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The *Quercus pubescens* and *Quercus faginea* forests in the Basque Country (Spain): distribution and typology in relation to climatic factors

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Abstract

A comparative study is made in order to establish relationships between floristic and bioclimatic gradient. An east-west strip of about 200 Km in the inner area of the Basque Country has been chosen. *Quercus faginea* and *Quercus pubescens* forests have been studied. The climatic parameters of eight meteorological stations located within the area have also been analysed. The results obtained show the existence of four different forest types, which can be easily distinguished among themselves. They extend following the geographical longitude. The eastern ones can be related to a more continental character, the western ones to a more mediterranean one.

Resumen

Se realiza un estudio comparativo con objeto de establecer relaciones entre un gradiente florístico y el determinado por diversos parámetros climáticos. Para ello se han estudiado los bosques de *Quercus faginea* y *Quercus pubescens* en una franja este-oeste de unos 200 km de longitud, en la zona interior del área vasco-navarra. Se han analizado los parámetros climáticos de ocho estaciones meteorológicas localizadas, en su mayoría, dentro del área. El análisis fitosociológico de los bosques permite distinguir cuatro tipos que se pueden agrupar en dos asociaciones con dos subasociaciones cada una. Su distribución a lo largo de la longitud geográfica se correlaciona con un clima más continental hacia el este y más mediterráneo hacia poniente.

Introduction

In the transitional strip between the Eurosiberian and the Mediterranean Regions, a part of which reaches into the inner parts of the Basque Country, there are some particular types of semi-deciduous forests, dominated by *Quercus faginea* and *Q. pubescens*. The first of these two species has an iberian distribution, and prefers base-rich soils and ombroclimates of a subhumid type (Rivas-Martínez 1987). This species is therefore widely distributed in the highlands of Castilla and Aragón (Maestrazgo), among other areas included in the Mediterranean Region. It reaches the Basque Country through the south-western side, forming forests in some of the inner valleys, which already belong to the Eurosiberian Region. On the other side, *Q. pubescens* is a widely distributed middle-european species, which enters the Iberian Peninsule through the southern slopes of the Pyrenees Range. The populations situated further westwards reach into the province of Navarra, and the habitats where this species grow are very similar, in their edaphic and climatic conditions, to the ones occupied by *Q. faginea*.

The contact of these two species occurs in the basque area, in the transitional strip between the Mediterranean and the Eurosiberian Regions. Westwards, *Q. faginea* is dominant, while, more to the east, nearer the Pyrenees, it is substituted by *Q. pubescens*. Due to this contact, a generalised phenomenon of introgressive hybridization between both species takes place in this area.

In order to establish its typology according to its floristic composition, the vegetation of the forest has been sampled after the Braun-Blanquet method. Several climatic parameters of the area have been analysed in order to find out if there is any relationship between the floristic and the bioclimatic gradients, being this the main aim of this paper.

Biogeography and bioclimatology

We will follow the biogeographical and bioclimatical typology of Rivas-Martínez (1987). According to it, the area studied belongs partially to the Cántabro-Euskaldún Sector (Navarro-Alavés Subsector), which is part of the Cántabro-Atlántica Province, and also to the Pirenaico Central Sector (Pirenaico Occidental Subsector and Jacetano-Guarense Subsector), which belongs to the Pirenaica Province (See map 1). From a biogeographical point of view, this means that the area is influenced by two different floristic types, the Ibero-Cantabrian from the south-west and the Pyrenaican from the north-east.

The forests we have studied are located mainly in the mesomontane and submontane (or upper colline) vegetation stages; there are only a few populations reaching down to the eucolline stage in the valleys of Mena, Ayala, and Orduña, all of them located in the western part of the area. Registrated data of the precipitations show a rainfall between 1300 mm and 700 mm (ombroclimates subhumid and humid), and most of these forests show preference to ombroclimates of the subhumid and lower humid types (700 to 1100 mm).

Apart from the already mentioned cantabric valleys of Mena, Orduña, and Ayala, the rest of the forests lay in the southern part of the main range, which divides the atlantic slope from the mediterranean one. Geological substrata are basically made up of several types of limestones from the Upper Cretacic and the Tertiary Periods, and the geological formations known as flysch are rather frequent in this area, mainly in its eastern part.

