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A global view on the riparian forests with *Salix neotricha* and *Populus alba* in the Iberian Peninsula (Portugal and Spain)

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Abstract

Forests dominated by *Salix neotricha*, and *Populus alba* found along the mesoeutrophic rivers in the Iberian Peninsula, were studied. We discuss the floristic circumscription, chorology, and community segregation based on the available relevés of all Iberian riparian communities included in *Populenion albae*. Eleven formerly described communities were analyzed and due to original floristic combination, habitat features, and biogeographic scope, a new willow and poplar forest type is proposed within a well-defined biogeographical unit (Sadensean-Dividing Portuguese Subprovince): *Clematido campaniflorae-Salicetum neotrichae*. This syntaxon is found under a semi-hyperoceanic thermomediterranean to lower mesomediterranean, subhumid to humid bioclimate. Cluster analysis including all Iberian communities of *Populenion albae* shows a clear floristic segregation within the suballiance and confirms the originality of the new association. Furthermore, chemical characteristics of the water along some of the Portuguese watercourses with *Populenion albae* were studied and compared to the oligotrophic rivers occupied by *Osmundo-Alnion* communities. This study suggests that floristic separation between the communities of *Populenion* and *Osmundo-Alnion* is accompanied by a differentiation of the water trophic level.

Keywords: *riverine forests*, Populenion albae, Populetalia albae, *running waters, trophic values of water*

Introduction

Mediterranean deciduous riparian forests that colonize alluvial plains with fluvial soils and mesoeutrophic waters have been referred in phytosociological literature as the *Populion albae* alliance. Within this alliance, poplar and willow forests that occupy biotopes closest to the riverbed belong to the *Populenion albae* suballiance. These poplar and willow forests colonize sections of the river with low to medium kinetic energy and are often flooded. As alluvial soils are important to agriculture, the *Populenion albae* forests were mostly replaced by crops. In recent years, there has been a slight recovery of the area occupied by *Populenion* as a result of land set-aside. Areas that are no longer devoted to agriculture and grazing activities are often recolonized by white poplars through vegetative spread (Brundu et al. 2008). However, the persistence of strong man-induced disturbances on many riparian corridors, along with riverengineering needs, points out critical issues for the conservation of river systems (Lockaby 1999; Naiman et al. 2005; Goetz 2006).

In the Iberian Peninsula, the riparian forests dominated by *Populus alba* and *Salix neotricha* are common in floodplains in the terminal sector of the main rivers. These areas are usually heavily modified by man. The eutrophication of waters is mostly the result of activities of man (domestic effluents, industrial activities, animal husbandry, and especially nitrate-enriched agricultural runoff, Cabezas et al. 2009). Although most of the *P. alba* were planted, it is, nonetheless, considered a native tree in the continental Mediterranean basin, as recently demonstrated by the discovery of fossil remains in southern France (Roiron et al. 2004).

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The abundance of willows and poplar forests (*Populenion albae*) in the terminal sector of the major peninsular rivers have been related to water eutrophication and to the low energy level of water flow (Rivas-Martínez & Cantó 2002). This tendency to eutrophication has simultaneously natural and anthropic origins. Mesoeutrophic riparian forests contrast in floristic composition and level of water eutrophication, with the *Osmundo-Alnion* communities. Thus, the analysis of trophic levels in ecosystems has been considered an important environmental correlate in understanding floristical differences among wetland forests (Lockaby 1999).

The communities along the mesoeutrophic watercourses in West-Central Portugal have never been an object of a thorough study even though tall poplar woods and willow groves belonging to *Populenion albae* are frequent. Both white willow (*S. neotricha*) and the black poplar (*Populus nigra*) are relatively common on the banks of the lower Tagus River (Gaspar 2003) as well as on the rivers and streams flowing in western Portugal (Lousã et al. 1998; Lopes 2001). According to Costa et al. (1999) and Rivas-Martínez et al. (2002), those forests are located in the Ribatagan District and in the Dividing Portuguese Sector (Sadensean-Dividing Portuguese Subprovince, Coastal Lusitan-Andalusian Province, Mediterranean Region). These woodlands have received different syntaxonomic interpretations (Rivas-Martínez et al. 1990; Aguiar et al. 1995; Lousã et al. 1998; Lopes 2001; Gaspar 2003), which we shall clarify during this study.

It is the purpose of this article to make a contribution adding to the knowledge of the *Populenion albae* communities on the Iberian Peninsula by accounting for the introduction of new ecological and syntaxonomical information, we intend to discuss chorology and floristic segregation among communities identified and currently accepted. In this scope, we focus our attention in what appears to be an original and poorly studied region including a new syntaxon standing for the river and stream vegetation in West-Central Portugal. The foremost characteristic features are the chalky hills of the *Estremenho* Limestone Massif upstream. All these watercourses share a common characteristic in that they are nutrient rich due the nature of the bedrock and also because watercourses run through medium- to high-density built-up areas, which have intensive farming and animal husbandry. Activities concerned with intensive farming and animal husbandry are also responsible for the serious pollution: field-applied fertilizers, particularly nitrogen phosphorus and also pesticides are a major form of non-point-source pollution (Angier et al. 2002; Jonathan et al. 2002). On the banks of these slow-flowing watercourses, riparian forests of *Populenion albae* may be found growing in rich alluvial soil with a close-to-the-surface water table. In Portugal, they stand out in contrast with the oligotrophy that characterizes watercourses colonized by riparian *Osmundo-Alnion* woodlands. The influence exerted by the oligotrophic or eutrophic nature of the watercourse on the composition of riparian vegetation has already been noted by several authors (Carbiener et al. 1990; Wiegers 1990; Vermaat & De Bruyne 1993; Jeffries & Drek 1995; Robach et al. 1996; Kelly & Whitton 1998; Amoros et al. 2000; Schneider & Melzer 2003). With analysis of the chemical composition of the water, we hope to support the tenent that the floristic separation correlates with two syntaxonomic units referred to *Osmundo-Alnion* (oligotrophic) and *Populenion albae* (mesotrophic to eutrophic).

In order to perceive the floristic identity of this new forest in the scope of the Iberian riparian forests, we have included a synthetic table of the poplar and willow forests of the *Populenion albae* on the Iberian Peninsula, which may be found in the checklist published by Rivas-Martínez et al. (2001, 2002). The taxonomy of the species of the *Salix* genus that grows in Portugal has only recently been established after the publication of a study by Rodríguez-González et al. (2003).

It is the purpose of this study to make a contribution adding to the knowledge about the *Populenion albae* communities on the Iberian Peninsula, and its consequences in the global system of Iberian riparian forests by resorting to a modified syntaxonomical coherent system in agreement with the Code of Phytosociological Nomenclature (Weber et al. 2000).

Material and methods

Phytosociological relevés were drawn up according to the principles of the Zurich–Montpellier landscape and ''sigmatist'' school (Braun-Blanquet 1965; Géhu & Rivas-Martínez 1980; Rivas-Martínez 2005). The taxonomic nomenclature follows the work of Castroviejo et al. (1986–2008), Franco (1971, 1984), Franco and Rocha Afonso (1994, 1998, 2003) and Coutinho (1939). The *Salix* species were determined on the basis of the work undertaken by Díaz and Llamas (1987). One hundred eighty-two relevés were submitted to Un-weighted Pair-Group Method using arithmetic Averages (UPGMA), with Bray-Curtis coefficient using SYNTAX 2000 software (Ludwig & Reynolds 1988; Podani 2001). To compose the synthetic table and run cluster analysis, some relevés were taken from the literature [Tchou 1949 (121–160); Bolòs & Bolòs 1950 (111–120); Braun-Blanquet & Bolòs 1957 (58–78); Bolòs & Bolòs 1950 (102–109), Bolòs 1967 (110); Rivas

Goday 1964 (48–57); Úrsula 1986; Alcaraz et al. 1987 (175–182); Díaz & Penas 1987 (27–47); Martínez-Parras et al. 1987; Navarro et al. 1987 (18–26); Peinado & Bartolomé 1987; Galán de Mera 1993; Biurrun et al. 1994 (161–174); Pérez Latorre et al. 1996 (95–101); García Fuentes et al. 1998 (79–90); Pinto Gomes & Paiva Ferreira 2005 (91–94)]. The final layout of the synthetic table followed the method of Mueller-Dombois and Ellenberg (1974). Bioclimatic nomenclature follows Rivas-Martínez's (2007) bioclimatic classification of the earth, and biogeographic nomenclature follows that of Costa et al. (1999) and Rivas-Martínez (2007). The parameters for the river and stream waters were taken from the Portuguese Water Institute (INAG 2005).

