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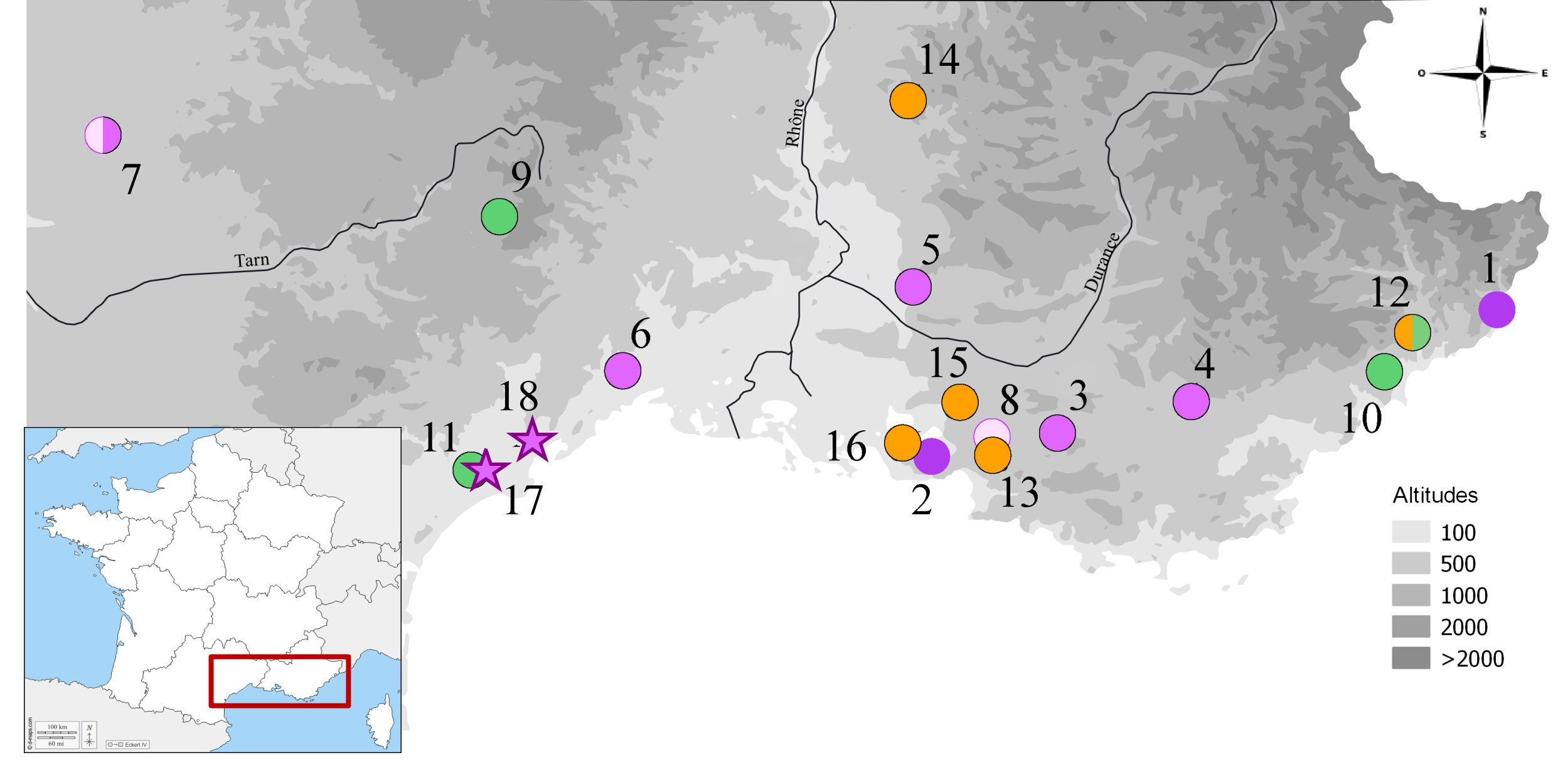


# Carbon and nitrogen stable isotope analysis on charred archaeobotanical remains: Investigating the diet of the past-populations of southern France