Material and methods

The forest vegetation has been analysed by means of 52 floristic relevés taken according to the approach of Braun-Blanquet (1979). We tried the relevés to be uniformly distributed throughout the area, so that the sampling was uniform enough (See map 1). According to the phytosociological methods of the Sigmatist School, the relevés have been ordered in a table allowing comparison and the establishment of their typology. By means of a synthetic table, we have compared our homogeneous groups of relevés with the tables of other groups of similar forests from the surrounding areas. This comparison allows the assimilation of the forest types observed by us to others already described, in order to know if the degree of similitude between both is high enough or, if this is not the case, to propose new syntaxa.

We have taken the meteorological data from eight stations located in this area (Elías Castillo & Ruiz Beltrán 1977), as shown in the map 1, selected according to:

a) Location inside the limits, geographical and altitudinal, where these forests live.

b) Period of observation, which should be as long as possible: some of the stations have rather short data series (10–15 years), but, in spite of it, we have considered them too because of their distribution, which reaches inside the limits mentioned above in a place where no other meteorological station exists nearly.

The meteorological data have been used to calculate the following parameters:

T : Mean Annual Temperature (°C)
m : Mean Temperature of the minimals of the coldest Month
M : Mean Temperature of the maximals of the coldest Month
It : Termicity Index (Rivas-Martínez 1987); It = (T + m + M) × 10
***ƒ*tn**: Negative thermic integral = $\sum$ Mean Temperature of the absolute minimals of the months in which this value is lower than zero × 10
H : Frostfree period
P : Mean annual rainfall
Pv : Mean summer rainfall

Continentality index (Daget 1977):

$$C = \frac{1'7\,\mathbf{A}}{\text{sen}\,(\phi + 10 + 9\,h)} - 14$$

A: Annual thermic amplitude
ϕ: Latitude
h : Altitude (Km)

Summer mediterraneity index: Imv (Rivas-Martínez 1987)

$$\text{I m v} = \frac{\textbf{ETP}\text{ July} + \textbf{ETP}\text{ August} - (\textbf{d}\text{ July} + \textbf{d}\text{ August})}{\textbf{P}\text{ July} + \textbf{P}\text{ August}}$$

$$\text{I m 3} = \frac{\textbf{ETP}\text{ June} + \textbf{ETP}\text{ July} + \textbf{ETP}\text{ August}}{\textbf{P}\text{ June} + \textbf{P}\text{ July} + \textbf{P}\text{ August}}$$

ETP: Evapotranspiration (Thornthwaite, 1948)
d: rainfall days

The values attained by these parameters are exposed in the Table 1.

To study the variation of these parameters in relation to geographical location and the altitude,

Table 1. Climatic parameters of eight meteorological stations in the research area.

	Station	Long	Long (min)	Alt (m)	N. years	T	m	M'	It	∫ tn	H	P (mm)	Pv (mm)	% Pv/P	C	Imv	Im3	H (days)
1	Reinosa	4°08' W	248	850	34	9.0	−2.20	6.6	134	439	24/V–1/X	981.0	129.0	13.14	12.70	2.75	2.32	130
2	Manurga	2°45' W	165	659	15	10.6	1.00	7.5	191	219	4/V–20/X	1320.0	133.0	10.07	14.20	2.67	2.31	169
3	Vitoria	2°40' W	160	550	38	11.1	1.30	7.8	208	224	1/V–27/X	843.0	143.0	16.96	16.00	2.82	2.24	179
4	Salvatierra	2°23' W	143	605	12	11.3	0.50	5.9	177	246	4/V–26/X	855.0	145.0	16.95	18.00	2.70	2.26	175
5	Alsasua	2°10' W	130	526	35	11.0	0.50	7.5	190	311	14V–16/X	1229.0	147.0	12.00	15.40	2.69	2.17	155
6	Pamplona	1°38' W	98	449	44	12.2	1.00	8.6	218	283	27/IV–23/X	1009.8	166.6	16.50	17.47	2.49	2.06	179
7	Villava	1°36' W	96	450	10	10.0	−4.30	8.8	145	•	25/VI–6/IX	961.0	148.4	15.44	18.87	2.40	2.15	73
8	Ustes	1°06' W	66	620	32	12.2	−0.20	7.3	193	314	28/IV–22/X	965.5	168.7	17.47	20.96	2.69	2.14	177

Table 2.