Results and discussion

At high similarity levels, the UPGMA clustering dendrogram (Figure 1) exhibits a clear segregation of all communities within the presupposed phytosociological classification, classifying the relevés according to the formerly described associations, except for relevé 106 (Figure 1). Lower similarity levels yield four main clusters that can be interpreted as biogeographic tendencies, as follows (see map on Figure 2):

1. the first one includes the communities of the western and north western Iberian Peninsula (*Clematido campaniflorae-Salicetum neotrichae*, *Salici neotrichae-Populetum nigrae* and *Salici atrocinereae-Populetum albae*);
2. the second are the associations from eastern and north eastern Iberian Peninsula (*Rubio tinctorum-Populetum albae*, *Populetum albae* and *Humulo lupuli-Alnetum glutinosae*);
3. the third cluster consists of *Carici pendulae-Salicetum atrocinereae*; and
4. the last one corresponds to associations from south and southeastern Iberian Peninsula (*Nerio-Populetum albae*, *Crataego brevispinae-Populetum albae*, *Vinco difformis-Populetum albae* and *Lonicero biflorae-Populetum albae*).

The relevés of the *Clematido campaniflorae-S. neotrichae* have a high dissimilarity in relation to the other associations. The relevés of the *Vinco difformis-Populetum albae* and *Lonicero biflorae-Populetum albae* show great heterogeneity.

Woodland sometimes reaching a height of over 15 m mainly consisting of *S. neotricha* and *P. nigra* may be seen on the muddy, limey banks of the lower Tagus basin watercourse and in the slow-flowing rivers and streams of the Diving Portuguese Sector, Sadensean-Dividing Portuguese Subprovince from Coastal Lusitan-Andalusian Province. They are often flooded during the winter by mesotrophic to eutrophic waters that have an alkaline pH and are rich in nitrates and bases (mainly calcium carbonate). These watercourses also have high

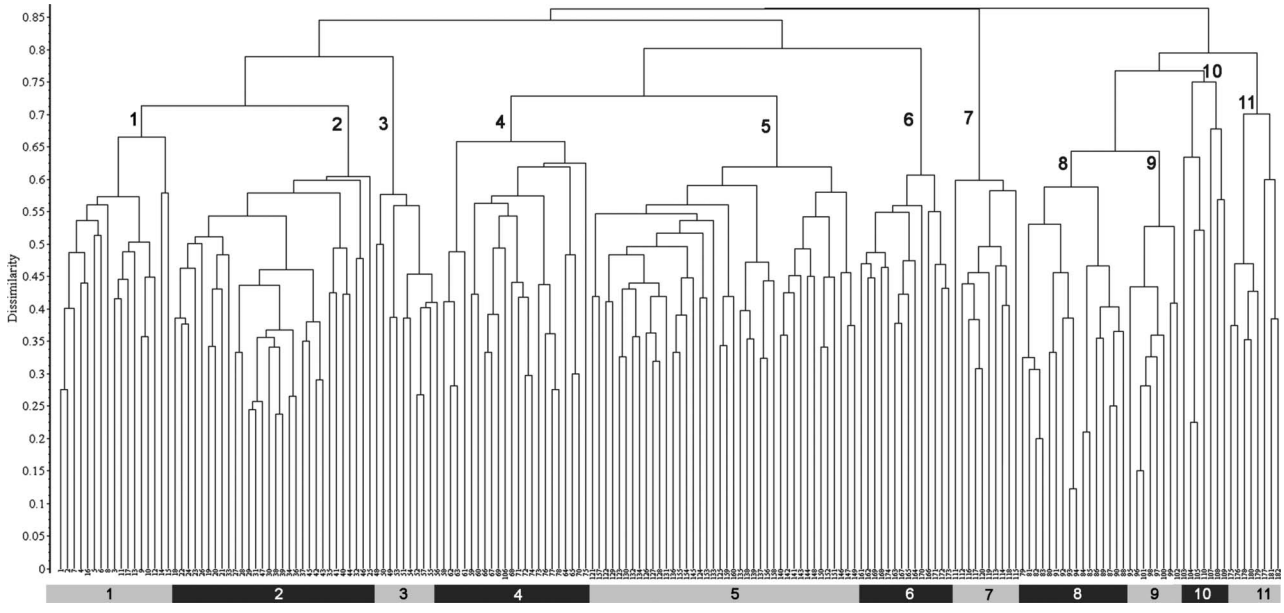


Figure 1. Dendrogram of the UPGMA with Bray-Curtis coefficient of the communities of *Populenion albae* in Iberian Peninsula. 1 (1–17) – *Clematido campaniflorae-S. neotrichae*; 2 (18–47) – *Populo nigrae-S. neotrichae*; 3 (48–57) – *Salici atrocinereae-Populetum albae*; 4 (58–78) – *Rubio tinctorum-Populetum albae*; 5 (121–160) – *Populetum albae*; 6 (161–174) – *Humulo lupuli-Alnetum glutinosae;* 7 (111–120) – *Carici pendulae-Salicetum atrocinereae*; 8 (79–94) – *Nerio oleandri-Populetum albae*; 9 (95–101) – *Crataego brevispinae-Populetum albae*; 10 (102–110) – *Vinco-Populetum albae*; 11 (175–182) – *Lonicero biflorae-Populetum albae*.

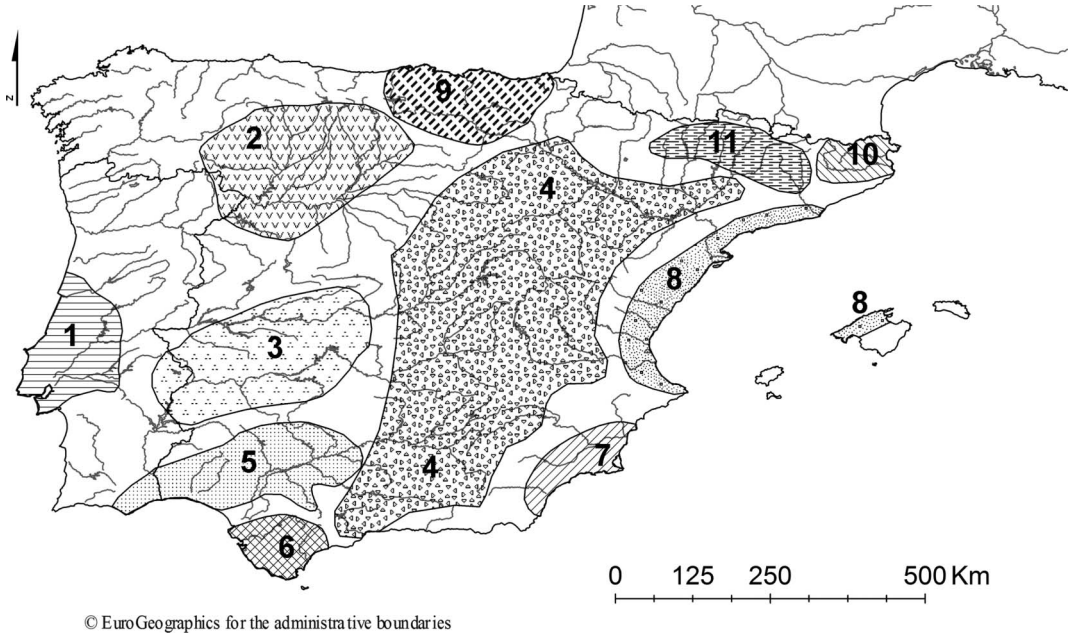


Figure 2. Distribution of Iberian associations of *Poupulenion albae*: (1) *Clematido campaniflorae-S. Neotrichae,* (2) *Populo nigrae-S. neotrichae,* (3) *Salici atrocinereae-Populetum albae,* (4) *Rubio tinctorum-Populetum albae,* (5) *Nerio oleandri-Populetum albae*, (6) *Crataego brevispinae-Populetum albae*, (7) *Lonicero biflorae-Populetum albae*, (8) *Vinco-Populetum albae,* (9) *Humulo lupuli-Alnetum glutinosae*, (10) *Populetum albae,* (11) *Carici pendulae-Salicetum atrocinereae*.

