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The fertility status of two protected saline wetlands in NE Spain

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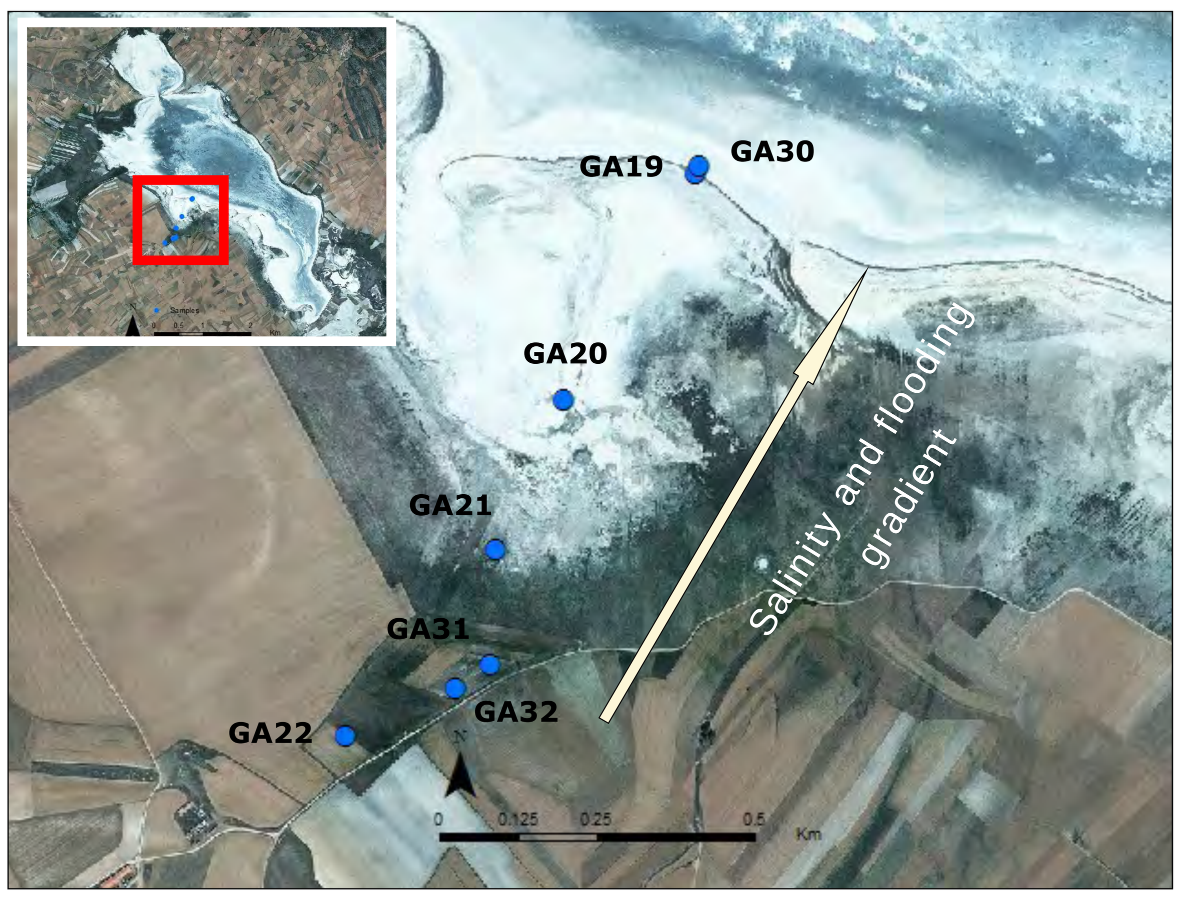
Gallocanta