Altitude (1=10 m)	44	44	40	27	26	50	40	40	62	57	52	70	64	70	56	60	86	78	78	66	75	77	66	75	50	86	53	85	60	49	60	78	64	91	63	77	96	57	57	54	76	70	78	55	78	74	50	63	92	80	54	69
Area (1=10 m²)	10	15	60	10	20	10	10	10	5	6	10	6	5	10	10	15	8	10	6	10	6	8	10	10	10	10	8	8	10	10	10	30	10	15	8	10	8	10	10	8	10 -	10	15	15	8	10	10	15	20	10	5	20
Nr.of species	23	31	19	28	18	20	18	28	16	19	30	20	27	24	21	18	20	27	16	24	15	19	17	26	25	25	21	23	25	27	29	24	26	31	16	29	15	30	18	32	24	17	43	44	25	18	26	22	26	23	23	32
Nr.order	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Char. and differ. species of the assoc. and subass.																																																				
Quercus faginea	5	5	4	4	5	5	5	4	3	5	5	5	5	4	5	3	5	2	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Pulmonaria longifolia	1	.	1	1	1	.	1	.	1	.	1	1	1	1	1	2	.	1	1	+	.	.	.	.	+	.	.	.	.	.	.	.	1	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Melampyrum pratense	.	1	.	.	.	.	.	.	+	2	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Smilax aspera	+	.	1	2	2	2	3	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Rosa sempervirens	1	2	.	2	2	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arbutus unedo	+	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypericum androsaemum	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Laurus nobilis	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Crataegus laevigata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	2	2	.	2	1	1	2	1	2	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.
Quercus subpyrenaica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	1	2	4	4	3	3	3	.	3	1	3	4	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	3	1	1	.	2	.
Quercus pubescens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	3	3	5	2	5	3	2	4	4	5	5	5	4	4	5	4	4	5	5	4	5	5	5	5	5	3	4	5	4	4	5
Buxus sempervirens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	3	3	4	4	5	3	4	5	3	4	4	4	.	3	4	4	4	4
Coronilla emerus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	+	1	1	2	.	.	2	.	.	2	1
Char. of Ord. & All.																																																				
Viburnum lantana	+	2	2	.	1	+	1	2	2	2	2	2	1	1	2	2	2	1	.	2	2	1	1	.	1	.	.	1	1	+	1	.	1	1	1	.	.	2	+	1	1	1	1	1	.	2	+	.	.	.	1	2
Acer monspessulanum	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	3	.	.	.	.	3	+	1	1	2	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	2	1	.	.	.	.	.	1	1
Sorbus torminalis	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	1	.	.	.	+	2	.	.	.	+	1	+	.	.	+	+	.	.	2
Primula veris columnae	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1	.	1	.	+	.	.	+	+	+	.	.	.	1	.	.	1
Viola alba	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	+	.	1	.	.	.	.	.	.	1	.	.	1	1	1	.	1	.	.
Amelanchier ovalis	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	2	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	+	.
Lonicera etrusca	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	1	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Melittis melisophyllum	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	.	2	.
Helleborus foetidus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	1	.	+	.	.	.	.	.	.	+	.	.	.	.	.
Epipactis helleborine	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	1	+	.	.
Lathyrus latifolius	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.
Tanacetum corymbosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	.	.	.	.	.
Lathyrus niger	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	+	.	.
Prunus mahaleb	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Acer opalus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Char. of Class																																																			
Crataegus monogyna	.	+	.	2	.	.	1	2	1	2	2	2	2	2	2	.	3	2	2	2	1	2	3	2	1	2	1	2	2	2	2	+	2	2	.	+	.	.	1	1	+	1	1	1	1	1	1	1	.	1	2	2
Hedera helix	3	3	5	2	3	4	3	2	1	1	2	2	2	2	3	.	2	3	.	4	4	1	2	.	2	1	1	2	1	.	1	.	.	1	2	2	.	+	1	1	1	1	1	1	.	.	1	2	1	.	1	2
Cornus sanguinea	1	1	2	2	2	2	1	2	2	.	1	2	1	.	3	.	2	1	.	2	2	1	2	.	2	.	.	2	2	.	+	+	2	.	2	1	.	1	+	2	+	.	1	1	.	+	.	1	.	.	2	1
Prunus spinosa	1	2	1	2	1	1	.	.	.	.	1	1	2	1	2	1	4	2	.	2	2	3	1	+	2	1	2	2	2	1	2	.	2	1	2	.	+	1	.	.	.	.	1	+	.	.	2	1	.	1	.	.
Rosa arvensis	.	1	.	+	+	1	.	1	1	1	3	1	2	2	1	.	1	2	1	1	2	2	1	.	1	.	2	.	2	1	1	1	+	.	+	.	+	1	1	+	1	.	.	.	.	1	1	.	+	.	.	.
Taxus communis	1	1	2	.	.	1	1	.	.	2	1	1	1	.	2	.	.	.	2	1	+	.	2	+	1	1	.	2	1	.	+	.	1	+	.	.	.	+	+	2	.	.	+	+	+	1	.	.	.	1	+	1
Acer campestre	.	3	.	.	1	.	.	1	3	.	3	1	3	.	.	+	2	3	2	1	1	3	2	.	1	.	1	2	1	.	1	+	1	1	.	.	.	2	.	1	.	.	2	+	.	.	.	.	.	1	1	1
Ligustrum vulgare	1	2	2	2	2	1	1	1	1	1	2	2	1	.	2	.	.	.	.	.	.	.	1	.	1	.	1	.	1	.	1	.	1	.	.	.	.	1	.	+	.	.	.	.	.	.	1	1	.	.	+	1
Corylus avellana	1	.	.	1	1	3	3	.	.	.	1	1	1	.	.	1	2	1	.	4	1	2	.	.	.	.	.	.	3	.	.	1	1	.	.	.	.	.	.	.	3	2	.	.	.	.	.	.	.	1	2	.
Rosa squarrosa	.	+	.	.	.	.	.	.	.	.	+	+	.	.	1	1	+	.	+	.	.	.	1	.	.	1	+	1	.	1	1	1	.	.	.	+	.	.	.	+	.	+	.	+	.	.	.	.	.	.	.	.
Euphorbia amygdaloides	.	.	1	1	1	1	.	1	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1	1	1	.	.	.	.	.	.	+	.	1	.	.	.	.	.	.	.	.	1	1	.	.	.	+	1	.	.	+
Rubus ulmifolius	2	.	.	.	.	.	.	.	.	2	.	2	.	.	.	.	1	2	2	.	.	.	.	.	.	.	.	2	.	3	1	.	1	.	.	.	.	1	.	1	1	.	+	.	.	.	1	.	.	.	.	.
Lonicera xylosteum	.	.	.	.	.	.	.	.	.	.	2	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	+	1	.	1	.	+	+	1	1	1	.	.	.	.	+	+	1	.	.	1
Viola gr. sylvatica	.	+	.	.	.	.	.	1	1	.	.	.	.	1	2	.	.	1	.	.	.	.	.	.	1	.	.	1	.	.	1	1	.	1	.	.	1	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Hepatica nobilis	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	.	+	.	1	.	.	.	1	.	.	.	.	.	.	.	2	.	.	.	1	.	.	.	.	.	2	.	.	.	2	.	.	2	1
Lonicera periclymenum	1	1	.	.	.	.	.	1	.	.	.	.	.	.	1	2	.	.	.	1	.	.	.	.	.	.	.	.	2	.	.	.	.	.	1	+	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
Fagus sylvatica	+	+	.	.	.	.	.	.	.	.	.	.	.	1	.	+	+	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
Ilex aquifolium	.	+	.	1	.	.	.	+	.	.	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brachypodium sylvaticum	.	2	.	2	2	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	+