conductance values and the water is extremely hard (Table I). The floristic composition of these forests also contains other trees such as *Fraxinus angustifolia, Salix atrocinerea*, *Alnus glutinosa*, *Ulmus minor*, *Salix alba*, and many climber plants such as *Clematis campaniflora*, *Hedera hibernica*, *Humulus lupulus*, *Tamus communis*, *Rubus ulmifolius*, *Lonicera hispanica*, *Calystegia sepium*, and *Vitis vinifera*. There is always a shrub and undershrub layer consisting of *Frangula alnus, Sambucus nigra*, *Tamarix africana*, *Salix salviifolia* subsp. *salviifolia*, *Crataegus brevispina*, *Rosa sempervirens*, *Laurus nobilis*, *Glycyrrhiza glabra*, as well as an herbaceous layer consisting of *Arum italicum* subsp. *neglectum*, *Vinca difformis*, *Equisetum telmateia*, *Carex pendula*, *Iris foetidissima*, *Solanum dulcamara*, *Brachypodium sylvaticum*, *Scrophularia scorodonia*, *Silene latifolia*, etc. (Table II). Both floristic patterns and ecological features define it as an original phytocoenosis that had not yet been described and therefore had not yet been given any formal phytosociological designation. We therefore propose the name *Clematido campaniflorae-S. neotrichae* ass. nova hoc loco (*holotypus* relevé # 4, Table II) to be applied to this new community. Its optimum is found in a semi-hyperoceanic thermomediterranean bioclimate, but it is also found in the subhumid to humid lower mesomediterranean bioclimate.

This community is frequently found along watercourses where the receptor basin is situated mostly in the hills of the *Estremenho* Limestone Massif or is fed water from water springs situated in substrata of Jurassic and Cretaceous age, extending over the biogeographical territories of the Dividing Portuguese Sector and the Ribatagan District. We placed this new community in the mesotrophic *Populenion albae* suballiance (*Populion albae*, *Populetalia albae*), in contrast to the *Osmundo-Alnion* oligotrophic alliance, due to its floristic composition and owing to the mesotrophic to eutrophic nature of the water (see Table I).

The *Clematido campaniflorae-S. neotrichae* has been interpreted as *Salici neotrichae-Populetum nigrae* by several Portuguese authors (Aguiar et al. 1995; Lousã et al. 1998; Lopes 2001; Gaspar 2003). However, the community in question has a Carpetan–Leonese distribution under the meso to supramediterranean thermotype and a dry to subhumid ombrotype. In turn, the later is found in alluvial soils rich in lime and clay sediments (Rivas-Martínez & Cantó 2002). The differential species of the Portuguese community, when compared to the Spanish, are *C. campaniflora*, *A. italicum, H. hibernica*, *R. sempervirens*, *V. difformis*, *G. glabra*, *T. africana*, *E. telmateia*, *L. nobilis*, *I. foetidissima,* and in the absence of *Salix triandra* subsp. *discolor*, *Salix* x *secalliana*, *Salix purpurea* subsp. *lambertiana*, *Salix* x *erythroclados*, *Salix* x *matritensis*, *Fraxinus excelsior*, *Rosa corymbifera*, *Poa nemoralis*, *Prunus avium*, *Ligustrum vulgare*, *Clematis vitalba*, *Elymus caninus, Cucubalus baccifer* (Table III). The community may also be sporadically found in northeastern Portugal.

Table I. Chemical analysis of the flow water (the location is available in Figure 3).

	Laboratory conductivity (20°C) (μS/cm)	Water hardness (mg/l)	Fe (mg/l)	P (mg/l)	Nitrites (mg/l)	Nitrates (mg/l)	pH	Total suspended solids (mg/l)
A-dos-Cunhados								
Average	–	–	0.92	2.66	18.03	1.67	7.9	120.24
Percentile 25	–	–	0.50	1.21	12.00	0.59	7.8	15.00
Percentile 75	–	–	1.41	3.40	22.92	1.95	8.0	87.00
Ança								
Average	586.04	–	–	0.10	2.96	0.27	7.7	7.94
Percentile 25	536.50	–	–	0.04	0.65	0.08	7.6	3.00
Percentile 75	657.00	–	–	0.13	4.12	0.30	7.8	9.60
Cheleiros								
Average	702.00	–	0.38	1.14	14.22	0.44	8.5	38.73
Percentile 25	689.50	–	0.19	0.61	7.20	0.13	8.3	4.43
Percentile 75	714.50	–	0.46	1.14	18.28	0.58	8.4	13.75
Milagres								
Average	634.05	274.3	1.33	4.74	14.10	2.17	7.8	117.81
Percentile 25	476.75	180.0	0.89	1.92	3.30	0.49	7.7	15.75
Percentile 75	695.50	293.4	1.45	6.22	21.06	2.15	8.0	50.00
Omnias1								
Average	352.63	125.5	0.14	0.36	4.13	0.06	7.4	13.39
Percentile 25	278.75	96.1	0.07	0.17	2.50	0.02	7.2	6.60
Percentile 75	376.25	143.8	0.17	0.26	5.24	0.06	7.6	16.50
Praia de Coruche								
Average	283.32	98.6	0.57	0.15	3.64	0.04	7.5	17.40
Percentile 25	234.25	81.0	0.35	0.09	1.87	0.02	7.1	7.25
Percentile 75	329.00	118.3	0.63	0.18	4.76	0.05	7.8	17.00
Sobral da Lagoa								
Average	855.23	398.1	0.87	1.96	13.11	0.79	7.7	118.89
Percentile 25	691.25	391.0	0.37	0.57	4.73	0.31	7.4	13.00
Percentile 75	1005.00	436.0	1.06	2.57	16.89	1.03	8.0	63.75
Tomar								
Average	447.46	229.1	–	0.09	4.21	0.03	7.7	13.86
Percentile 25	437.50	219.0	–	0.07	2.56	0.02	7.4	4.18
Percentile 75	474.50	256.0	–	0.10	5.22	0.04	8.0	11.25
Tornada								
Average	704.08	355.2	0.80	0.80	11.00	0.20	–	156.44
Percentile 25	617.50	310.5	0.14	0.32	6.49	0.06	–	9.20
Percentile 75	824.25	431.0	1.03	0.69	15.13	0.26	–	64.00
Alto Cávado								
Average	27.74	19.6	0.27	0.09	3.30	0.04	6.6	4.22
Percentile 25	22.00	10.0	0.22	0.02	2.20	0.02	6.2	1.75
Percentile 75	32.00	22.0	0.31	0.08	2.53	0.05	6.8	5.60
Salamonde								
Average	21.85	17.5	0.06	0.08	2.54	0.04	6.6	3.59
Percentile 25	19.00	8.0	0.06	0.01	2.20	0.02	6.3	1.60
Percentile 75	23.00	22.0	0.07	0.06	2.20	0.05	6.9	4.40
Cerca dos Pomares								
Average	226.09	65.8	0.02	0.04	–	0.01	7.2	10.20
Percentile 25	200.00	58.0	0.02	0.02	–	0.01	7.1	0.40
Percentile 75	249.00	70.0	0.02	0.04	–	0.02	7.3	2.85
Foz do Louredo								
Average	39.92	21.12	–	0.11	3.43	0.03	6.6	4.32
Percentile 25	26.00	10.0	–	0.03	2.50	0.01	6.4	1.20
Percentile 75	45.20	24.0	–	0.10	4.20	0.04	6.8	3.45
Oleirinhos								
Average	50.81	–	–	0.04	1.57	0.02	7.1	5.17
Percentile 25	39.00	–	–	0.02	0.36	0.01	6.9	2.00
Percentile 75	56.75	–	–	0.05	2.00	0.03	7.4	5.40
Ponte Pedra								
Average	62.58	–	–	0.04	2.07	0.02	6.8	10.83
Percentile 25	48.25	–	–	0.04	2.00	0.02	6.5	3.60
Percentile 75	77.75	–	–	0.05	2.20	0.02	7.3	9.40

(*continued*)

Table I. (*Continued*).

