"Evaluation of drought-induced water stress on Holm Oak (*Quercus ilex* L.) and wild Olive trees (*Olea europaea* L. var. *sylvestris* Brot.) in Mediterranean forests by remote sensing: a case study from the Sardinia region, Italy"

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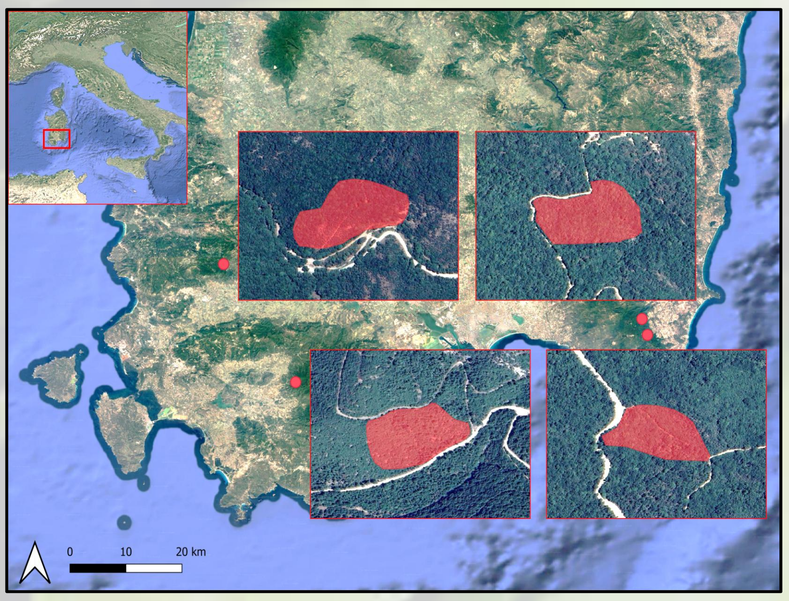
Agricultural and ecological drought: "Depending on the affected *biome*: a period with abnormal *soil moisture* deficit, which results from combined *shortage of precipitation* and excess *evapotranspiration*, and during the growing season impinges on crop production or *ecosystem* function in general" (IPCC AR6, 2022).

- It is necessary to consider the different response strategies of species against water stress to assess the actual impact of drought on forests.
- Considering this aspect can allow for a precise identification of forest areas with the most sensitive species through remote sensing.



Sites visited every 2 weeks: from late May to October

Sampling conducted between 12:00 and 15:00

4 individuals per species selected randomly

Collection of 5 sun-exposed leaves from each individual

Aims and methods

Compare the trend in leaf water content between *Quercus ilex* and *Olea europaea* var. *sylvestris* within and across 4 sites in South Sardinia (inter- and intra-specific differences) by ground-based measurements.

Evaluate the correlation between trends in leaf water content of the two species and a remotely acquired vegetation index, and whether remotely sensed values reflect the same water content values at all four sites.

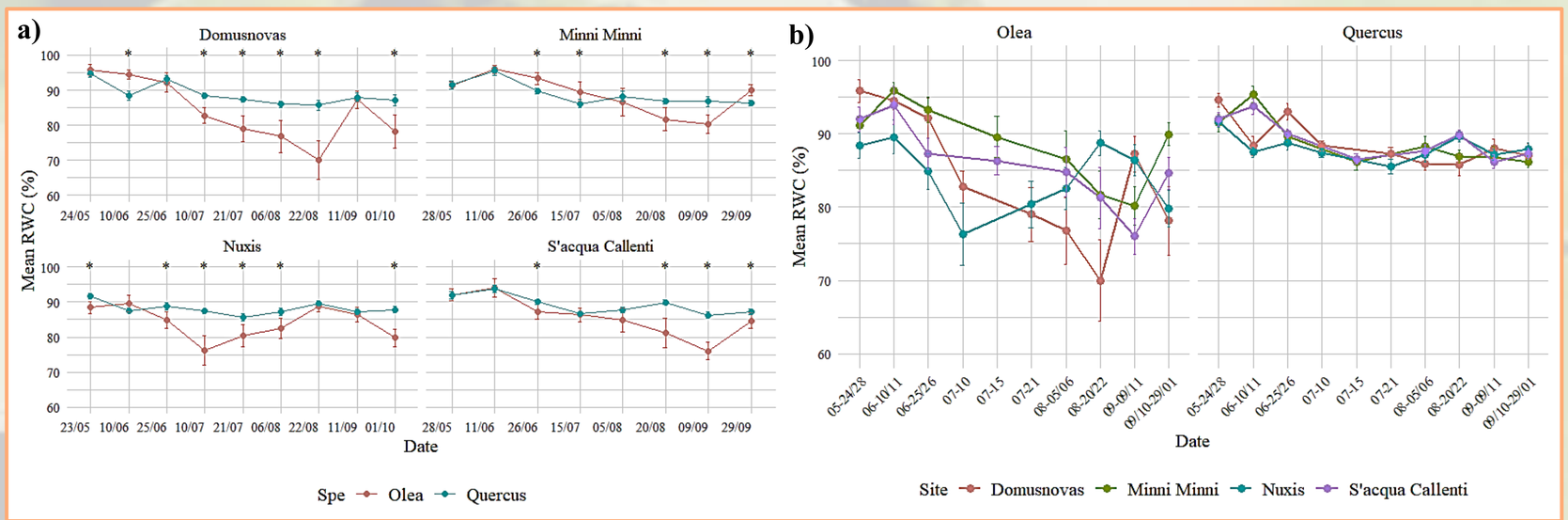
- Fresh Weight (FW): 2-3 hours after collection;
- Turgid Weight (TW): after leaves rehydration;
- Dry Weight (DW): after leaves dehydration;
- Relative Water Content (RWC) calculation.