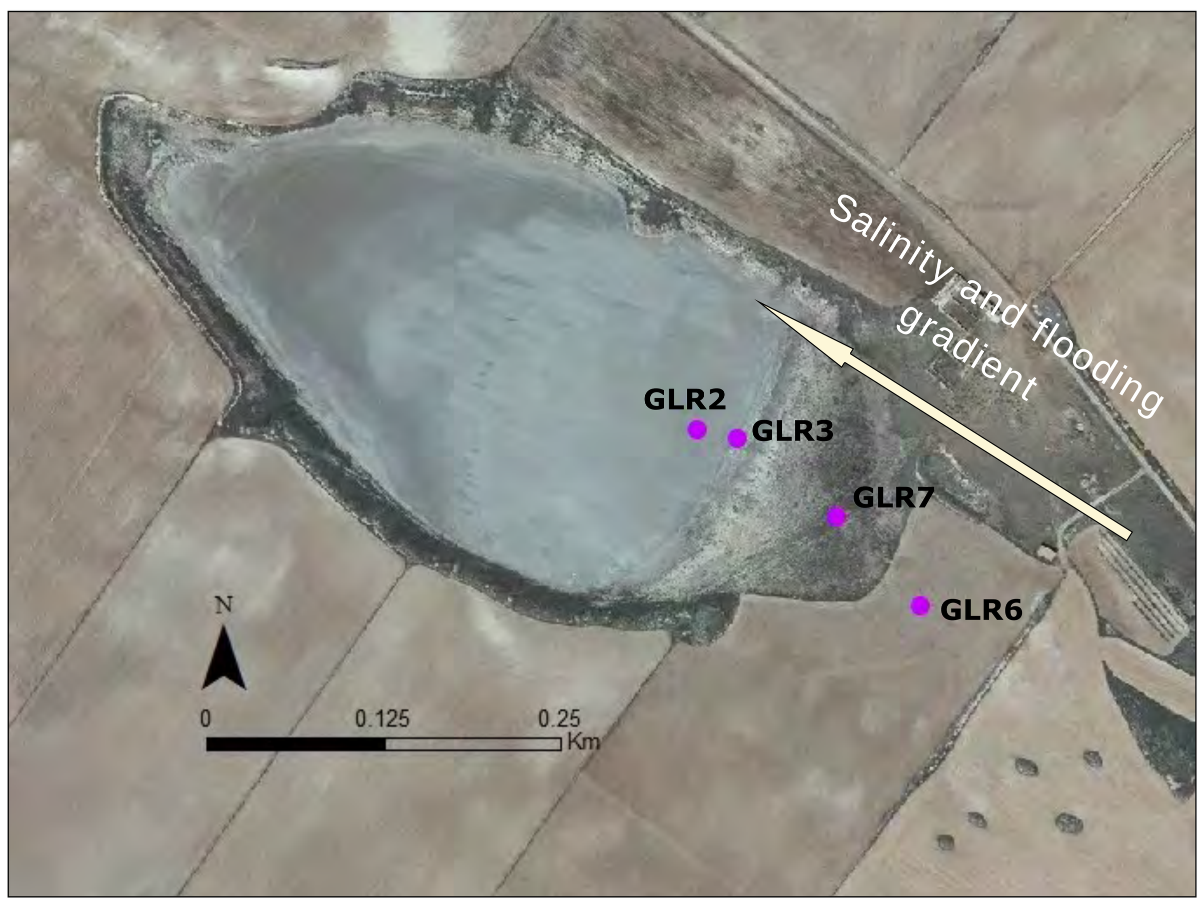


Wetland	Site	Land use	Vegetation
Gallocanta	GA19	Natural vegetation	*Salicornia ramossissima* and *puccinellia pungens*
	GA20	Natural vegetation	*Puccinellia pungens*
	GA21	Natural vegetation	*Puccinellia pungens*
	GA22	Winter cereal	Wheat (*Triticum aestivum*)
	GA30	Surface water	
	GA31	Dryfarmed cereal	Wheat (*Triticum aestivum*)
	GA32	Dryfarmed cereal	Wheat (*Triticum aestivum*)

Two saline wetlands

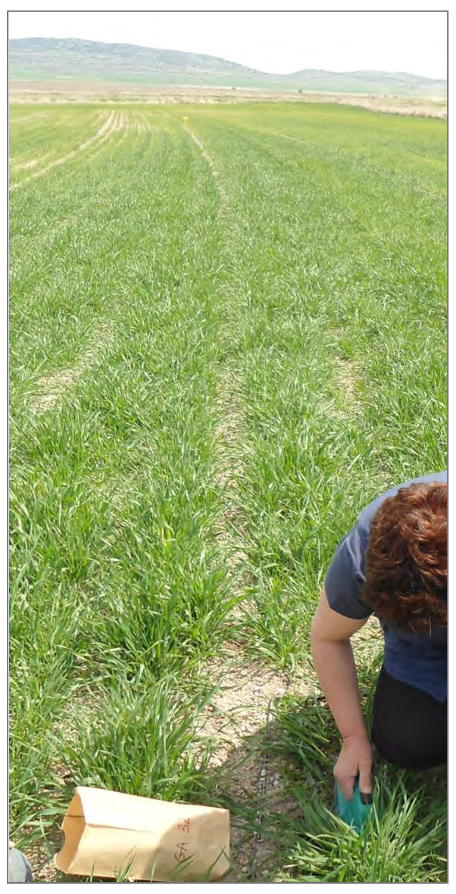
- We studied the soil and vegetation **fertility** of two saline wetlands located in arid (Guallar) and semiarid (Gallocanta) environments, with a mean rainfall of 346 and 488 mm, respectively. Fertility data could be useful to apply agro-environmental measures in vulnerable areas under the Nitrates Directive (91/676/EEC), as is the case of saline wetlands in agricultural areas. Soil management in semiarid lands is key to preserve diversity and to reconcile agriculture with habitats conservation.
- The sampling was performed in April 2013, and the sampling sites followed a gradient in soil salinity and flooding conditions. The first 25 cm of the soil (5 cm in GA19, GA20 and GA21), the surface water, and the vegetation were sampled along a soil transect extending from the crop towards the wetlands shoreline.