	Laboratory conductivity (20°C) (μS/cm)	Water hardness (mg/l)	Fe (mg/l)	P (mg/l)	Nitrites (mg/l)	Nitrates (mg/l)	pH	Total suspended solids (mg/l)
Vila F. Da Serra								
Average	67.10	–	–	0.14	–	0.06	6.9	7.87
Percentile 25	50.25	–	–	0.12	–	0.02	6.6	2.20
Percentile 75	76.75	–	–	0.19	–	0.08	7.1	6.65

Table II. *C. campaniflorae-S. neotrichae* (*P. albae, P. albae, P. albae, S. purpureae-P. nigrae*).

Numerical order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Sampling area (1=10 m^2)	6	4	2	10	10	10	5	6	10	6	5	10	5	16	32	5	10
Number of taxa	20	14	23	21	12	31	29	27	35	34	24	27	26	22	16	16	35
Characteristics and differentials																	
S. neotricha Goerz	5	5	5	4	4	3	3	3	2	3	3	3	1	5	5	5	4
P. nigra L.	1	2	1	2	2	3	4	2	3	2	2	1	4				
F. angustifolia Vahl				1	2	2	2	+	2	2	2	1	2	+	+	2	
A. italicum Miller subsp. *neglectum* Townsend	1	1	+	+		1	+	1		+	+	+			1	+	
S. atrocinerea Brot.		1	+	2				4	3	2	1	3	1			1	2
T. communis L.	1	+	+		+	1	1	1	1	+						+	2
H. hibernica Bean			3	2			1	3	1	1	1					1	1
V. difformis Pourr.	+		2	2			1		3	1	+	1		1		+	2
R. sempervirens L.	+			1	1	+	+	1	2	1			2				1
H. lupulus L.	+	1	1	2			1				+		1		1		1
S. nigra L.	+	+	+	1			1	+	+	+						1	
C. campaniflora Brot.	1			1	1	1	1	1	+								
B. dioica Jacq.						+			1	1				+		+	+
C. brevispina G. Kuntze			+				+				+	+	+		+		
U. minor Mill.			1		+						1			+			1
E. telmateia Ehrh.			1					+			1		2				2
F. alnus Mill.	+			1			+						+			+	
L. hispanica Boiss. & Reuter	+	+				1	+										+
C. pendula Huds.									1					1	1		+
G. glabra L.	1	2					+									+	
A. glutinosa (L.) Gaertner						1			+	+				1			
S. scorodonia L.						+	+		+	+							
I. foetidissima L.					+				+	+	+						
S. dulcamara L.	+					+		+					+				
T. africana Poir.				1			1			2							
S. salviifolia Brot. subsp. *salviifolia*								2						1	1		
B. sylvaticum (Hudson) Beauv.								+			+		+				
S. alba L.				1													1
P. × *canadensis* Moench					1								1				
S. latifolia Poir.									+					+			
Companions																	
R. ulmifolius Schott	+	1	3	2	+	2	1	1	3	1	2	3	3	2		2	3
C. sepium (L.) R. Br.	+	1			+		+	2	+	1	1	2	+	1		1	1
L. salicaria L.				1		+		1	1	+	2	1	+			+	+
Oenanthe crocata L.			+	+		+			+	+	+	+	+				+
Rumex conglomeratus Murray	+	+				+	+		+	+		+	+				1
Arundo donax L.			3		1	2			2		1		2	1			2
Lotus pedunculatus Cav.							+		2	1		1	+			+	1
Holcus lanatus L.			+						+	+		1	+		2		
Parietaria judaica L.			2			+	+		1	+		+					+
Solanum sublobatum Roemer & Schultes	+	+			1	+	+										
Cyperus badius Desf.										+	+	+	+	1			
Heracleum sphondylium L.						+	+			+	+						+
Galium aparine L.						+	+			+		+					+
Mentha suaveolens Ehrh.			+						+			+	+				+

(*continued*)

Table II. (*Continued*).

Numerical order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Cyperus eragrostis Lam.										+	+	+	+				+
Laurus nobilis L.			1					+			1						1
Juncus inflexus L.								1	+			1					+
Urtica dioica L.	+	+				1	+										
Nasturtium officinale L.			1	+		+				+							
Apium nodiflorum (L.) Lag.				+		+		1			+						
Chelidonium majus L.	+					+	+					+					
Polygonum lapathifolium L.						+				+						+	+
Phragmites australis (Cav.) Steudel													+		2		1
Lycopus europaeus L.								1					+				+
Pteridium aquilinum (L.) Kunh			+			+					+						
Smilax aspera L.							+		+								+
Iris pseudacorus L.								+							2		
Polygonum hydropiper L.														1	+		
Poa trivialis L.												1					+
Urtica membranacea Poir. in Lam.	+						+										
Torilis neglecta Thell.						+			+								
Rhamnus alaternus L.						+		+									
Euphorbia characias L.						+			+								
Epilobium tetragonum L.									+	+							
Polygonum persicaria L.										+			+				
Lysimachia vulgaris L.										+				+			
Euphorbia hirsuta L.												+					+

More characteristics: 1 *Salix viminalis* L. in 4; 1 *Vitis vinifera* L. in 9; 1 *Saponaria officinalis* L. in 14.
Companions: 1 *Quercus faginea* Lam. subsp. *broteroi* (Coutinho) A. Camus, + *Ruscus aculeatus* L. in 3; + *Rumex crispus* L. in 4; + *Juncus effusus* L. in 6; 1 *Mentha aquatica* L., + *Pulicaria dysenterica* (L.) Bernh., + *Ranunculus repens* L., + *Teucrium scordioides* Schreb. in 8; + *Rosa canina* L., + *Cheirolophus sempervirens* (L.) Pomel, + *Verbena officinalis* L. em 9; + *Conium maculatum* L., + *Veronica anagallis-aquatica* L. em 10; 2 *Phalaris coerulescens* Desf., + *Cistus psilosepalus* Sweet, + *Aster squamatus* (Spreng.) Hieron, + *Lathyrus clymenum* L. em 12; 1 *Scirpoides holoschoenus* (L.) Soják, 1*Brachypodium phoenicoides* (L.) Roem. & Schult., 1 *Sparganium erectum* L., 1*Equisetum palustre* L., + *Agrimonia eupatoria* L., + *Anthriscus caucalis* M. Bieb. in 14; 1 *Carex hispida* Willd., + *Cladium mariscus* (L.) Pohl, + *Coleostephus myconis* (L.) Reichenb. + *Illecebrum verticillatum* L. em 15; + *Polygonum equisetiforme* Sibth. & Sm., + *Polypogon viridis* (Gouan) Breistr. in 17.
Localities: 1, Lezíria do Tejo; 2, Caneiras (Tejo); 3, Caldas da Rainha (rio Arelho); 4, Agroal (rio Nabão); 5, Ómnias (Santarém); 6, Pedreira (Tomar); 7, Marianaia (Tomar); 8, Pombal (Rio Anços); 9, Cheleiros (Rio Lisandro); 10, Carvalhal (Rio Lisandro); 11 Vimeiro (Rio Alcabrichel); 12, Sobral da Lagoa (Óbidos); 13, Alfeizerão (Ribeira da Tornada); 14, 15, Ribeira dos Milagres (Leiria); 16, Benavente (Sorraia); 17, Tornada.

Bearing in mind the above discussion on the Iberian Peninsula, the *Populenion albae* suballiance consists of the plant communities' synthesized in Table III.

