Ecophysiological responses of coastal forests to groundwater changes: comparing functional groups and climatic regions

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Groundwater alterations, particularly lowering, will affect ecosystems sensitive to water limitation as coastal dune forests. This can produce dramatic changes in plant communities, on physiological performance or survival of plant species. Groundwater abstraction and the additional impact of drought due to climatic change on groundwater-dependent ecosystems has become of increasing concern: it aggravates groundwater reduction with consequent uncertainties about how vegetation will respond. Plant functional groups may be affected by water distribution and availability differently.

We **aim** to evaluate, in different climatic regions (Tropical, Meso-mediterranean and Thermo-mediterranean) the responses of different coastal plant functional groups to changes in groundwater availability

Study Sites

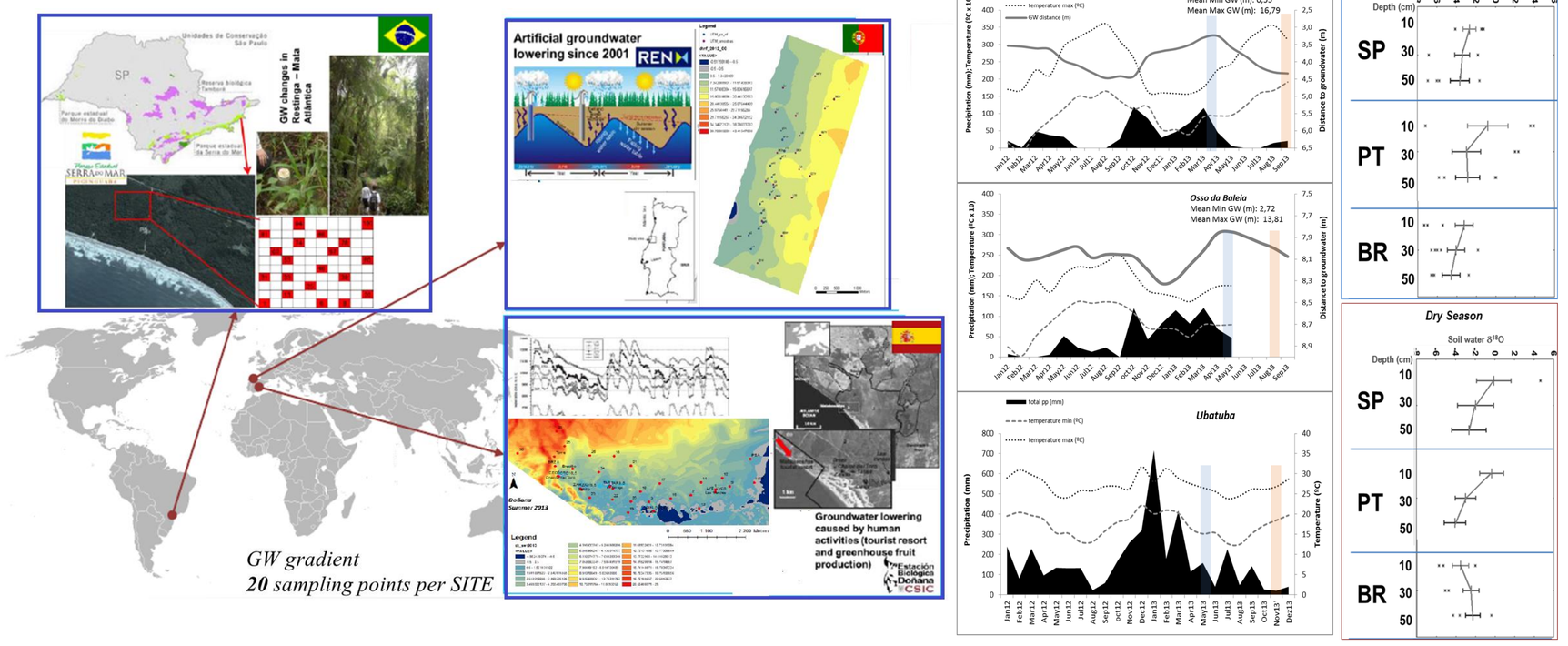


Fig. 1: Study sites in Tropical (Brazil: BR), Meso-Mediterrean (Portugal:PT) and Thermo-Mediterranean (Spain: SP): Sampling points considered, Climatic data and soil profiles of each site. Sampling campaigns (2013) marked as blue (wet season) and red (dry season)