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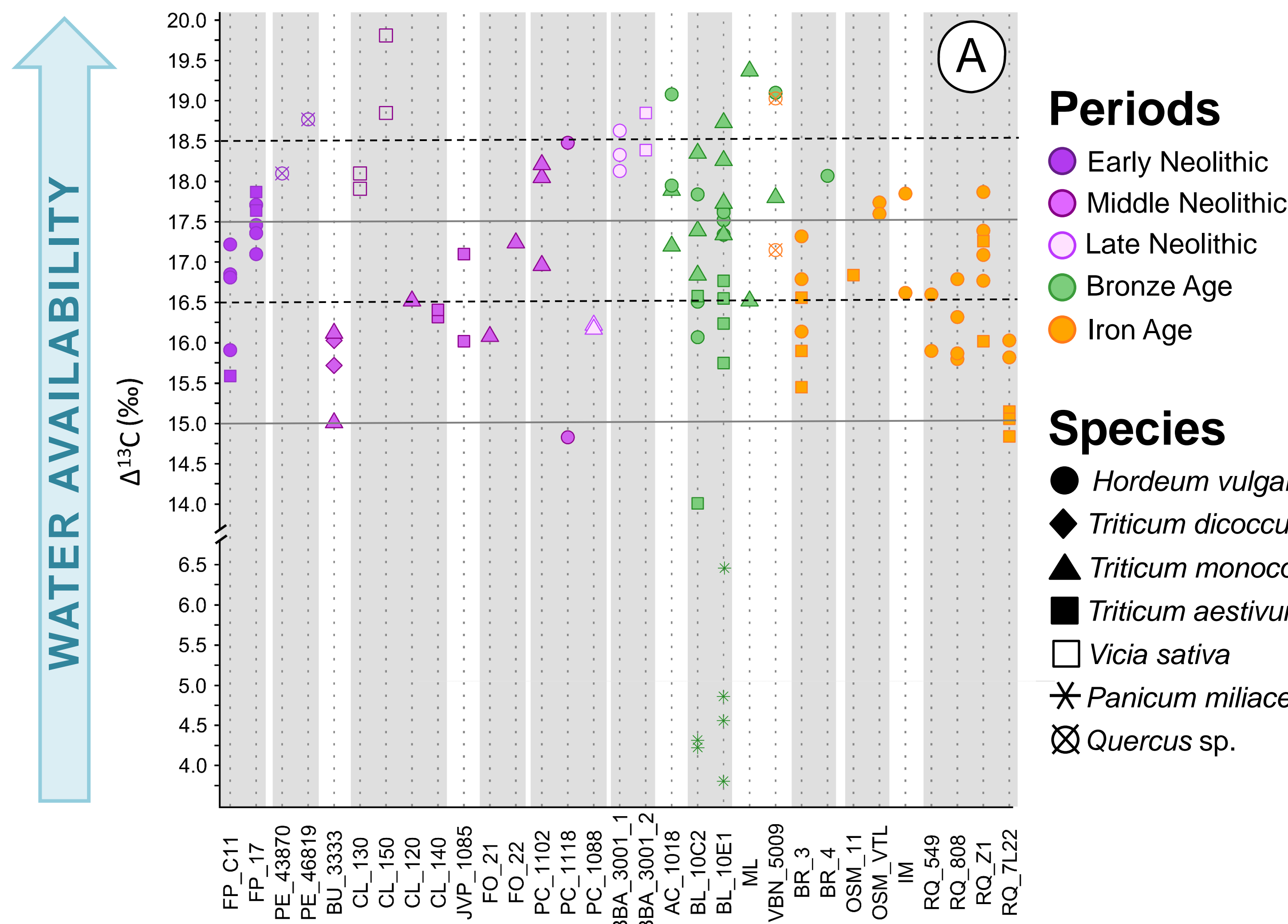
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**CONTEXT** The use of **carbon and nitrogen stable isotope analyses** on human and animal bones contributed, over the last decades, to the better comprehension of past-population subsistence strategies in **Southern France**. Although they represented 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).



