THE PAST DISTRIBUTION OF *PINUS NIGRA* ARNOLD IN NORTHERN IBERIA. CONTRIBUTION FROM ITS MACROREMAINS.

Moreno Amat, E.[1], Gómez Manzaneque, F.[1], Morales del Molino, C.[1], Morla Juaristi, C.[1], Rubiales Jimenez, J.M.[1], García-Amorena, I.[1]

[1] Universidad Politécnica de Madrid. Escuela Técnica Superior de Ingenieros de Montes (Departamento de Silvopascicultura). Avda. Ramiro de Maeztu s/n, 28040 Madrid, Spain.

Introduction

➢ 32,9% of the nearly nine million hectares occupied by the Castilla y León region (in central-northwestern Spain) are now forested.
➢10% of these forest areas are of natural origin.
➢The presence of microthermal pines (*Pinus nigra* Arnold and *Pinus sylvestris* L.) whose natural ranges within the region are at present very small, has led to different interpretations of the current vegetation dynamics.
➢However, there is now appreciable evidence that *Pinus* was locally dominant on the Northern Meseta and surrounding foothills throughout most of the Holocene.

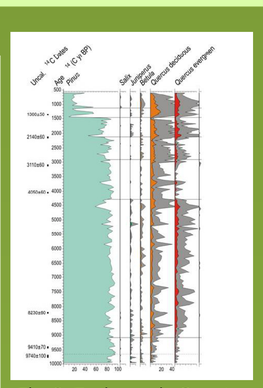
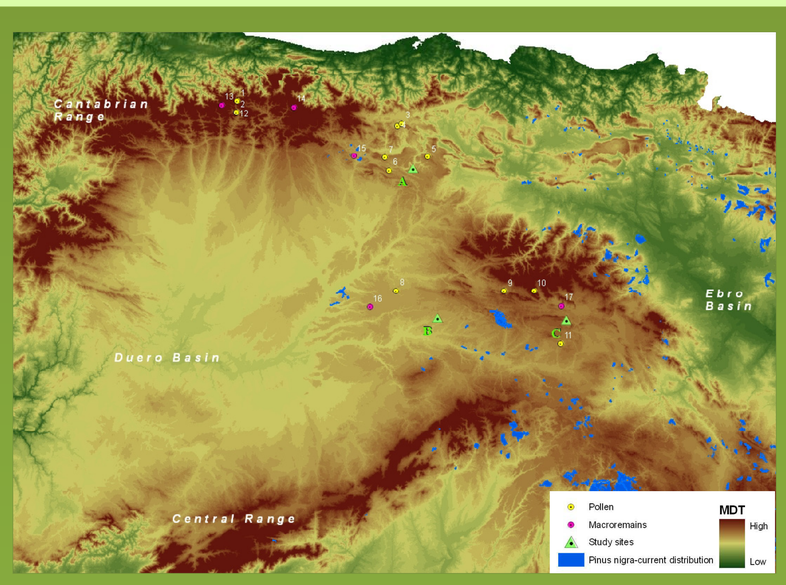


Fig. 2. Espinosa de Cerrato (Palencia). Franco Múgica et al., 2001.



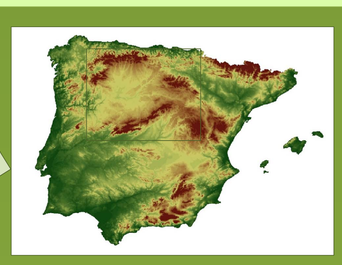


Fig. 1. Study sites. (A -Tubilla del Agua, B-Tubilla del Lago, and C-Fuentetoba) and nearby sites for which published palaeobotanical studies are available (pollen and macroremain studies). 1: Mampodre (Muñoz Sobrino et al., 2003). 2: Lillo (García Antón et al., 1997). 3: Valle de la Nava (Menéndez Amor, 1968). 4: Santa Gadea, 5: Huidobro (Iriarte et al., 2003). 6: San Mamés de Abar (Iriarte et al., 2001). 7: La Piedra (Ramil-Rego et al., 1998). 8: Espinosa de Cerrato (Franco Múgica et al., 2001). 9: Quintanar de la Sierra (Peñalba, 1994; Peñalba et al., 1997). 10: El Hornillo (Gómez-Lobo, 1993). 11: Quintana Redonda (García Antón et al., 1995). 12: Curueño, 13: Porma, 14: Esla (Sánchez Hernando et al., 1999). 15: Aguilar de Campoo (Alcalde et al., 2001). 16: Cevico Navero (Roig et al., 1997). 17: Vega Cintoria (Alcalde et al., 2003).

Objectives

➢Increase the knowledge of the vegetation dynamics of the Duero and High Ebro Basins during the Holocene, particularly the past distribution of *P. nigra*.

Material and methods

Pinecones

71 cones from Tubilla del Lago

Casts

16 casts Tubilla del Agua & Fuentetoba

Variables for morfological comparison.