Contrasting isotopic patterns in Mediterranean and Tropical coastal ecosystems

METHODS: For each site 20 plots were considered (Fig. 1). In each plot a maximum of 4 species were sample (3 individuals per specie) from different functional groups in two different seasons: wet and dry season (Fig.1). A Total of 1243 samples (3 Sites X 20 plots X ~4 FG X 3 ind X 2 seasons). For each individual was analyzed: leaf **$\delta^{13}C$**, leaf **$\delta^{15}N$,** leaf **C/N** and xylem water **$\delta^{18}O$** (with a Isotope Ratio Mass Spectrometer, dual inlet, ISOPrime, GV, Micromass, UK) and Reflectance Indices: Photochemical index (PRI), Water Index (WI), Chlorophyll content index (CHL), Normalized difference vegetation index (NDVI) (UNISPEC- PP Systems). Water sources **$\delta^{18}O$** were also sampled: soil water in 3 depths (10, 30 and 50 cm) in each plot (with 3 replicates) (Fig. 1), precipitation and groundwater.

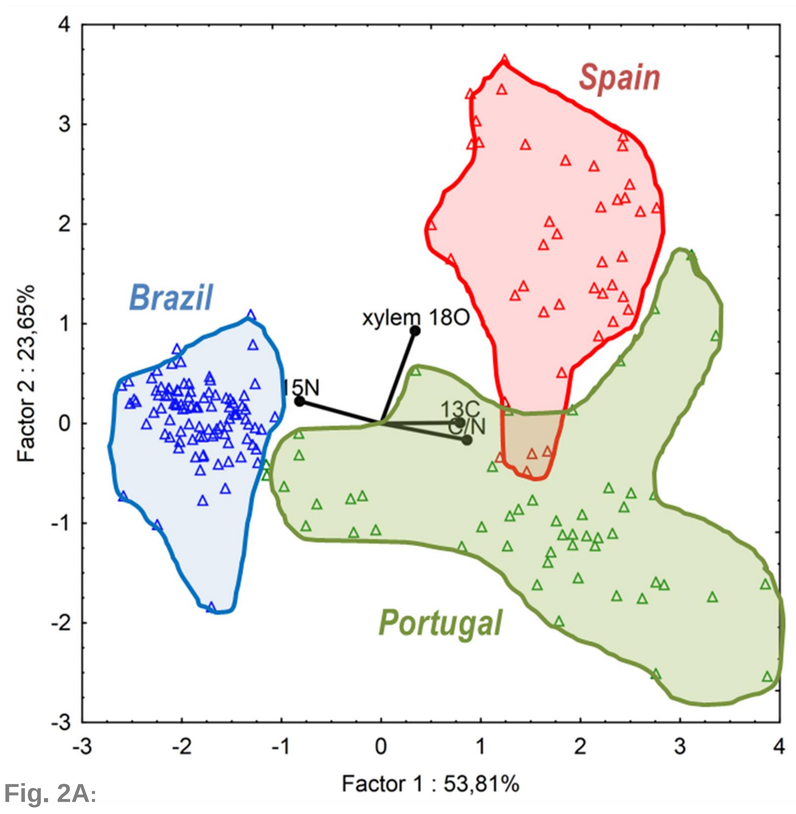


Fig. 2A: PCA results plotting (individual) cases with sum of cosine^2 > 0,9 and (isotopic) variables with factor coordinates > 0,79. 3 Sites, 2 seasons and a total n= 1243.