5. 1. *Clematido campaniflorae-S. neotrichae* is described here as new (relevés 1–17).
6. 2. *Salici neotrichae-Populetum nigrae* was formerly described (relevés 18–47).
7. 3. *Salici atrocinereae-Populetum albae* (relevés 48–57) is an association found on siliceous river beds, frequently flooded, throughout the Lusitan-Extremadurean subprovince, under a mesomediterranean, subhumid bioclimate, dominated by *S. atrocinerea* and *P. alba* (Rivas Goday 1964; Peinado & Bartolomé 1987). It is distinctive from the community in western Portugal owing to the presence of *Flueggea tinctoria*, *E. caninus*, *Nerium oleander*, and *Tamarix gallica* and the absence of *R. sempervirens*, *H. lupulus*, *L. nobilis*, *F. alnus*, and *E. telmateia* among others (Table III). This kind of woodland may also be found in Alto Alentejo in the flooded alluvial terraces of regularly flowing rivers.
8. 4. *Rubio tinctorum-Populetum albae* (relevés 58–78), a limey poplar forest in limestone–sandy soil with a shallow water table that is frequently flooded meso to supramediterranean, semicontinental, dry to subhumid is dominated by *P. alba* or *S. neotricha*, along the medium courses of eutrophic rivers, found in the Mediterranean Central Iberian Province (Peinado & Bartolomé 1987; Rivas-Martínez et al. 1991; Loidi et al. 1997; Rivas-Martínez & Cantó 2002) and, according to the proposal put forward by Rivas-Martínez et al. (1990), in the lower Tagus Basin. However, the two communities (*Rubio tinctorum-Populetum albae* and *Clematido campaniflorae-S. neotrichae*) are distinct owing to *Rubia tinctoria*, *T. gallica*, *N. oleander*, *C. baccifer*, *C. vitalba*, *Rubus caesius*, *Rosa dumalis*,

Table III. Synthoptic table of the *P. albae* vegetation in the Iberian Peninsula.

Numerical order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Number of relevées	17	9	26	21	13	8	10	8	12	4	7	6	8	1	40	14	10	8
Characteristics and differentials of association																		
S. neotricha	V	V	V	II	IV													
P. nigra	V	V	V	III	III		III	IV	II						IV	II		
P. alba		II	II	V	V	V	II	IV	V	4	V	V	V	1	IV		II	V
S. atrocinerea	IV	III	V			II	V	II							I	III	IV	
F. angustifolia	V	V	III	IV	II	II	V	V	III	2	III	III	II	1		IV		
A. glutinosa	II	IV	IV	I	I		II	V					I		III	V	II	
U. minor	II	I	I	V	II	II	IV		II		II	II	II	1	V	II	II	I
B. dioica	II	III	II	I		II	IV						II		III	II	II	
B. sylvaticum	I	IV	II	III	IV	II	II	V		3			IV	1	V	IV	IV	
C. brevispina	II							II	+	1	V	V						
S. dulcamara	II	III	II	II		II		IV					I		III	II		
H. lupulus	III	V	II	I	I								II		III	V		
S. salviifolia subsp. *salviifolia*	I	V	IV				IV	V										
Rosa canina	+	I	II						+						I	II		
S. viminalis	+	I	+															
S. latifolia	I	II	II	I			III						I					
Saponaria officinalis	+		II	II	II		III	I							III	I		
V. vinifera	+			III			II		I	2	I	I	I		+	+	I	
S. nigra	III	II	+				II						I		III	II		
F. alnus	II	II	r													III		
S. alba	I	II	+	II		V							I		III	III		
A. italicum s.l.	V					II	V		I	4	I	I	IV		II	II	IV	I
T. communis	IV		r				IV			3						+	I	
H. hibernica	IV																	
V. differmis	IV						II		+	2	V	V	IV					
R. sempervirens	III										III	II	II		II		III	
C. campaniflora	III						III											
E. telmateia	II					I							I	1			V	
G. glabra	II			II	I				+									
C. pendula	II						II			1					III	II	V	
S. scorodonia	II	I					II											
I. foetidissima	II						II		+	3	I	I			III	II		
L. nobilis	II														I		I	
T. africana	I						II		III	2								
Populus × *canadensis*	I	I											II			II		
Quercus faginea subsp. *broteroi*	+																	
S. × *secalliana* Pau & C. Vicioso		III	III							4								
S. triandra L. subsp. *discolor* (Koch) Arcang.		IV	III													+		
S. purpurea L. subsp. *lambertiana* (Sm) Neumann		III	II	I					III							V		I
S. × *erytroclados* Simonkai		II	II													I		
S. × *matritensis* Pau & C. Vicioso		III	r															
Crataegus monogyna Jacq.		I		IV			IV	II					II	1	III	III	I	
P. nemoralis L.		II	II												+	II		
Viola riviniana Reichenb.		II	r												I		III	
C. baccifer L.		II	r	I	I										II	+		
Ranunculus ficaria L.		II	+				II				I	I						
Athyrium filix-femina (L.) Roth		II	+													I		
Salix × *viciosorum* Sennen & Pau		II	r															
R. corymbifera Borkh.		II	I													+		
S. eleagnos Scop subsp. *angustifolia* (Cariot)Rech		II						I								II		
Salix × *pseudoeleagnos* T.E. Díaz & Llamas		II											I					
Salix fragilis L.		I	r												I			
Salix × *rubens* Schrank		I						II								IV		
R. tinctoria L.		I		III	II	III									r			II
C. sanguinea L.			II	II	I								II	1	IV	V	IV	
F. excelsior L.			II													+		
Salix × *multidentata* T.E. Díaz & Llamas			I															

(*continued*)

Table III. (*Continued*).

Numerical order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
E. amygdaloides L.			I										III	1	II	II		
Salix × *expectata* Rivas Mart. et al.			I													II		
Lonicera periclymenum L.			I														II	
P. avium L.			I	I											r	I		
Teucrium scorodonia L.			I													+		
Salix × *viridifolia* T.E. Díaz & Llamas			I															
L. vulgare L.			I												II	III	I	
Geum urbanum L.			I												I	+		
C. vitalba L.			+	I									II	1	IV	IV	III	
Salix × *quercifolia* Sennen			+															
Symphytum tuberosum L.			+												I			
Salix caprea L.			r															
Stachys sylvatica L.			r													+		
V. opulus L.			r												I			
V. lantana L.			r													II		
Prunus spinosa L.			r	I											II	I		
Carex remota L.			r				II								I		II	
Helleborus foetidus L.			r										I		I		I	
R. caesius L.				V	II			IV					II		V	III		I
T. gallica L.				II	II	V	III		II						+			
R. dumalis Bechst.				II														
Celtis australis L.				I									I		r			I
Viola odorata L.				I											II			
L. officinale L.				I									II		I			
Acer negundo L.				I											II			
N. oleander L.						II	IV		V	4	III	IV						I
Opopanax chironium (L.) Koch						II												
Aristolochia paucinervis Pomel						I	V	II					II					
Salix pedicellata Desf.						I												
Rubus thyrsoideus Wimmer							III											
F. tinctoria (L.) G.L. Webster							IV											
Acanthus mollis L.							II											
Geum sylvaticum Pourret							III											
H. helix L.							III		II		I	I	IV	1	IV	IV	V	
E. caninus (L.) L.							II									III		
Rosa agrestis Savi								II								II		
S. triandra L.								I							I			
Vitex agnu-castus L.									+									
D. rectum (L.) Ser.										2	I	I					I	
C. flammula L.										2	I	I		I	I			
B. gaditanum Talavera											V	V						
C. cirrhosa L.											III	III						
O. europaea L. var. *sylvestris* (Miller) Lehr.									I	2	IV	IV						
A. campestre L.													II		II	+		
F. oxycarpa Willd.															V	II		
C. avellana L.															I	II	I	
E. europaeus L.															III	I	I	
S. purpurea L. subsp. *purpurea*															III			
Ranunculus ficaria L. *calthifolius*(Rchb.) Arcang.															II			
Pastinaca sativa L. subsp. *urens* (Req.) Çelak															II			
Quercus pubescens Willd.															II			
Vinca major L.													I		I			
Salix incana Schrank															I			
Circaea lutetiana L.															I	+	I	
Scrophularia nodosa L.															I			
Sambucus ebulus L.															+	+		
Tilia platyphyllos Scop.															r	+		
Salix × *pormensis* T.E. Díaz & Llamas																II		
Epipactis helleborine (L.) Crantz																II		
Rosa squarrosa (Rau) Boreau																II		

(*continued*)

Table III. (*Continued*).