Identified by examining their shape and size, the external border of the apophysis and the position and the shape of the mucron in the umbo by morfological comparison.

Woods

17 wood remains from Tubilla del Lago.

identified via comparative anatomical studies making use of thin sections prepared in all three major planes.

➢All materials were compared with a reference collection. In the case of pinecones, they were compared with current populations and other studied palaeobotanical sites.
➢Radiocarbon dating was performed by Beta Analytic Inc. (Miami, USA) and the Centro Nacional de Aceleradores (CNA) (Seville, Spain). Standard radiometric and AMS analyses were used.

Fig. 3. Study site **A-Tubilla del Agua**.

Fig. 4. Study site **B-Tubilla del Lago**.

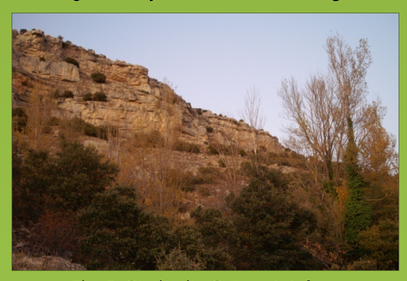


Fig. 5. Study site **C-Fuentetoba**.

Study area

✓Climate is Mediterranean with marked continental characteristics
✓Calcareous lithofacies dominated by gypsum, marls and Cretaceous limestone.

STUDY SITES:

A- Tubilla del Agua, 765m (Burgos):
This site represents an ancient travertine barrier that has been disconnected from other, smaller travertines that formed later in the drained valley. Some pinecone casts and a pinecone fragment were found.

B- Tubilla del Lago, 900m (Burgos):
Excavation work to create an artificial lake has brought to light large trunks, branches and pine cones from the fossil marsh. The marsh deposit has an extent of about 3.8 ha and a thickness of more than 7.5 m.

C- Fuentetoba, 1120m (Soria):
At this site, water draining from Upper Cretaceous limestone–marl strata emerges to form a large travertine edifice. A pinecone cast was found at the foot of the travertine edifice.

Results

Radiocarbon dates

Site	Sample code	Lab code	Type	14C age (BP)	2σ calibrated age (cal BP)
Tubilla del Lago	TUB-G-01	Beta-243503	wood	3160±50	3260–3480
	TUB-A-04	CNA-171	wood	3680±70	3840–4230
	TUB-D-04	CNA-172	wood	3150±70	3210–3550
Tubilla del Agua	TUAG.BU.01	Beta-260006	CaCO3	2650±40	2730–2850
	TUAG.P	Beta-277713	cone	1570±40	1370–1540
Fuentetoba	TOBA.SO.01	Beta-260005	CaCO3	8220±50	9020–9400

Characteristics of the wood remains

Site	Type of sample	Anatomical characters	Taxon
Tubilla del Lago	wood	1º absence of thick epitelial cells in the resiniferous channels 2º window like crossfield pits 3º Ray tracheids with sharp dentated walls	P. sylvestris/P. nigra

Characteristics of the pine cone remains (R: Rounded, H: Hooked, E: eccentric)

Site	Samples	Type of sample	L (Cone length-cm)	A (Cone width-cm)	L (Apophysis length-cm)	AA (Apophysis width-cm)	Scale shape	Mucron	Taxon
Tubilla del Lago	TUB	cone	4.45±0.61	2.82±0.33	0.83±0.68	0.70±0.42	R	HE	*P. nigra*
Tubilla del Agua	TUAG.BU.01	mould	-	3.1	0.85±0.05	0.75±0.05	R	HE	*P. nigra*
	TUAG.BU.02	mould	-	2.43±0.01	0.56±0.13	0.52±0.12	R	HE	*P. nigra*
	TUAG.BU.03	mould	4.38	2.63±0.58	0.51±0.08	0.72±0.13	R	HE	*P. nigra*
	TUAG.BU.04	mould	-	1.53	0.26±0.043	0.36±0.04	R	HE	*P. nigra*
	TUAG.P	cone	3.05	1.25	-	-	-	-	*P. sylvestris/P. nigra*
Fuentetoba	TOBA.SO.01	mould	4.42	3.04	0.76±0.06	0.091±0.05	R	HE	*P. nigra*

Fig. 6. A: Cast from Tubilla del Agua. B: Latex pinecone obtained from the casts.

Fig. 7. Microscopic detail of the transverse section (A) and radial section (B): 1: crossfield pits, and 2: dentition of the radial tracheid walls.

Fig. 8. Apophysis of a pinecone. The edge is rounded and the mucron hooklike and eccentric.

Discussion and main conclusions

✓*P. nigra* was present during the Holocene at all three of the study sites, where there are currently no natural populations of this taxon. The nearest natural pine populations are nearly 30km away.