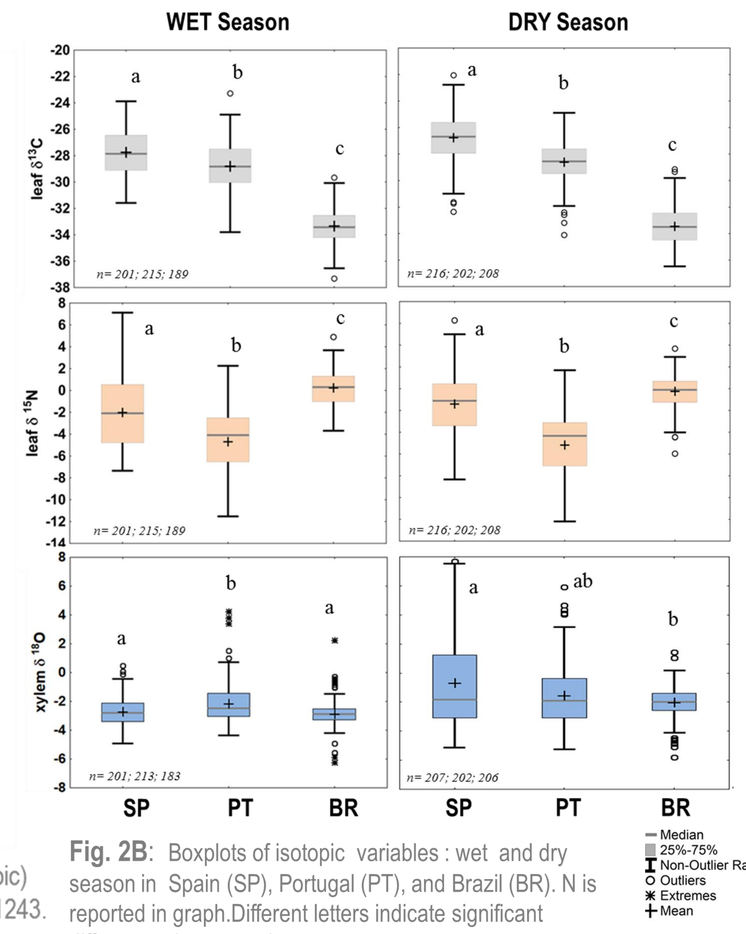


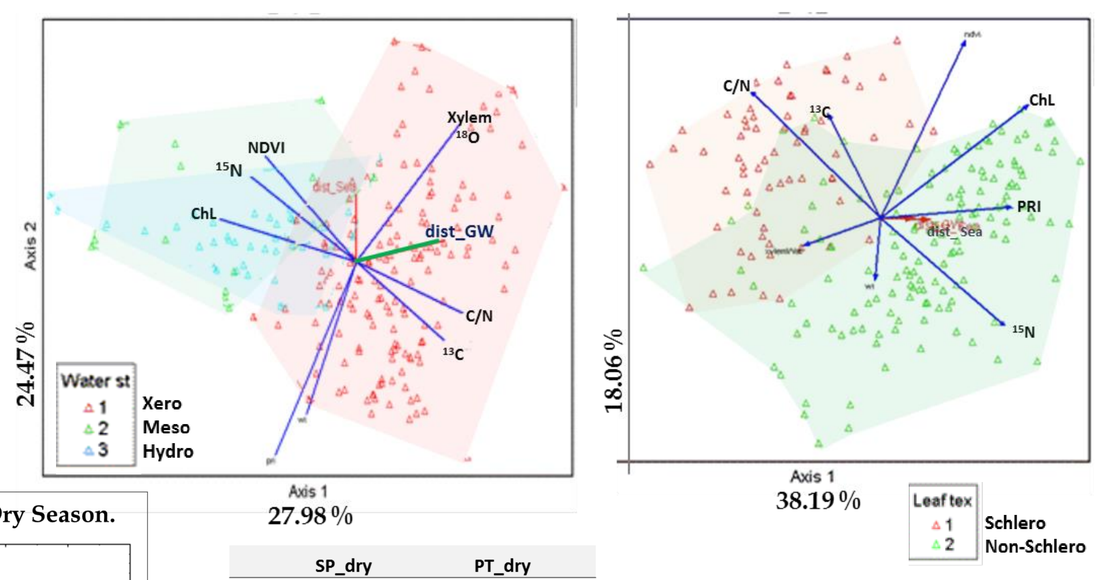
Fig. 2B: Boxplots of isotopic variables : wet and dry season in Spain (SP), Portugal (PT), and Brazil (BR). N is reported in graph.Different letters indicate significant differences between sites.