Numerical order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Lonicera xylosteum L.																II		
Ajuga reptans L.																I		
Viola sylvestris Lam.																+		
Acer monspessulanum L.																+		
Hepatica nobilis Schreb.																+		
Rosa nitidula Besser																+		
Acer pseudoplatanus L.																+		
Quercus faginea Lam.																+		
Ulmus glabra Huds.																+		
M. uniflora Retz																+	III	
M. officinalis L.																	III	
S. europaeae L.																	III	
H. androsemum L.																	II	
A. laevigata L.																	II	
P. setiferum (Forssk.) Woynar																	II	
Carex sylvatica Huds.																	I	
L. biflora Desf.																		IV
T. canariensis Willd.																		IV
S. ravennae (L.) Murray						I												II
Principal companions																		
Rubus ulmifolius	V	IV	V	V		V	III		V	4	IV	IV	V	1	III	+	V	II
Calystegia sepium	V		I	II	I					2			I		III	III	II	II
Lythrum salicaria	IV	II	I	I			V			2					II	III		
Oenanthe crocata	III		+				III											
Rumex conglomeratus	III				IV						I	I	I		III	III	III	
Arundo donax	III			III		II			II	2			I					II
Lotus pedunculatus	III		r															
Holcus lanatus	II		r				I									II	I	
Heracleum sphondylium	II		+													II		
Galium aparine	II	I	I	I							I	I	II		III	II		
Mentha suaveolens	II									2	I					I		
Urtica dioica	II	II		III				II							III	III	I	
Apium nodiflorum	II															+	II	I
Polygonum lapathifolium	II														+			
Cyperus badius	II		r		III		IV			1								
Lycopus europaeus	I	I	r		III	I							II			+		
Pteridium aquilinum	I												II	1	I	+	II	
Smilax aspera	I						V		+	4	IV	IV	II		I		I	
Poa trivialis	I	II		I											+	I	I	
Iris pseudacorus	I	I	I												+	III		
Phragmites australis	I			III	I				III						I	III		III
Rhamnus alaternus	I						II		+		II	I			I	+		
Euphorbia characias	I					I			II									
Urtica membranacea	I										I	I						
Polygonum hydropiper	I						III											
Brachypodium phoenicoides	+			III	I	I			II	1			I		I			I
Polygonum persicaria	I															+		
Lysimachia vulgaris	I														I	III		
Conium maculatum	+	II				II					I	I			r	+		
Rumex crispus	+			II		II									+			
Verbena officinalis	+						III								+			
Ruscus aculeatus	+						II						I		II	+		
Agrimonia eupatoria	+			I						1					I	+		
Veronica anagallis-aquatica	+					I												
Equisetum palustre	+		r													II		
Mentha aquatica	+															III		
Pulicaria dysenterica	+														II		I	
Ranunculus repens	+		r												I	III	III	
Galega officinallis L.		II									I	I						
Typha latifolia L.		II																
Lepidium latifolium L.		II													r			
Geranium robertianum L.		II	I														IV	

(*continued*)

Table III. (*Continued*).

Numerical order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Epilobium hirsutum L.		I	II												+	II		
Carex broteriana Samp.		I	I													II		
Scirpoides holoschoenus (L.) Soják		I				II	V	III	+				I	1	+	+		
Equisetum arvense L.			II	II				IV					II	1	II	III		
Mentha × *rotundifolia* (L.) Hudson			II												+			
Scrophularia auriculata Loefl. ex L.			+				II									+		
Eupatorium cannabinum L.			+												III	I	III	
Dactylis glomerata L.			+				I								I	+		
Filipendula ulmaria (L.) Maxim.			+													IV		
Juglans regia L.			+	II									I		+	+		
Equisetum ramosissimum Desf.				II					+					1	II	+	III	II
Asparagus acutifolius L.				I		II			II		1	i	II		II			III
Bromus sterilis L.				I			III								+			
Agrostis stolonifera L.				I	V	I										IV		I
Asparagus officinalis L.				II												I		II
Torilis arvensis (Hudson) Link				III	II	II							II		II			
Elymus hispidus(Opiz) Melderis				III											I			II
Cynanchm acutum L.				IV												I		II
Trifolium pratense L.				II													II	
Coriaria myrtifolia L.				I		II							II		r		II	
Festuca fenas Lag.				I											+			
Poa pratensis L.				I											I	I		
Galium palustre L.					III													
Rumex obtusifolius L.					III											+		
Mentha pulegium L.					II		V											
Dittrichia viscosa (L.) Greuter						II			+	1								I
Piptatherum miliaceum (L.) Cosson							II											II
Eleagnus angustifolia L.																		I
Urtica pilulifera L.						II												
Osyris alba L.						I			I	2			I		II			
Smyrnium olusatrum L.						I					I	I						
Plantago major L.						I									I	+		
Myrtus communis L.							V			1	I	I						
Galium mollugo L.							V								IV	+		
Allium ampeloprasum L.							IV											
Pistacia lentiscus L.							III			2			I		r			
Campanula rapunculus L.							III								r			
Torilis nodosa (L.) Gaertn.							III											
Stachys lusitanica Hoffmanns.& Link							II											
Thapsia garganica L.							II											
Ranunculus acris L. subsp. *despectus* M. Laínz								IV										
Rubia peregrina L.									+		II	II		1	I	+	I	I
Ficus carica L.									III						r			
Capparis spinosa L.									I									
Bupleurum fruticosum L.									+	2								
Arctium minus Bernh.									+						II	+		
Aristolochia baetica L.										2	I	I						
Arbutus unedo L.										2						+		
Potentilla reptans L.										1					I	I		
Viburnum tinus L.											I	I			r	I	I	
Viola alba subsp. *dehnhardtii*													II	1			I	
Carex flacca Schreb.													I	1		I		
Prunella vulgaris L.														1	II	II	III	
Tussilago farfara L.														1		+		
Aristolochia clematitis L.															III			
Alliaria petiolata (M. Bieb.) Cavara & Grande															III	II		
Artemisia verlotiorum Lamotte															II			
Plantago lanceolata L.															II	+		
Angelica sylvestris L.															I	+		
Cirsium arvense (L.) Scop.															I	II		

(*continued*)

Table III. (*Continued*).

Numerical order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Picris hieracioides L.															I	+	I	
Lonicera etrusca G. Santi															+	+		
C. elata All.																III		
Buxus sempervirens L.																II		
Aquilegia dichroa Freyn																	III	
Epilobium parviflorum Schreb.																	II	
Samolus vellarandi L.																	II	
Hypericum tetrapterum Fr.																	II	
P. dactylifera L.																		II

C. campaniflorae-S. neotrichae: 1; *S. neotrichae-P. nigrae*: 2 Navarro et al. (1987) tab. 3; 3 Díaz González and Penas (1987) tab. 1; *R. tinctorum-P. albae*: 4 Braun-Blanquet and O. Bolòs (1957) tab. 43, 5 Úrsula (1986) tab. 57, 6 Martínez-Parras et al. (1987) tab 3; *S. atrocinereae-P. albae*: 7 Rivas Goday (1964) tab. 81, 8 Peinado and Bartolomé (1987) tab.2; *Nerio-P. albae*: 9 García Fuentes et al. (1998) tab. 1, 10 Pinto Gomes and Paiva Ferreira (2005) tab. 67 under *Salici atrocinereae-Populetum albae; Crataego brevispinae-Populetum albae*: 11 Pérez Latorre et al. (1996) tab. 6, 12 Galán de Mera (1993) tab. 14; *Vinco-P. albae*: 13 Bolòs (1962) tab. 9, 14 Bolòs (1967) tab. 58; *P. albae*: 15 Tchou (1949) tab. 9; *H. lupuli-A. glutinosae*: 16 Biurrun et al. (1994) tab. 2; *C. pendulae-S. atrocinereae*: 17 Bolòs and Bolòs (1950) tab. 14, 15; *L. biflorae-P. albae*: 18 Alcaraz et al. (1987) tab. 4, under name *R. tinctorum-P. albae* and community of *T. canariensis*.

Cornus sanguinea, *Lithospermum officinale*, *Cynanchum acutum*, which are included in the *Rubio tinctorum-Populetum albae* and, are absent in the Portuguese community, and on the other hand, *C. campaniflora*, *R. sempervirens*, *H. hibernica*, *T. communis*, *V. difformis*, *S. nigra*, *T. africana*, *F. alnus*, *S. scorodonia*, *L. nobilis*, and *S. salviifolia* are lacking in the Castilian community (see Table III).