✓*P. nigra* was more widely distributed during the Holocene than at present, which is also suggested by 6000-yr-BP bioclimatic models (e.g.: Benito Garzón *et al*. 2007).

✓The pollen record of Espinosa de Cerrato (Fig.XX) shows that *Pinus* was locally dominant until anthropogenic forest clearance occurred after 1500 yr BP (Franco Múgica *et al*., 2001).

✓Coherent with the importance of *P. nigra* in the potential vegetation on carbonated soils of the supra-mediterranean Iberian plains

- → Palaeodata: e.g.: Franco et al., 2001; García-Amorena et al. 2010
- → Relict populations at various sites in the Duero Basin.
- → Potential maps and interpretations (Costa et al., 1988; García-Cervigón *et al*., 2009)

We propose that *P. nigra* underwent recent local extinction probably induced by the increasing human activity.

References

ALCALDE, C., GARCÍA-AMORENA, I., GÓMEZ MANZANEQUE, F., MALDONADO RUIZ, J., MORLA, C., POSTIGO MIJARRA, J.M., 2001. Estudio de los macrorrestos vegetales del yacimiento de Lomilla (Aguilar de Campoo, Palencia, España). An. Jard. Bot. Madr. 59 (1), 101–112.
ALCALDE, C., GÓMEZ MANZANEQUE, F., POSTIGO, J., SANZ, E., MENÉNDEZ-PIDAL, I., 2003. Pinus sylvestris L. en el Pleistoceno Superior del Duero (Vega Cintoria, Soria, España). Cuat. Geom. 17 (1–2), 21–28.
FRANCO MÚGICA, F., GARCÍA, M., MALDONADO, J., MORLA, C., SAINZ, H., 2001. The Holocene history of Pinus forests in the Spanish nothern meseta. Holocene 11 (3), 343–358.
GARCÍA ANTÓN, M., FRANCO MÚGICA, F., MALDONADO, J., MORLA, C., SAINZ, H., 1995. Una secuencia polínica en Quintana Redonda (Soria). Evolución holocena del tapiz vegetal en el Sistema Ibérico septentrional. An. Jard. Bot. Madr. 52 (2), 187–195.
GARCÍA ANTÓN, M., FRANCO MÚGICA, F., MALDONADO, J., MORLA JUARISTI, C., SAINZ OLLERO, H., 1997. New data concerning the evolution of the vegetation in Lillo pinewood (León, Spain). J. Biogeogr. 24 (6), 929–934.
GÓMEZ-LOBO, A., 1993. Historia de la vegetación durante los últimos 15,000 años en los Picos de Urbión (Soria) en base al análisis polínico. Universidad de Alcalá de Henares, Facultad de Ciencias, Alcalá de Henares.
IRIARTE, M., MUÑOZ SOBRINO, C., RAMIL REGO, P., RODRÍGUEZ GUITIÁN, M., 2001. Análisis palinológico de la turbera de San Mamés de Abar (Burgos). In: Fombella, M., Fernández, D., Valencia, R. (Eds.), Palinología: Diversidad y Aplicaciones. Serv. Publ. Univ. León, León, pp. 87–93.
IRIARTE, M.J., RAMIL-REGO, P., MUÑOZ-SOBRINO, C., 2003. El registro postglaciar de dos turberas situadas en el Norte de la provincia de Burgos. Polen 13, 55–68.
MENÉNDEZ AMOR, J., 1968. Estudio esporo-polínico de una turbera en el Valle de la Nava (provincia de Burgos). Bol. R. Soc. Esp. Hist. Nat. Secc. Geol. 66, 35–39.
MUÑOZ SOBRINO, C., RAMIL REGO, P., GÓMEZ ORELLANA, L., 2003. La vegetación postglaciar en la vertiente meridional del Macizo del Mampodre (Sector Central de la Cordillera Cantábrica). Polen 13, 31–44.
PEÑALBA, M., 1994. The history of the Holocene vegetation in northern Spain from pollen analysis. J. Ecol. 82, 815–832.
PEÑALBA, M., ARNOLD, M., GUIOT, J., DUPLESSY, J.-C., DE BEAULIEU, J., 1997. Termination of the Last Glaciation in the Iberian Peninsula inferred from the pollen sequence of Quintanar de la Sierra. Quat. Res. 48, 205–214.
RAMIL-REGO, P., MUÑOZ-SOBRINO, C., RODRÍGUEZ-GUITIÁN, M., GÓMEZ-ORELLANA, L., 1998. Differences in the vegetation of the north Iberian Peninsula during the last 16,000 years. Plant Ecol. 138, 41–62.
ROIG, S., GÓMEZ, F., MASEDO, F., MORLA, C., SÁNCHEZ, L., 1997. Estudio paleobotánico de estróbilos y maderas subfósiles holocenas en el yacimiento de Cevico Navero (Palencia, España). An. Jard. Bot. Madr. 55 (1),