Differential water use strategies in Mediterranean coastal dune ecosystems: ecophysiological responses to groundwater changes

WET Season

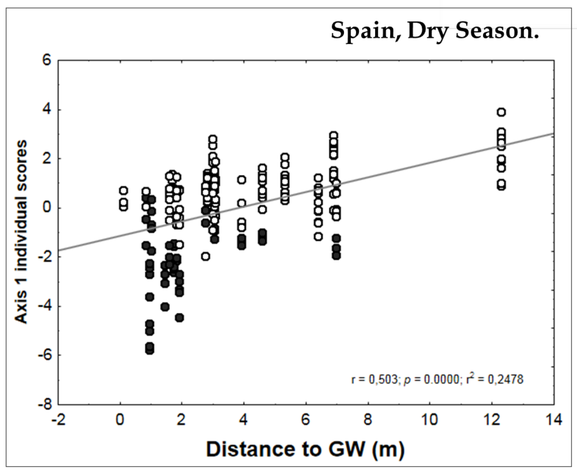
	SP_wet		PT_wet	
Axis	1	2	1	2
leaf_13C	**0,669**	0,035	0,415	-0,148
leaf_15N	**-0,619**	-0,122	**-0,828**	-0,015
leaf_CN	**0,681**	0,474	**0,850**	0,168
xylemWat	-0,431	-0,219	0,051	0,301
wi	**-0,612**	0,088	-0,021	-0,773
pri	-0,305	-0,450	**-0,586**	**-0,620**
chl	-0,481	**0,777**	**-0,884**	0,198
ndvi	-0,244	**0,924**	**-0,589**	**0,532**
Dist_SEA	-0,221	0,023	-0,246	0,096
Dist_GW	0,381	0,060	-0,184	0,095
n	*142*		*214*	

DRY Season



	SP_dry		PT_dry	
Axis	1	2	1	2
leaf_13C	**0,546**	-0,300	-0,290	0,448
leaf_15N	**-0,667**	0,330	**0,688**	-0,467
leaf_CN	**0,661**	-0,197	**-0,716**	**0,549**
xylemWat	**0,637**	0,521	-0,428	-0,119
wi	-0,309	**-0,581**	-0,029	-0,270
pri	-0,499	**-0,739**	**0,727**	0,047
chl	**-0,847**	0,162	**0,814**	0,487
ndvi	**-0,567**	0,404	0,466	**0,763**
Dist_SEA	-0,021	0,339	0,365	-0,083
Dist_GW	**0,503**	0,228	0,301	-0,017
n	*202*		*207*	

Fig. 3: PCA results: Wet and Dry season in Meso and Thermo-mediterranean sites.(Spain and Portugal respectively). All ecophysiological responses and the predictors Distance to Sea and Distance to groundwater were considered. See specific legends and *n* in figure.



Conclusions

- **Climatic** conditions **influences** different isotopic patterns
- **Mediterranean sites** presented **higher variability** comparing to Tropical site
- **Mediterranean plant responses** influenced by Season, different drivers, and Plant traits:
  - **No** influence of GW distance in **wet** season in both sites;
  - In **meso-mediterranean** site leaf morphology is an important grouping trait for the ecophysiology observed;
  - Influence of **GW distance** in **dry season** only in **Thermo-mediterranean** site : the ecophysiological response is linked to **water strategies**.

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