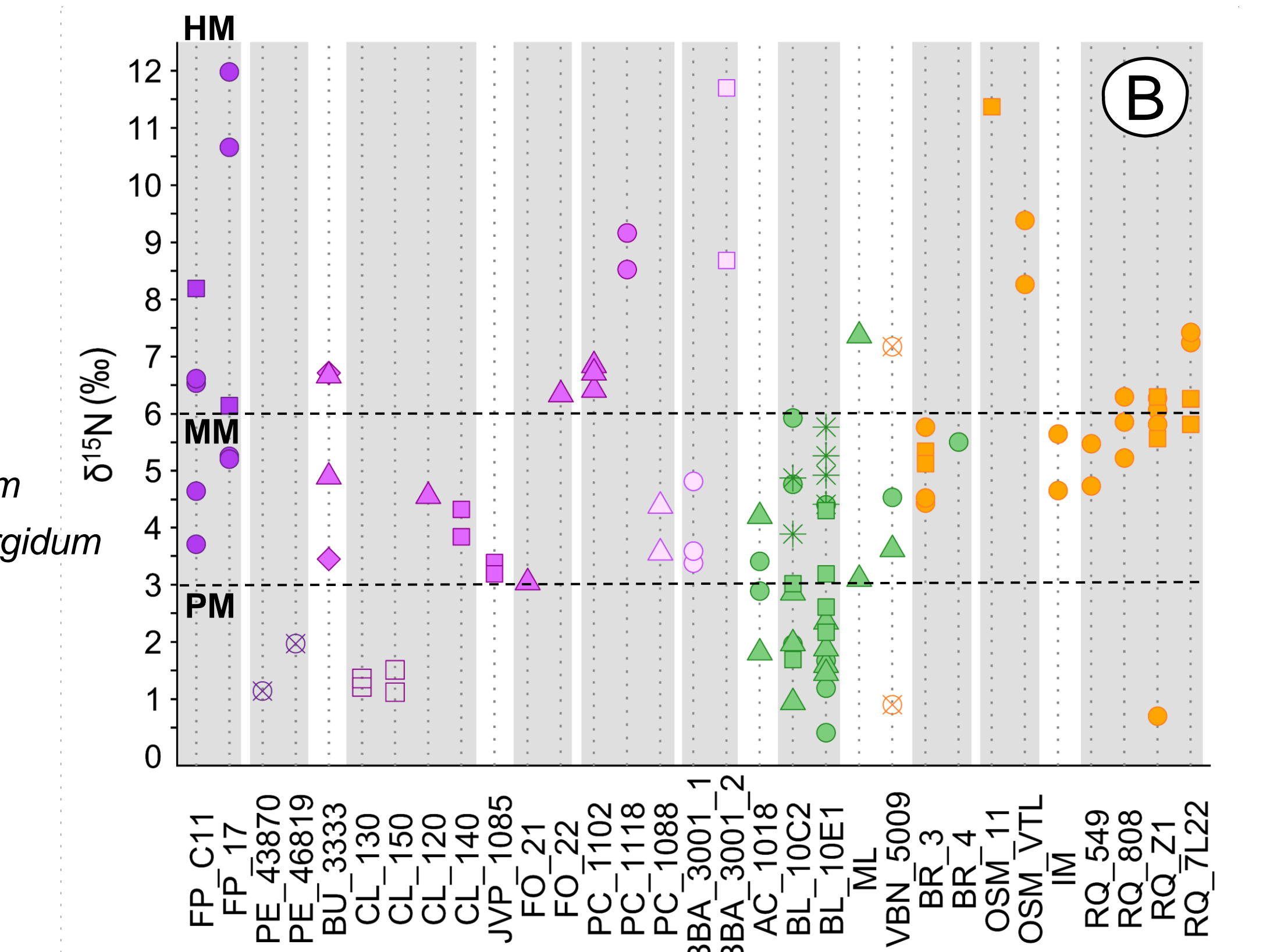
**Figure 1.** Location of the archaeological sites from southern France dated between the Neolithic and Iron Age periods (see **Figure 2** for periods). **1. PE** Pendimoun, **2. FP** Font-aux-Pigeons, **3. BU** Burlière, **4. FO** Fontbrégoua, **5. CL** Claparouse, **6. JVP** Jardin de Vert Parc **7. 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** Roqueperrute, **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](http://web.udl.es/usuaris/x3845331/AIRCO2_LOESS.xls))