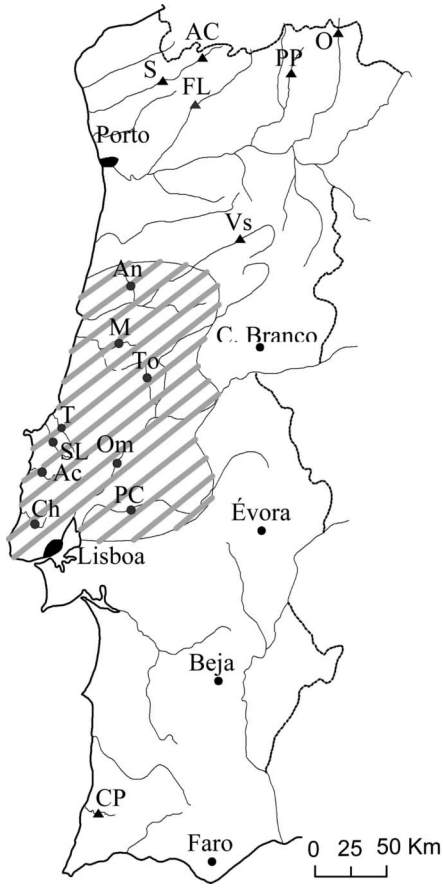
9. 5. *Nerio-Populetum albae* (relevés 79–94) is a community that reaches the limestones of Algarve. It is calcicolous poplar woodland dominated by *P. alba* growing in very hot places thermomediterranean to lower mesomediterranean, on marly limey soils, of the Betic Province, along large rivers in the Guadalquivir hydrographic basin that is prone to serious droughts during the Summer (García Fuentes et al. 1998). Its differentials when compared with *Clematido campaniflorae-S. neotrichae* are the presence of *N. oleander*, *S. purpurea* subsp. *lambertiana*, *T. gallica*, *Hedera helix*, *Vitex agnus-castus*, *Clematis flammula*, *Dorycnium rectum* and the absence of *C. campaniflora*, *F. alnus*, *S. scorodonia*, *T. communis*, *H. lupulus*, *S. salviifolia*, *R. sempervirens,* and *L. nobilis* (Table III).
10. 6. In the Algibic and Hispalensean Sectors, under thermomediterranean to mesomediterranean bioclimate and on clayish soils with vertic properties, on the river banks that are periodically flooded, although also undergoing long periods of drought, a poplar forest comprises *P. alba*: *Crataego brevispinae-Populetum albae* (relevés 95–101), which is different from the new community in that it has *N. oleander*, *Brachypodium gaditanum*, *Clematis cirrhosa*, *C. flammula, Olea europaea* var. *sylvestris*, *D. rectum*, without *S. neotricha*, *C. campaniflora*, *H. lupulus*, *H. hibernica*, *F. alnus*, *S. salviifolia*, *T. communis*, *S. scorodonia*, *T. africana*, *L. nobilis*, among others (Galán de Mera 1993; Pérez Latorre et al. 1996; Rivas-Martínez & Cantó 2002) (Table III).
11. 7. *Vinco difformis-Populetum albae* (relevés 102–110) is a forest growing on frequently flooded river banks where the water table is shallow and shows only slight variations, calcicolous, thermomediterranean to mesomediterranean, of the Valencian Subprovince, dominated by *P. alba* and *U. minor* with *V. difformis* (Bolòs 1962, 1967). As differentials, it has to the Portuguese community *C. vitalba*, *R. caesius*, *H. helix, C. sanguinea*, *Acer campestre*, *Euphorbia amygdaloides*, and *Viola alba* subsp. *dehnhardtii* (Table III).
12. 8. *Lonicero biflorae-Populetum albae* (175–182) is a *P. alba* forest, of river banks that are periodically flooded in temporary water courses, under thermomediterranean semiarid bioclimate of the Murcian-Almeriensian Province (Alcaraz et al. 1989; Peinado et al. 1992). *Lonicera biflora*, *Tamarix canariensis*, *Saccharum ravennae*, *Phoenix dactylifera* are the differential taxa of this association (Table III).
13. 9. *Populetum albae* (relevés 121–160) is a community that was described as belonging to the limey river waters of the Languedoc, in southern France (Tchou 1949) and has extended into northern Catalonia (Catalan-Provençal Subprovince) in euoceanic thermo to mesomediterranean bioclimate and in permanently moist alluvial soils showing a gley horizon (Gesti Perich 2000; Rivas-Martínez & Cantó 2002; Carreras et al. 2005). This poplar

woodland is dominated by *P. alba* and *P. nigra* and, as differentials, has to the Portuguese community *Fraxinus oxycarpa*, *C. baccifer*, *A. campestre*, *Acer negundo*, *S. purpurea*, *Salix incana*, *R. caesius*, *Pastinaca sativa* subsp. *urens*, *C. vitalba*, *Euonymus europaeus*, *S. purpurea*, *H. helix*, *L. vulgare*, *Prunus spinosa*, *Viburnum opulus*, *Lamium flexuosum*, etc. (Table III).

14. 10. Another Iberian community that is included in the *Populenion albae,* is the Castilian-Cantabrian and Riojan Sectors (Oroiberian Subprovince), alder forest found along rivers that do not have high variations in their flows owing to the fact that in the headwater region, the pluviometric regime is characteristic of a temperate zone, in meso to supramediterranean bioclimate: *Humulo lupuli-Alnetum glutinosae* (relevés 161–174). According to Biurrun et al. (1994) and Loidi et al. (1997), this extensive woodland contains *A. glutinosa*, *Salix lambertiana*, *Salix* x *rubens*, *P. nigra*, *F. angustifolia*, *F. oxycarpa*, *S. alba*, *Bryonia dioica*, *C. sanguinea*, *H. helix*, *L. vulgare*, *F. alnus*, *E. europaeus*, *Salix* x *pormensis*, *Salix eleagnos* subsp. *angustifolia*, *Corylus avellana*, *Viburnum lantana*, *Carex elata*, *E. caninus*, *H. lupulus*, *C. vitalba*, *R. caesius*, *E. amygdaloides*, *I. foetidissima*, *C. pendula*, etc. (Table III).

15. 11. *Carici pendulae-Salicetum atrocinereae* (relevés 111–120) is an open woodland, under mesomediterranean bioclimate, on permanent wet soils of temporary water courses, in the Pyrenean Subprovince (Bolòs & Bolòs 1950; Bolòs 1967; Carreras et al. 2005). *S. atrocinerea*, *U. minor*, *P. alba*, *A. glutinosa*, *C. pendula*, *Carex remota*, *E. telmateia*, *B. sylvaticum*, *C. sanguinea*, *C. vitalba*, *A. italicum*, *Melica uniflora*, *Melissa officinalis*, *Sanicula europaea*, *Hypericum androsaemum*, *Asperula laevigata*, *Polystichum setiferum*, and *H. helix* are the more representative species of this association (Table III). Its inclusion in *Populenion albae* is not consensual given its ecology and the presence of *P. setiferum*. The results of the cluster analysis reveal its distinctiveness from other communities of the suballiance. In our opinion, it is of community *Osmundo-Alnion*.

Figures 3 and 4 allow for a comparison between the characteristics of the water in rivers associated



Name of the Surface-water Station		River	Floristic Associations	Order
PC	Praia de Coruche	Sorraia	*Clematido campaniflorae-Salicetum neotrichae*	***Populion albae***
Om	Ómnias1	Tejo		
Ac	A-dos-Cunhados	Alcabrichel		
M	Milagres	Ribeira dos Milagres		
To	Tomar	Nabão		
SL	Sobral da Lagoa	Arnoia		
An	Ança	Ribeira de Anca		
Ch	Cheleiros	Lizandro		
T	Tornada	Tornada		
FL	Foz do Louredo	Tâmega	*Scrophulario scorodoniae-Alnetum glutinosae*	***Osmundo-Alnion***
Vs	Vila Franca da Serra	Mondego		
O	Oleirinhos	Sabor	*Galio broteriani-Alnetum glutinosae*	
PP	Ponte Pedra	Tuela		
S	Salamonde	Cávado		
AC	Alto Cávado	Cávado		
CP	Cerca dos Pomares	Ribeira de Aljezur	*Campanulo primimulifoliae-Alnetum glutinosae*	

Figure 3. Location of the measurement stations for water quality. (In the annex table, we have made a correspondence between the measurement station and the riparian community of the area.)