Guallar



Wetland	Site	Land use	Vegetation
Guallar	GLR2	Surface water	
	GLR3	Natural vegetation	*Suaeda vera, Sphenopus divaricatus, Hymenolobus procumbens, Poa pratensis*
	GLR7	Natural vegetation	*Hymenolobus procumben* and *Suaeda vera*
	GLR6	Bare soil of an intercrop period	Without vegetation

Sampling site



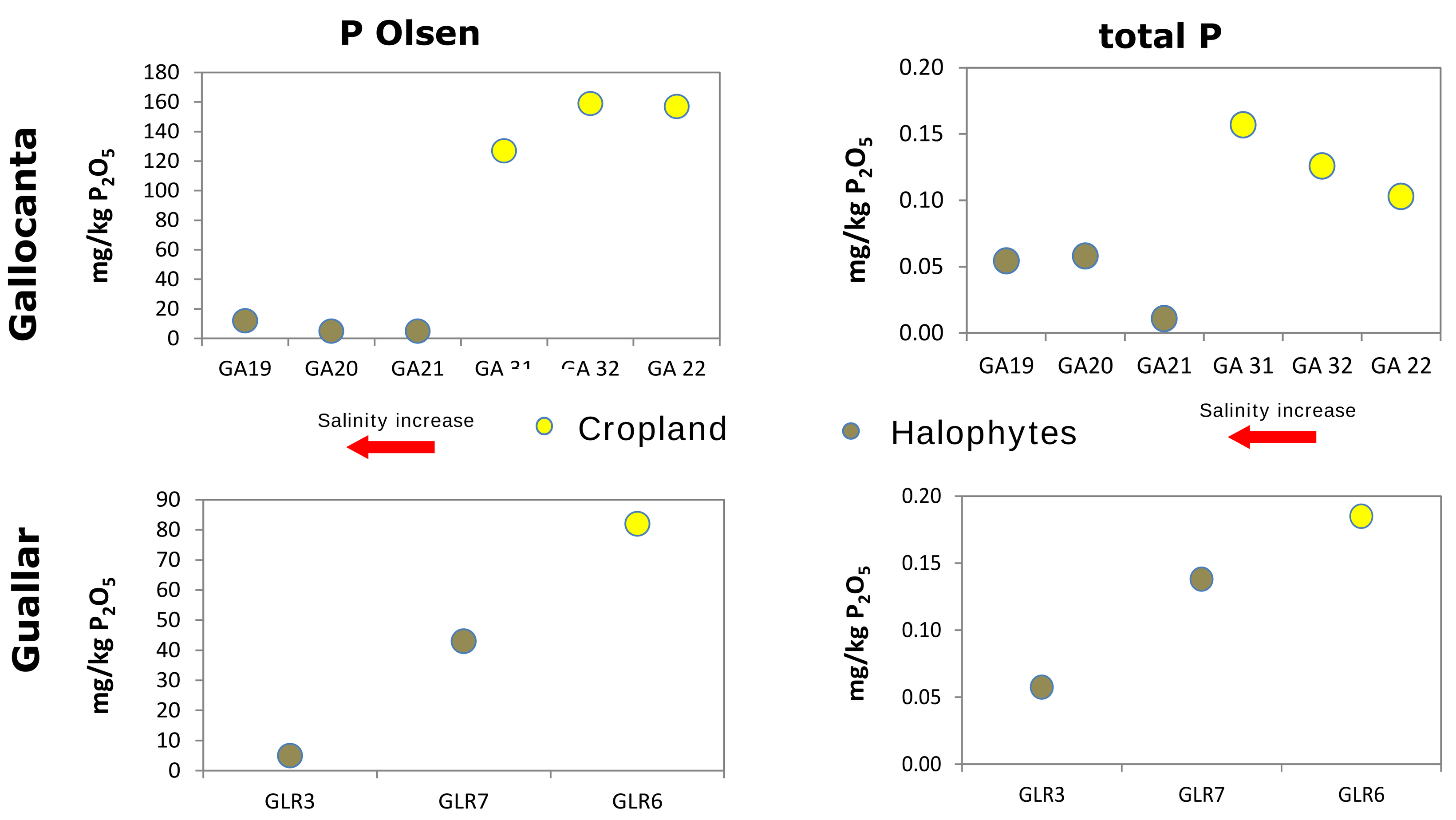
Wetland	Site	Electrical conductivity (dS/m) Water	Electrical conductivity (dS/m) Soil:water extract 1:5	pH 1:2.5	Gypsum %	Calcium carbonate equivalent %
Gallocanta	GA30	39.9		7.2	-	-
	GA19	-	2.6	7.2	2.6	32.2
	GA21	-	25.5	7.8	<2	37.2
	GA31	-	18.7	7.7	<2	50.4
	GA32	-	18.5	7.7	<2	42.6
	GA22	-	13.2	7.8	<2	46.4
Guallar	GLR2	170.5		6.3	-	-
	GLR3	-	128.6	7.3	64.2	23.3
	GLR7	-	118	7.4	11.2	38.9
	GLR6	-	2.3	7.4	8.3	51.1

