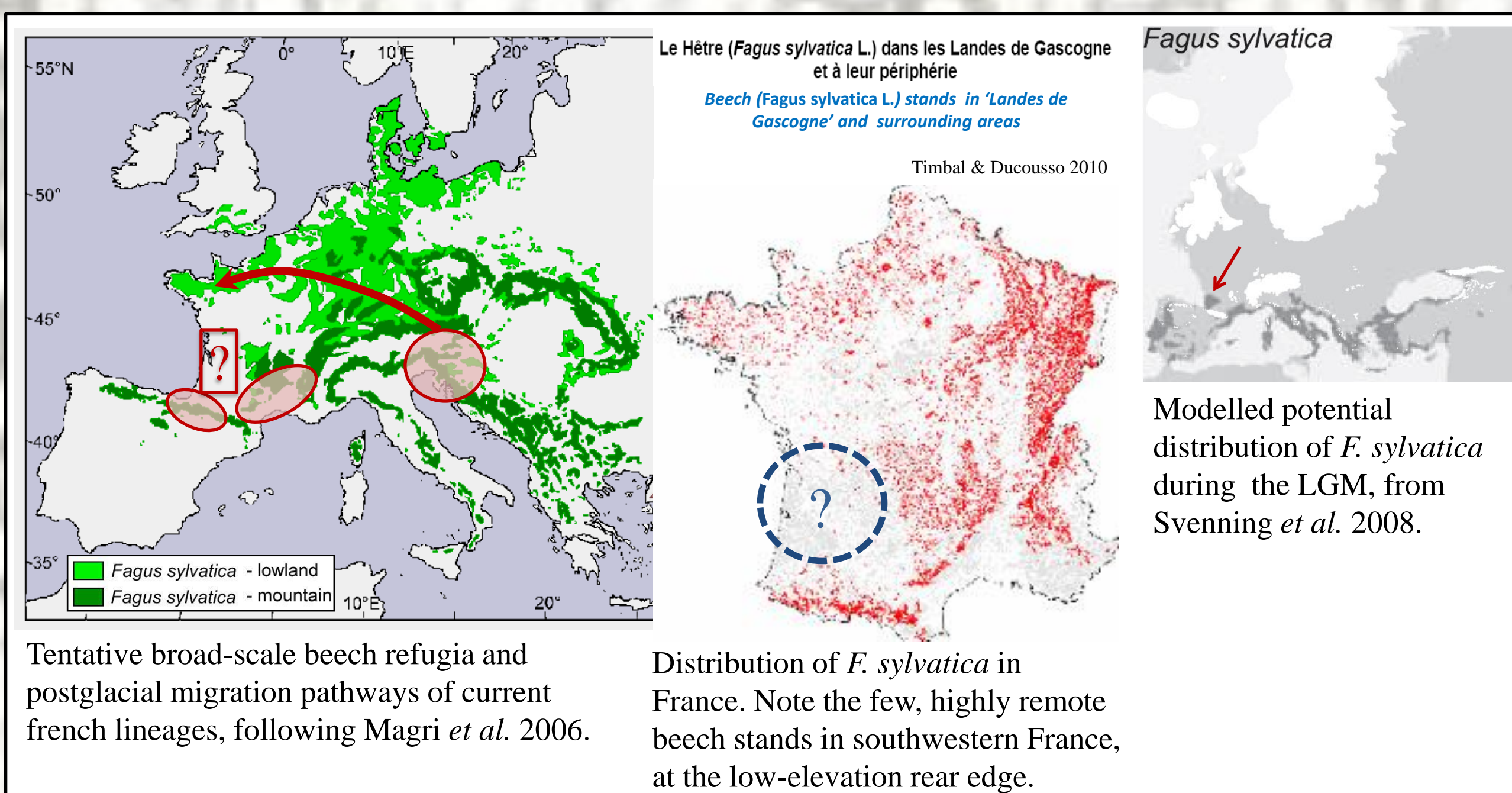


## INTRODUCTION

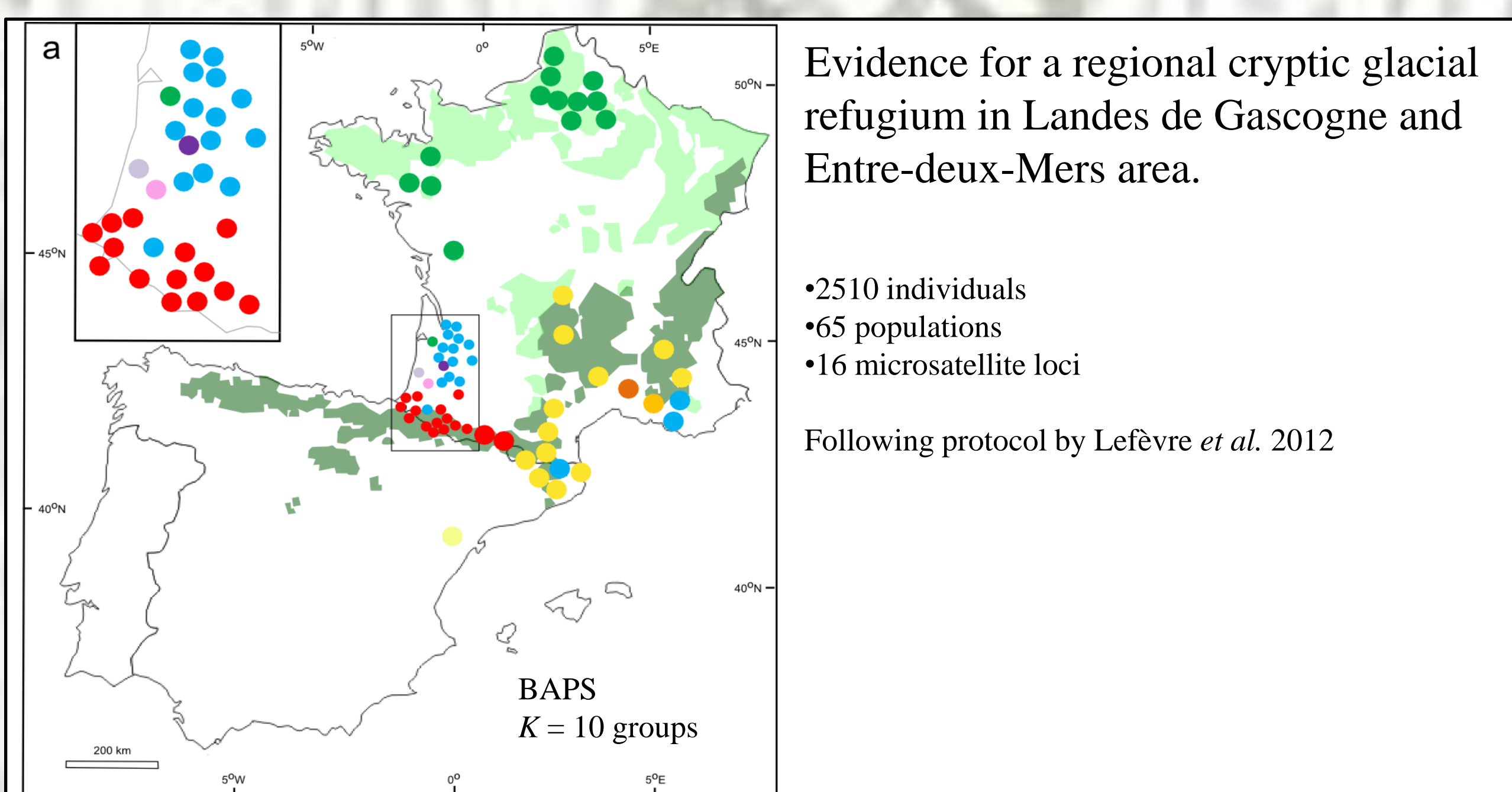
Glacial refugia usually refer to broad regions where boreal and temperate taxa persisted through the Last Glacial Maximum (LGM) (Bennett et al. 1991). Traditionally, such regions were defined by regional scale pollen analysis or transcontinental phylogeographical surveys. The scale at which refugia are defined might be irrelevant to determine specific stand-scale ecological or evolutionary processes.

