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Carbon and nitrogen stable isotope analysis on charred archaeobotanical remains: Investigating the diet of the past-populations of southern France

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CONTEXT The use of **carbon and nitrogen stable isotope analyses** on human and animal bones contributed, over the last decades, to the better comprehension of past-population subsistence strategies in **Southern France**. Although they represented a big part of the diet, **plants were rarely taken into consideration** into dietary reconstructions based on stable isotope analyses. In addition, animal bones are usually used to infer the local environmental baseline and plants are considered mainly through a broad range of values coming from modern specimens. However, several studies stressed the impact of the **local environment and climate**, as well as **anthropogenic practices** on plant stable isotope ratios, making it essential to include them to this type of study. This work aims to **reconsider paleodietary reconstructions by integrating carbon and nitrogen stable isotope analyses of charred plant remains**. **Barley, emmer and millet grains as well as acorns** were analyzed. They are coming from **16 archaeological sites in southern France** and are dated between the **Neolithic and Iron Age**. **Paleodietary models** are proposed, integrating **plant's isotopic results**, for the sites where stable isotopic results from animal and human bones were already available (Farese et al. 2023).

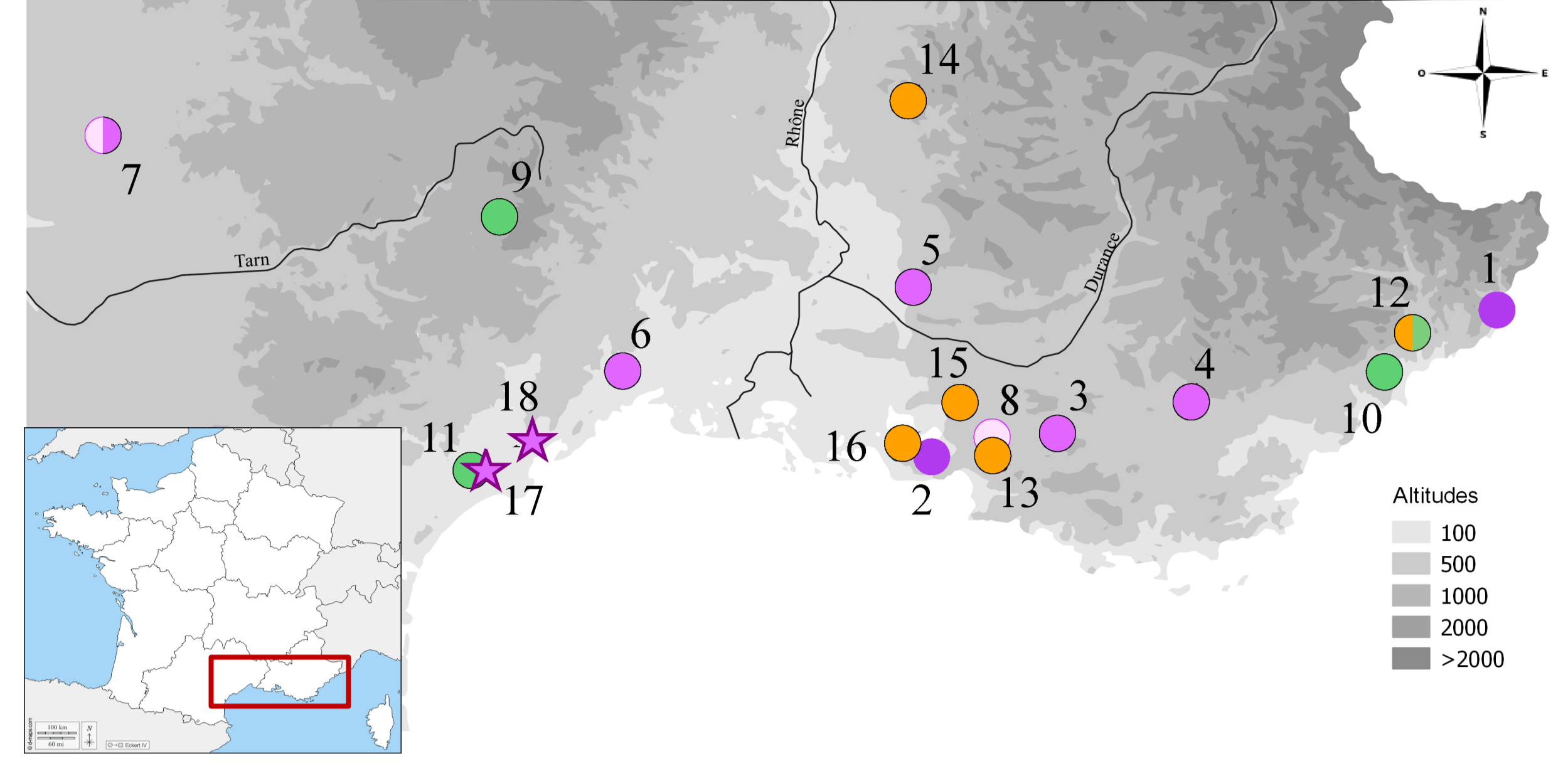
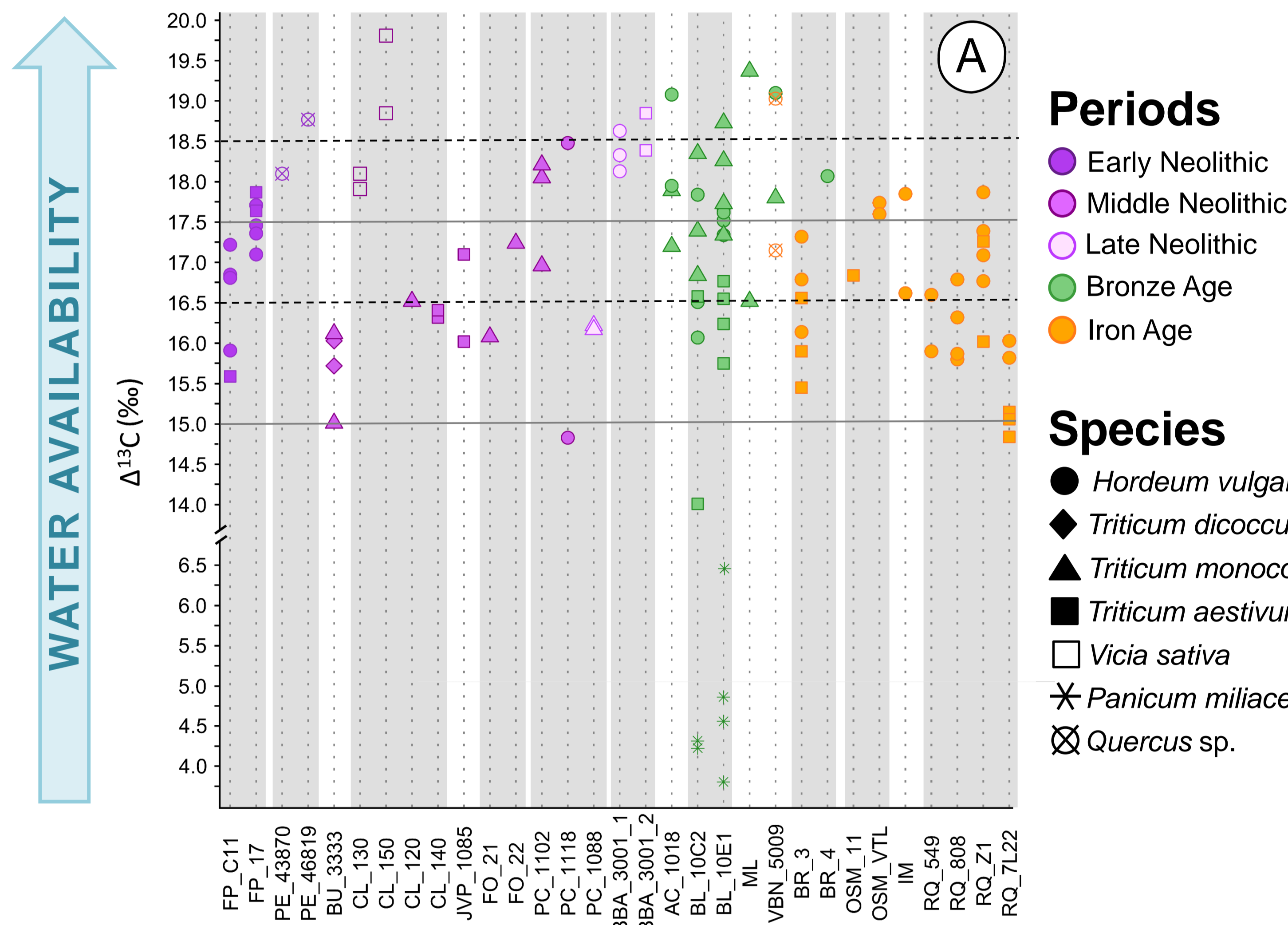