Biomass and **soil samples** were taken in 0.25 m^2 plots for crops (two rows) and in 0.1875 m^2 plots for halophytes. Soil salinity, measured as electrical conductivity of 1:5 soil:water extract, ranged from 2.3 to 128.6 dS m^{-1} in Guallar, and from 2.6 to 25.5 dS m^{-1} in Gallocanta. Soils were slightly alkaline, with pH ranging from 7.2 to 7.8. Gypsum content was < 3% in Gallocanta soils whereas in Guallar it was highly variable, from 8.3 to 64% in GLR3. Calcium carbonate equivalent was high in both wetlands, 42% (Gallocanta) and 38% (Guallar).

Surface water was highly saline, with electrical conductivity of 40 and 170.5 dS m^{-1} in Gallocanta and Guallar, respectively.

Fertility in cultivated and natural areas

Fertility was evaluated through P Olsen and total P values in soils, and through N and P content and plant nutrition indices (NNI and PNI) in vegetation samples.



	Sample	N content N(%)	P content P (‰)	N Nutrition Index NNI (%)	P Nutrition Index PNI (%)	N/P	Soil EC 1:5 (dS/m)
Gallocanta	GA19.1	3.2	2.2	68.4	60.2	14.9	2.6
	GA19.2	2.1	1.5	52.8	50.9	14.4	2.6
	GA19.3	2.0	1.5	46.5	55.3	12.9	2.6
	GA31	2.7	3.6	54.5	112.4	7.3	18.7
	GA32	4.7	5.1	122.4	111.8	9.2	18.5
	GA22	4.2	4.2	97.4	99.5	10.0	13.2
Guallar	GLR3	1.7	1.8	55.8	70.5	9.2	128.6
	GLR7	1.8	1.7	67.6	61.8	11.0	118.0
Mean	Halophytes	2.2	1.7	58.2	59.7	12.5	50.9
	Cropland	3.8	4.3	91.4	107.9	8.8	16.8

- Soils showed differences in fertility between cultivated and natural vegetated areas following the salinity gradient from the crops to the halophytes. In both wetlands, P Olsen and total P values of soils under halophytes were quite low whereas cultivated soils displayed higher values due to the effect of cultivation and the use of fertilizers.
- In Guallar there was a **gradient in P** values from the cultivated zone to the natural vegetation. P Olsen and Total P values decreased from the cultivated plot (GLR6) towards the wetland floor (GL3), which suggests a transfer of P from the cultivated plot to the halophytes fringing the wetlands.

- The nutrients content (N and P) of plants was twice in crops than in halophytes, whereas average N/P was higher in halophytes than in crops, 12.5 and 8.8, respectively.
- Plant analysis confirmed that in cultivated plots the nutrition indexes were higher than in halophytes, with mean NNI and PNI values of 91% and 108%, respectively, indicative of non-limiting N and P supply for growth as a consequence of fertilization by farmers. Mean NNI and PNI values for halophytes were 58.2% and 59.7%.
- In Gallocanta, nutrition indices (NNI and PNI) were high in fertilized land (GA31, GA32 and GA22). However, the lower area of the agricultural plots (GA31), occasionally affected by shallow saline groundwater, showed a NNI value lower than the uplands, indicative of a possible interaction between soil salinity and plant nitrogen nutrition.

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