## OBJECTIVES

Macrofossil soil charcoal analysis (de Lafontaine and Payette 2011, 2012) and SSR markers (Lefèvre et al. 2012) were used to uncover stand-scale history of isolated *Fagus sylvatica* (beech) populations at its low-elevation rear edge in Landes de Gascogne and Entre-deux-Mers, Southwestern France (Timbal and Ducouso 2010). Predictive models linked to estimates of LGM climate indicated that beech could have found suitable climatic conditions in this area during the LGM (Svenning et al. 2008).

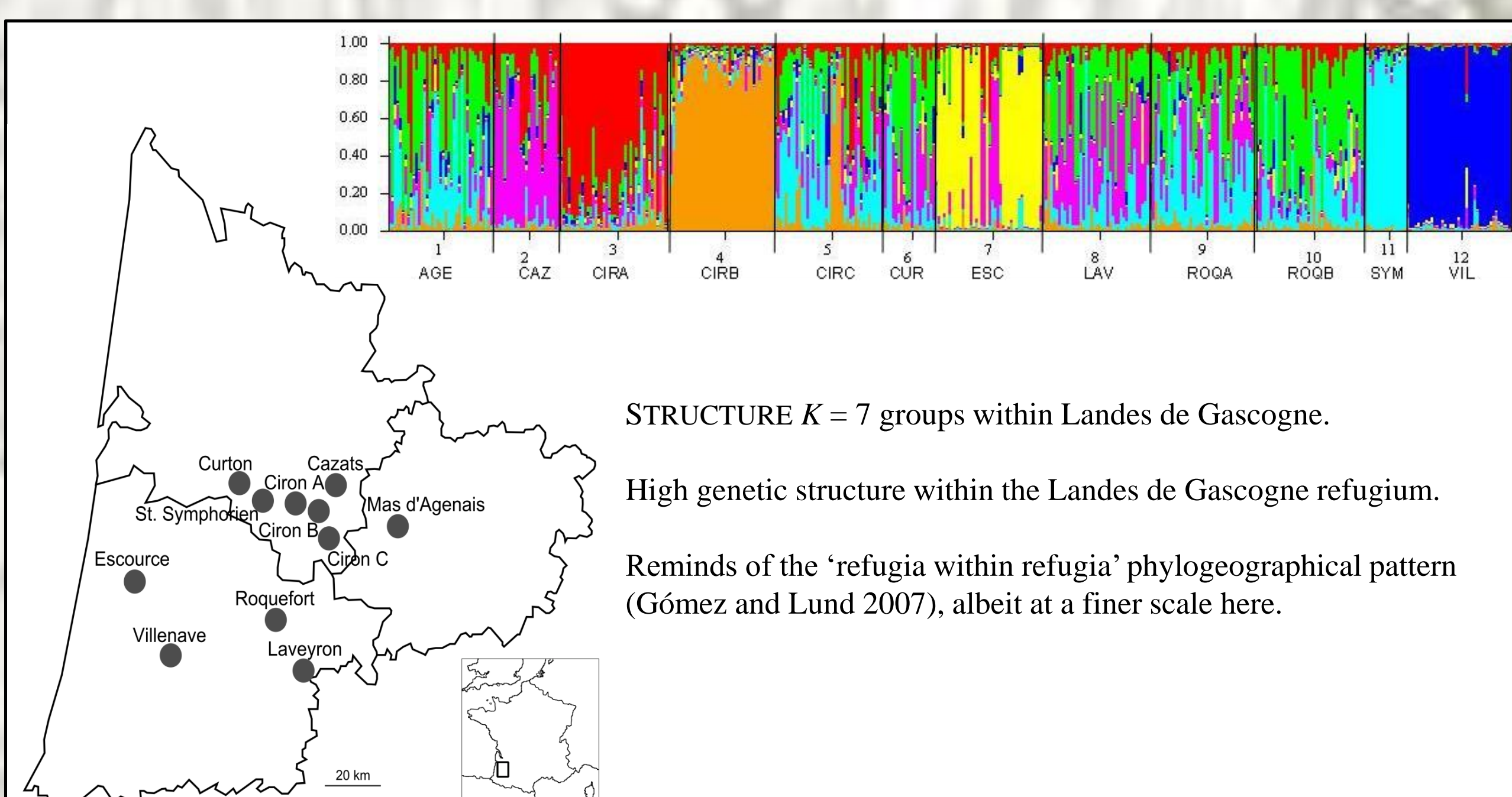


## BROAD-SCALE GENETIC STRUCTURE



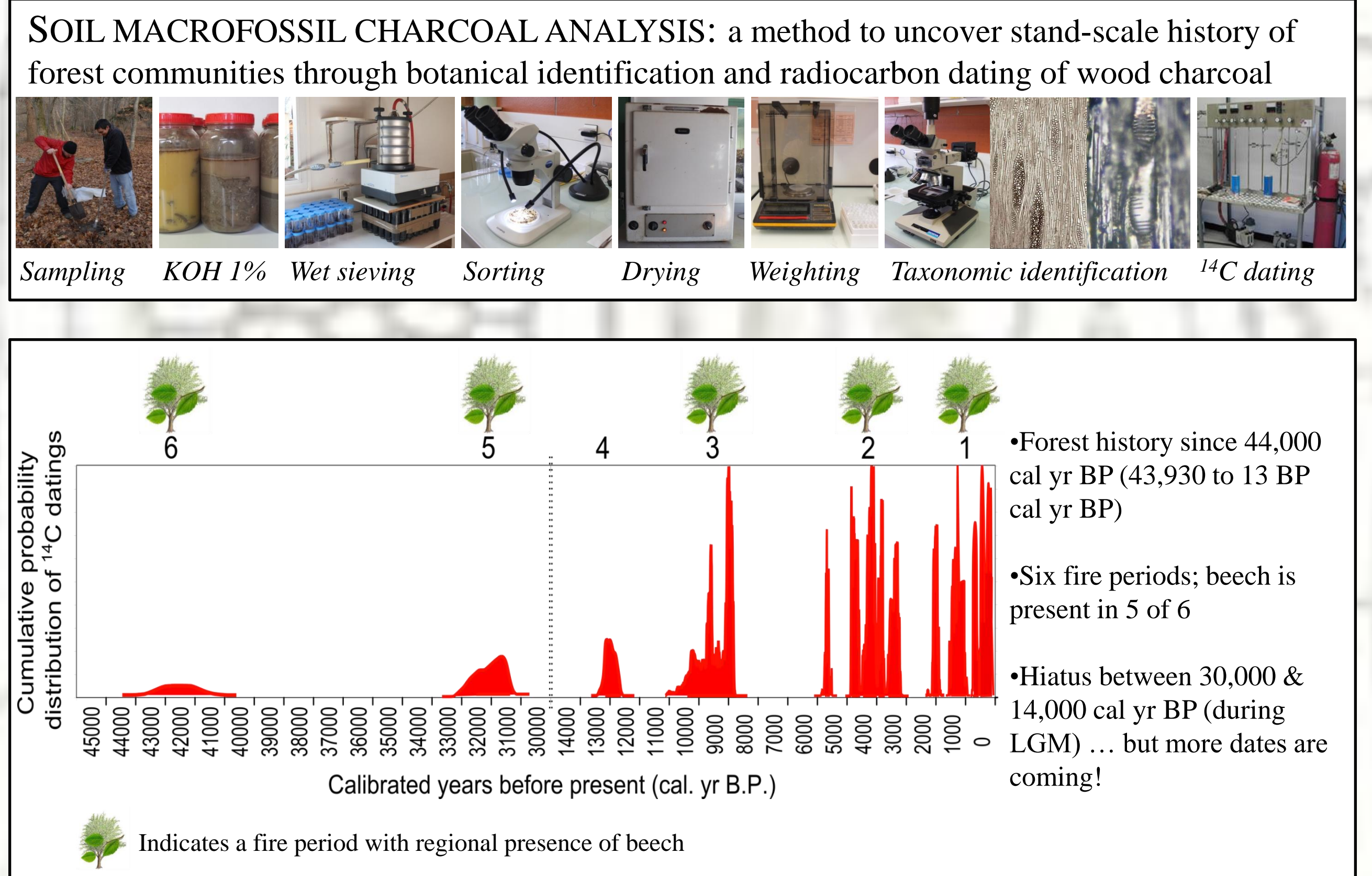
## REGIONAL-SCALE ANALYSIS

**Genetic structure analysis** including only sites from Landes de Gascogne.

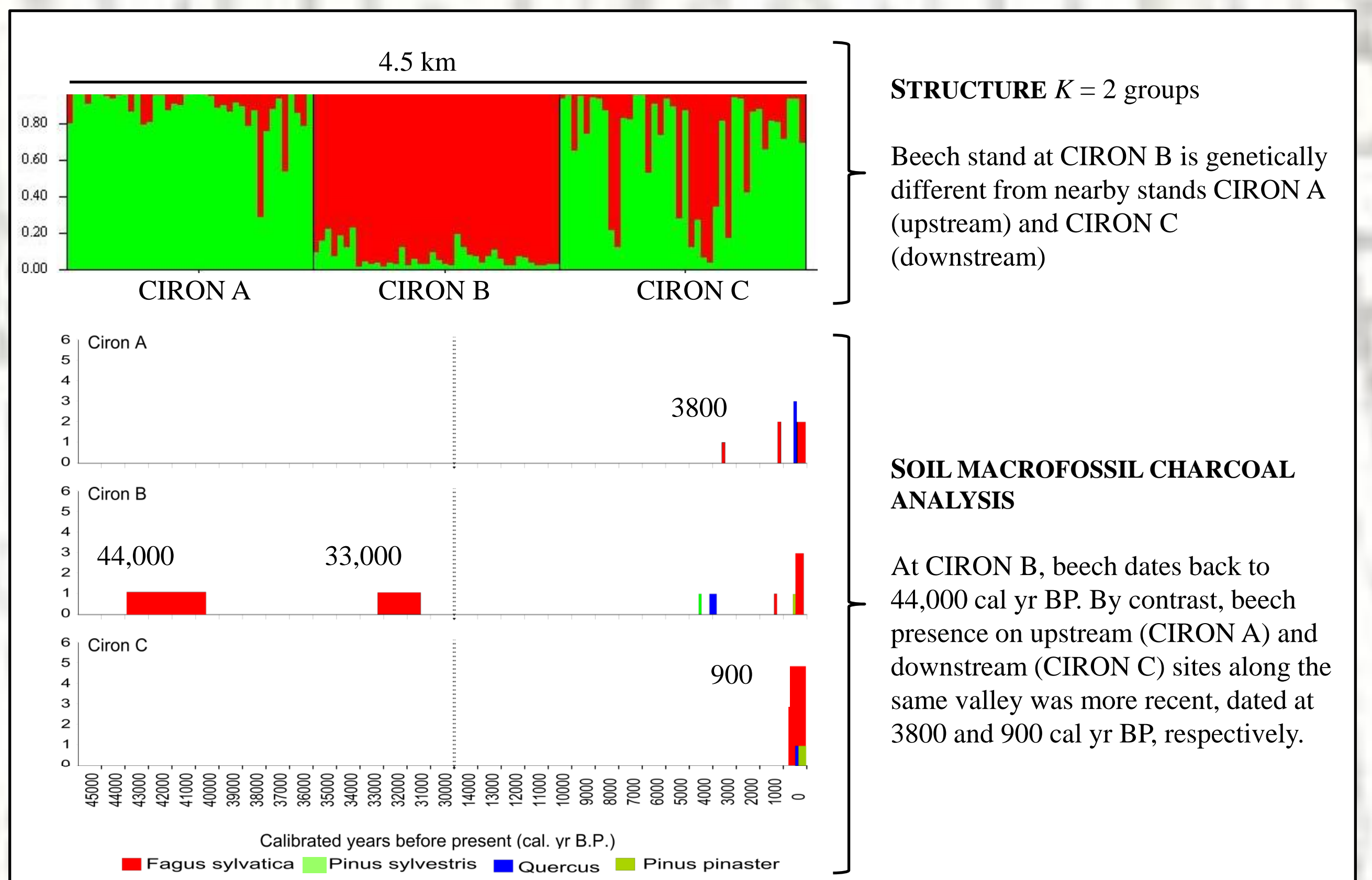
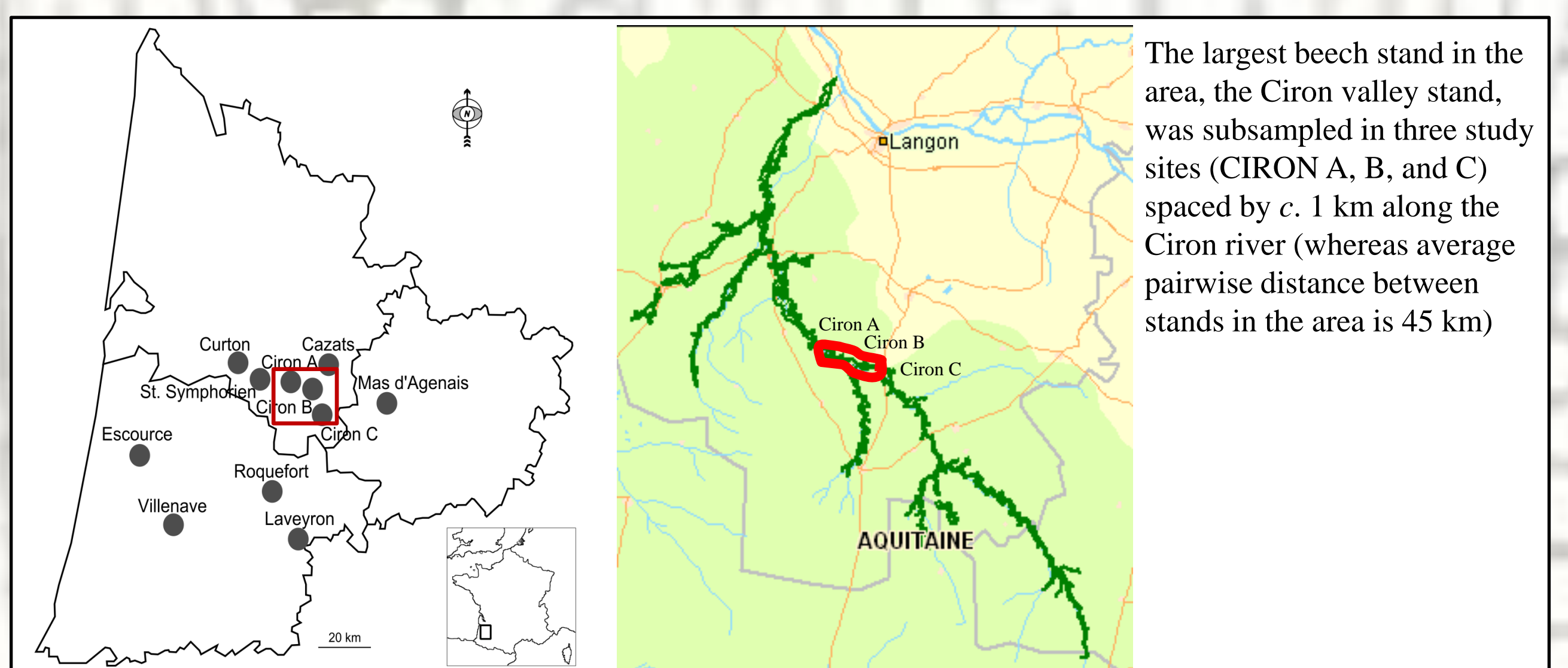


## REGIONAL-SCALE ANALYSIS

**Soil macrofossil charcoal analysis** including only sites from Landes de Gascogne.



## STAND-SCALE ANALYSES



## CONCLUSION

At CIRON B, radiocarbon dating of beech at c. 44,000, c. 33,000 cal yr BP and after the LGM, suggested *in situ* persistence of beech through Late Pleistocene but direct macrofossil charcoal evidence from the LGM are still needed to ascertain this inference. Genetic structure analyses showed a strong differentiation between CIRON B and all the other populations in the area, including the proximate CIRON A and CIRON C.

Together, results of this integrated research at increasingly refined scales suggested that beech persisted through the Last Glacial Maximum *in situ* in at least one stand-scale refugium (CIRON B) within a regional cryptic refugium as defined by a more broad-scale analysis (Landes de Gascogne and Entre-deux-Mers).