Figure 1. Location of the archaeological sites from southern France dated between the Neolithic and Iron Age periods (see **Figure 2** for periods). **1. PE** Pendimoun, **2. FP** Font-aux-Pigeons, **3. BU** Burlière, **4. FO** Fontbrégoua, **5. CL** Claparouse, **6. JVP** Jardin de Vert Parc **7. PC** Perte du Cros, **8. BBA** Bouc-Bel-Air, **9. BL** Baume Layrou, **10. ML** Mort Lambert, **11. AC** Acropole, **12. VBN** Baou des Noirs, **13. BR** Baou Roux, **14. OSM** Oppidum Saint-Marcel, **15. RQ** Roqueperruse, **16. IL** Ile de Martigues, **17. Le Pirou**, **18. Le Crès**

STABLE ISOTOPE ANALYSES OF ARCHAEOBOTANICAL REMAINS



METHODS

- ❖ A sample is **two or three seeds together**
- ❖ **ABA full-gentle** chemical treatment (Vaiglova et al. 2014)
- ❖ $\Delta^{13}\text{C}$ was calculated following **Farquhar's equation** (Farquhar et al. 1982), using $\delta^{13}\text{C}_{\text{air}}$ values from the **AIRCO2_LOESS** database (Ferrio et al. 2005, CU-INSTAAR/NOAA-CMDL database, http://web.udl.es/usuaris/x3845331/AIRCO2_LOESS.xls)