$$RWC = \frac{FW - DW}{TW - DW}$$

- Selection of 1 multispectral image for each visit as close as possible to the sampling dates;
- NIR and SWIR bands extraction for Normalised Difference Moisture Index (NDMI) calculation.

$$\text{NDMI} = \frac{(NIR - SWIR)}{(NIR + SWIR)}$$

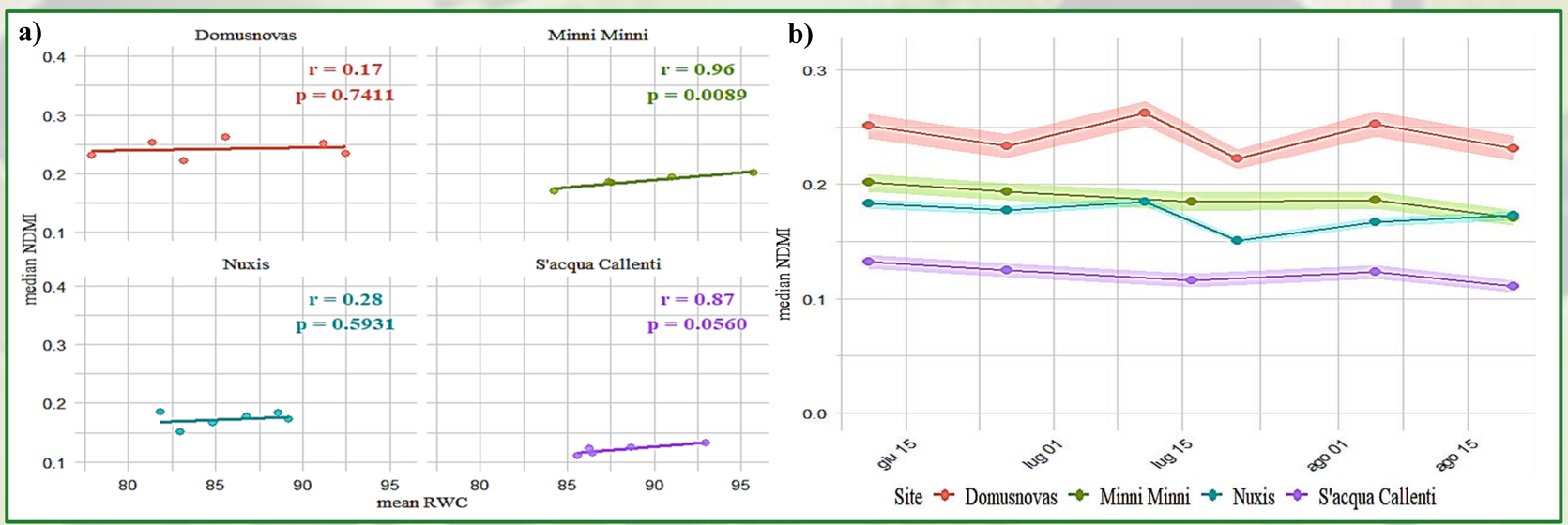
Results



Significant differences in mean RWC trends between the two species were observed across the four sites, particularly in the sites of "Nuxis" and "Domusnovas" (Fig. 1a).

Intraspecific differences in mean RWC trends across the four sites were generally stable in holm oak and much more variable in wild olive (Fig. 1b), even at the individual level.

Figure 1. a) Trend in mean RWC values for both species at each site. * indicates statistically significant differences ($p < 0.05$) between the values of the two species on a given date; **b)** Trend in RWC values between species for each site.



Significant and strong correlations between mean RWC and median NDMI values were not observed in all sites (Fig. 2a).

Median NDMI trends do not seem to reflect always the same range of mean RWC values measured in the field across the four sites (Fig. 2a, b).

Figure 2. a) Correlation between mean RWC of both species and median NDMI values of each site. Pearson's r coefficients and associated p-values (p) are also reported.; b) Trend in median NDMI values of each site.

Conclusions

The implementation of effective monitoring systems for forest vegetation health using remote sensing requires a better comprehension of how different species respond to stress conditions and how this response influences the measured parameters. To ensure a consistent interpretation of remote sensing data based on the actual vegetation health , it is necessary to consider the physiological response of vegetation under stress conditions.

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