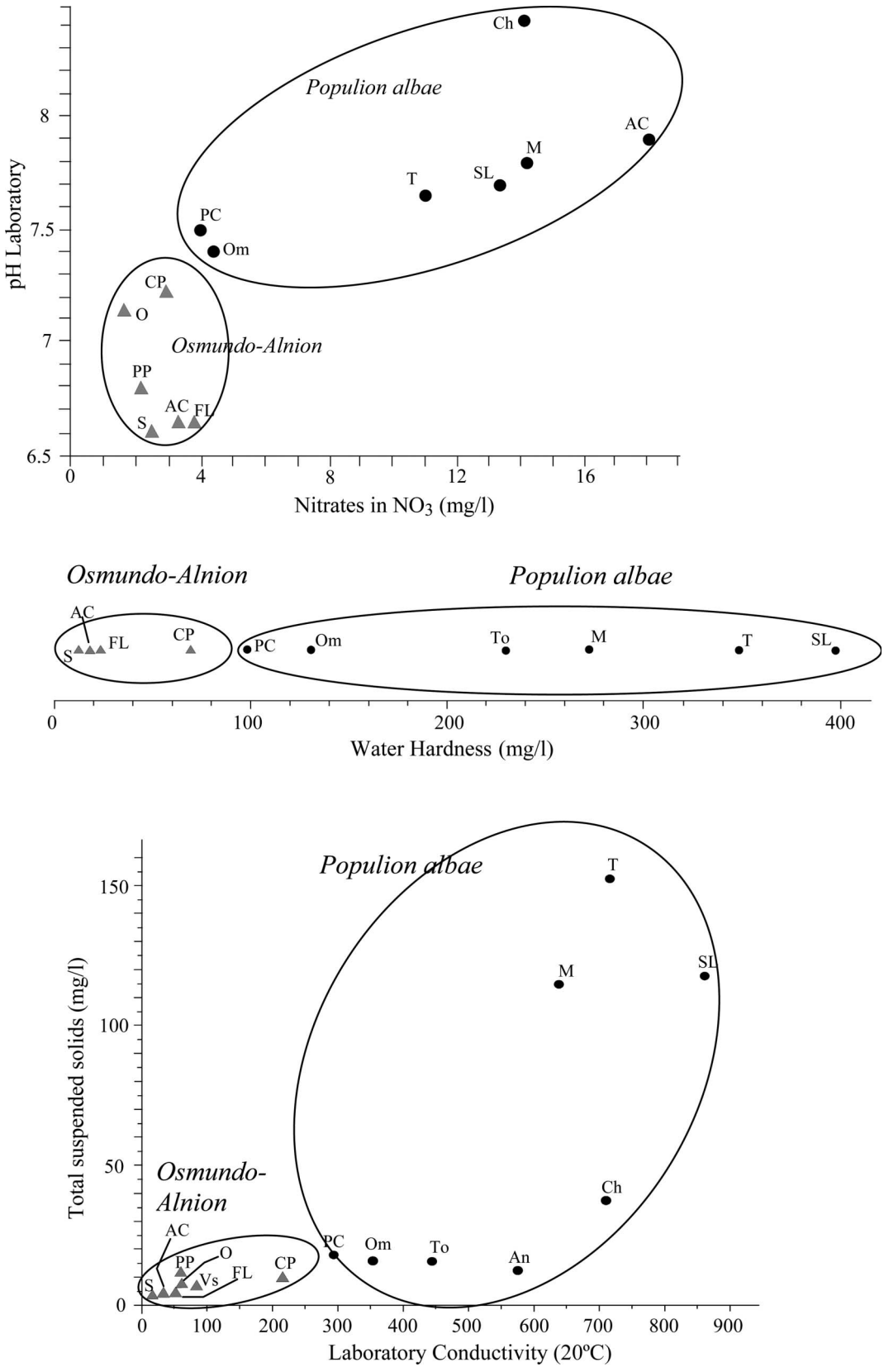


Figure 4. Comparison of the chemical characteristics of the water between the stations with floristic communities of the *Osmundo-Alnion* (▲) and the stations with floristic communities of the *Populenion albae* (●).

with associations of the *Osmundo-Alnion* alliance in Portugal and the new association of the *Populenion albae* described above. In Figure 3, the measurement stations with communities of an *Osmundo-Alnion* alliance constitute a well-defined group with lower pH and nitrate values when compared with the values recorded in the stations for the new *S. neotricha* willow forests. The individualization of the two groups of inventories continues to be evident in the hardness of the water, in the suspended solid matter and their conductance.

The different chemical characteristics of the water associated with the two groups of inventories defined in the figures are correlated to the following factors:

1. The *Populenion albae* riparian forests as a rule occupy the terminal sectors of watercourses flowing through wide alluvial plains or they are watercourses with hydrographical basins located in limestone areas. Owing to this fact, the water is always rich in calcium, rich in nutrients (phosphorous, nitrogen, nitrides, and nitrates), has a large quantity of suspended solids in it, and also has high pH and hardness.
2. In contrast, the *Osmundo-Alnion* forests are usually found along rivers where the hydrographical basin substrata are mostly acidic and almost always granitic and where flows are medium to fast. This fact explains why the pH, the lime content, the water hardness and the conductance are all lower than that for the *Populeion albae* forests. The indices of water contamination with nitrides, nitrates, phosphorous, and nitrogen are also much lower and indicate that this is a clearly oligotrophic situation.

The *Clematido campaniflorae-S. neotrichae* is an association with a distinct nature due to the fact that it has an original floristic composition that is different from all the other Iberian communities of *Populenion albae* and has a characteristic biogeographical territory. In all the places it is found, it shows a high degree of disturbance and has a sporadic character. This degree of disturbance is due to the fact that communities of *Populenion albae,* as a rule, occupy the lower river altitudes, usually on alluvial plains. These areas are the most sought after for intensive agriculture and animal husbandry as well as for building urban agglomerations. This fact therefore explains the chemical qualities of the water along watercourses where *Populenion albae* is found, and in particular, the new community that has been described in this study.

The analysis of some of the chemical parameters of the water has shown that the oligotrophic communities of the *Osmundo-Alnion* has lower values registered for the pH, phosphorous, nitrates, nitrides, water hardness, conductance, and suspended solids in comparison with the eutrophic communities of the *Populenion albae*.

Syntaxonomical scheme

SALICI PURPUREAE-POPULETEA NIGRAE (Rivas-Martínez & Cantó ex Rivas-Martínez, Báscones, T.E. Díaz, Fernández-González & Loidi) Rivas-Martínez & Cantó 2002

Populetalia albae Br.-Bl. ex Tchou 1948

Populion albae Br.-Bl. ex Tchou 1948

Populenion albae

Populetum albae Br.-Bl ex Tchou 1948

Rubio tinctorum-Populetum albae Br.-Bl. & O. Bolòs 1958

Vinco-Populetum albae (O. Bolòs & Molinier 1958) O. Bolòs 1962

Salici atrocinereae-Populetum albae Rivas Goday 1964

Humulo lupuli-Alnetum glutinosae Biurrun, García-Mijangos & Loidi 1994

Crataego brevispinae-Populetum albae Galán in A.V. Pérez, Galán, Deil & Cabezudo 1996

Nerio oleandri-Populetum albae A. García & Cano in A.García, Torres, P. Gomes, Leite, Salazar, Melendo, J. Nieto & Cano 1998

Lonicero biflorae-Populetum albae Alcaraz, Ríos & P. Sánchez in Alcaraz, T.E. Díaz, Rivas-Martínez & P. Sánchez 1989

Salici neotrichae-Populetum nigrae T.E. Díaz & Penas ex Rivas-Martínez & Cantó 2002

Clematido campaniflorae-Salicetum neotrichae J.C. Costa, Capelo, Neto, Lousã & Rivas-Martínez ass. nova hoc loco

Osmundo-Alnion (Br.-Bl., P. Silva & Rozeira 1956) Dierschke & Rivas-Martínez in Rivas-Martínez 1975

Scrophulario scorodoniae-Alnetum glutinosae Br.-Bl., P. Silva & Rozeira 1956

Galio broteriani-Alnetum glutinosae Rivas-Martínez, Fuente & Sánchez-Mata 1986

Campanulo primulifoliae-Alnetum glutinosae Br.-Bl., P. Silva & Rozeira ex J.C. Costa, Capelo & Lousã 2004

Carici pendulae-Salicetum atrocinereae A. & O. Bolós 1950

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