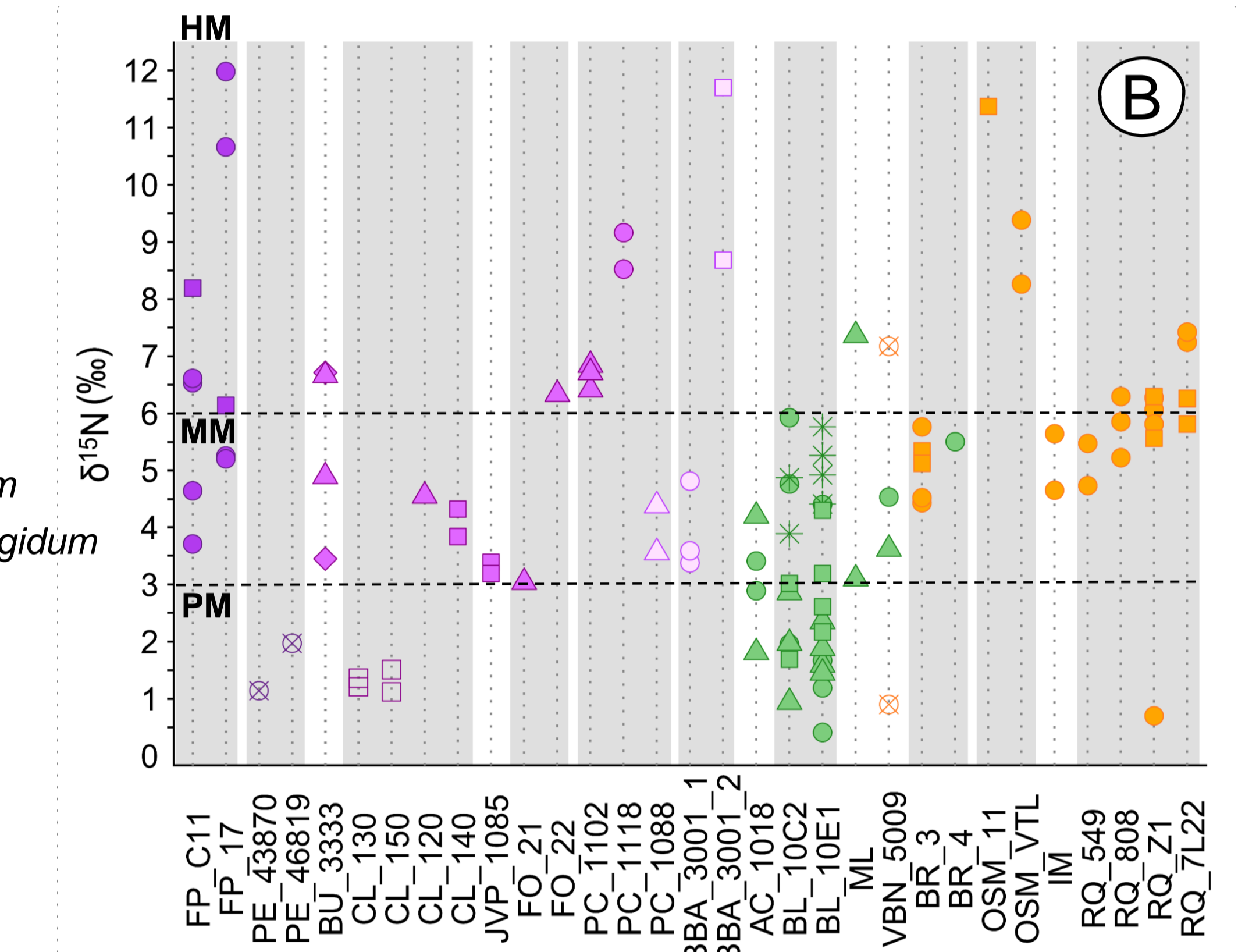
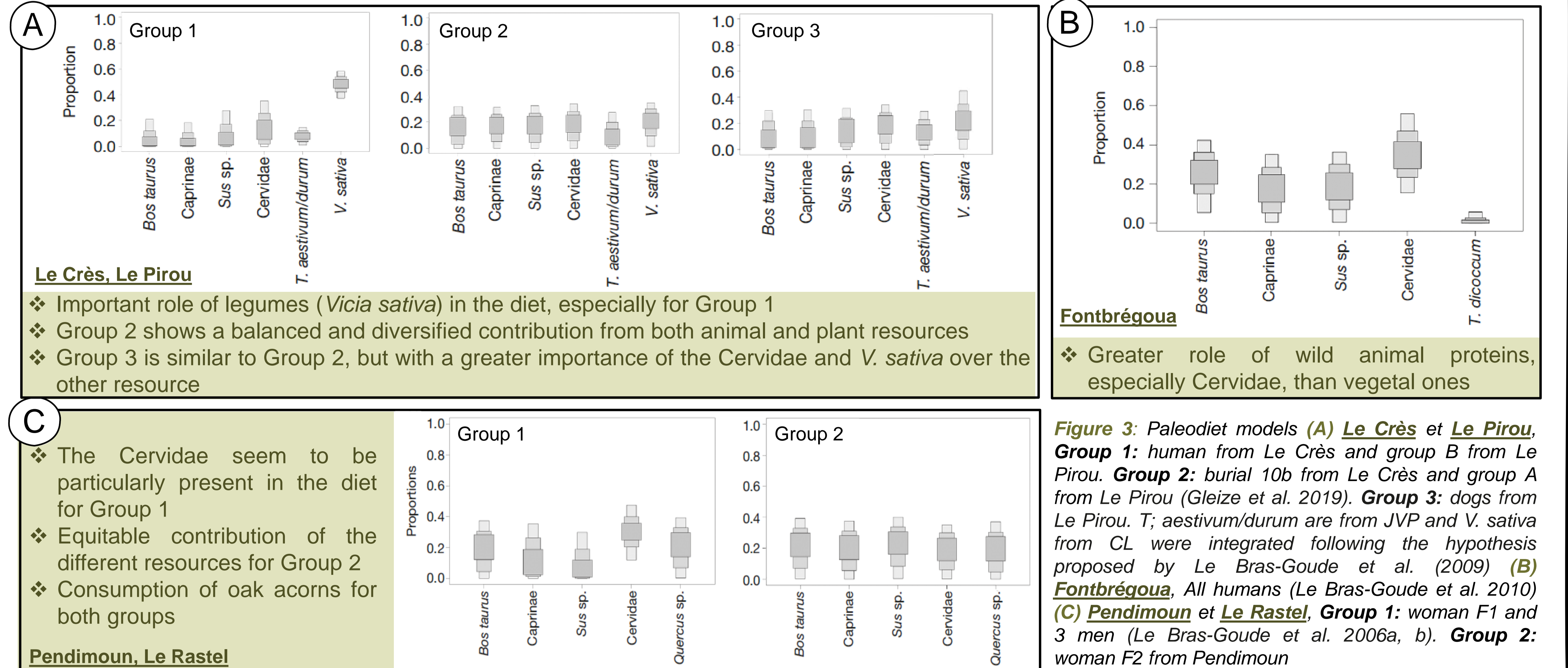