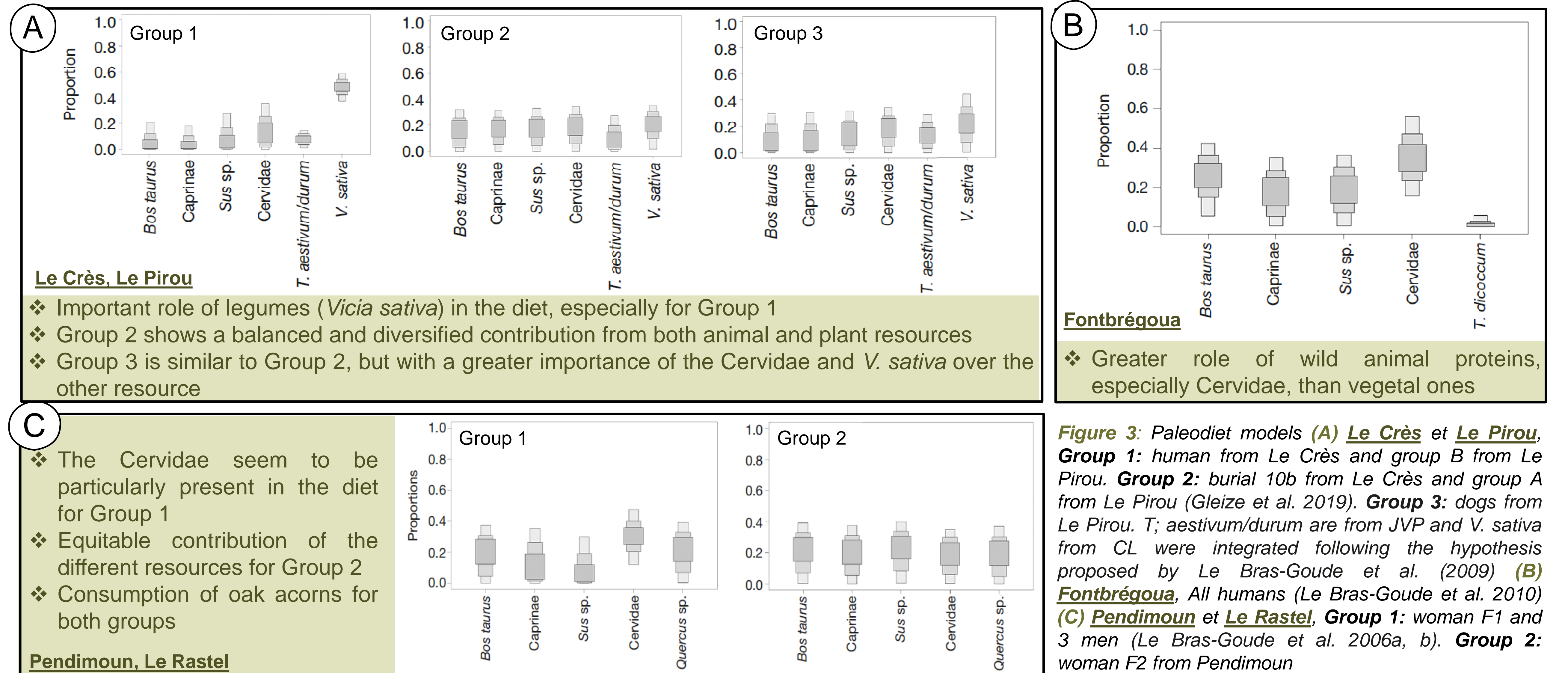


**Figure 2:** Stable isotope results of charred remains coming from different stratigraphic units identified for the 16 southern France archaeological sites. **For sites abbreviations see legend Figure 1.** The analytical error was, maximum **0.14 ‰** for  $\delta^{15}\text{N}$  and **0.1 ‰** for  $\delta^{13}\text{C}$  (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,  $\text{C}_3$  and  $\text{C}_4$  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.



**Le Crès, Le Pirou**

- ❖ Important role of legumes (*Vicia sativa*) in the diet, especially for Group 1
- ❖ Group 2 shows a balanced and diversified contribution from both animal and plant resources
- ❖ Group 3 is similar to Group 2, but with a greater importance of the Cervidae and *V. sativa* over the other resource

**Pendimoun, Le Rastel**

- ❖ The Cervidae seem to be particularly present in the diet for Group 1
- ❖ Equitable contribution of the different resources for Group 2
- ❖ Consumption of oak acorns for both groups

**Fontbrégoua**

- ❖ Greater role of wild animal proteins, especially Cervidae, than vegetal ones

**Figure 3:** Paleodiet models (A) **Le Crès** et **Le Pirou**, **Group 1:** human from Le Crès and group B from Le Pirou. **Group 2:** burial 10b from Le Crès and group A from Le Pirou (Gleize et al. 2019). **Group 3:** dogs from Le Pirou. *T. aestivum/durum* are from JVP and *V. sativa* from CL were integrated following the hypothesis proposed by Le Bras-Goude et al. (2009) (B) **Fontbrégoua**, All humans (Le Bras-Goude et al. 2010) (C) **Pendimoun** et **Le Rastel**, **Group 1:** woman F1 and 3 men (Le Bras-Goude et al. 2006a, b). **Group 2:** woman F2 from Pendimoun

- 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.