Figure 2: Stable isotope results of charred remains coming from different stratigraphic units identified for the 16 southern France archaeological sites. **For sites abbreviations see legend Figure 1.** The analytical error was, maximum **0.14 ‰** for $\delta^{15}\text{N}$ and **0.1 ‰** for $\delta^{13}\text{C}$ (A) $\Delta^{13}\text{C}$: according to Flohr et al. (2019) for semi-arid environments, **barley** (black lines) and **wheat** (grey lines) are **well-watered**, above, respectively, **18.5-19 ‰** and **17.5-18 ‰** and **poorly watered** below **16.5 ‰** and **15 ‰**. (B) $\delta^{15}\text{N}$: lines represent thresholds calculated by Bogaard et al. (2013) on modern cereal fields from Northern Europe. **PM: Poorly manured, MM: Moderately manured, HM: Highly manured.**

- DISCUSSION**
- ❖ Differences clearly visible between species (legumes, C_3 and C_4 cereals)
 - ❖ Signal is linked to local environment and climate
 - ❖ No trend or differences across time or between regions was identified
 - ❖ Possible human influences (manuring, irrigation...)

PALEODIET MODELLING

Archaeological sites for which carbon and nitrogen stable isotope analyses were already available on animal and human remains were selected. They are all dated from the **Neolithic period** (see **Figures 1 and 2**). In order to propose new interpretations, these results were integrated in paleodietary models that were done using **SIAR package** (Parnell et al. 2008; Parnell & Jackson 2013) available on R.



- CONCLUSION**
- ❖ Data allows to discuss the **role of wild plants in diet** such as **acorns** whose isotopic signal can sometimes be similar with legumes. It also permits the **confirmation or re-interpretation of results** obtained without taking into consideration the local plant remains.
 - ❖ However, the role in the diet of **other resources**, not retrieved or underestimated in the archaeological record and therefore **not integrated into the models, should be further considered.**
 - ❖ In addition, the analyzed charred remain are from **different chrono-cultural phases** as well as **diverse geographical and paleo-climatic conditions**. Together with the **potential anthropic practices**, this could **influence the isotopic signals** and therefore need also to be addressed.