Table 2. (continued).

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Sorbus aria	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	1	.	.	+	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.
Hypericum montanum	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	1	1	.	.	2	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Stellaria holostea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1	.	+	.	.	.	.	.	.	+	.	.	+	.	.	1	.	.	.	.	.	.	.	.
Ranunculus nemorosus	.	.	.	1	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	+
Fraxinus excelsior	.	+	.	1	.	.	.	.	.	.	.	.	.	.	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sanicula europaea	.	1	1	1	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helleborus occidentalis	.	.	.	1	.	.	.	1	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mercurialis perennis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	.	.	.	+	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla sterilis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	.	.	.
Melica uniflora	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	2	.	1	.	.	+	.	.	3	.	.	.	.	1	.	2	1
Rosa agrestis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	+	.	.
<u>Accompanying</u>:																																																				
Brachypodium rupestre	1	.	.	3	2	2	.	.	3	4	.	2	3	.	2	3	3	2	2	2	2	1	.	+	3	3	2	3	2	2	3	3	3	1	1	1	1	.	1	1	+	+	1	.	+	2	3	1	2	3	.	.
Rubia peregrina	1	1	1	1	1	1	1	1	1	2	1	1	1	2	3	.	.	.	.	.	+	.	+	1	2	1	1	2	.	.	.	.	.	1	1	2	.	+	+	1	.	.	1	1	1	.	1	1	1	.	1	1
Juniperus communis	1	+	1	.	.	.	.	+	.	.	+	.	.	1	1	1	.	1	.	.	.	1	.	+	.	.	.	.	.	1	2	+	1	1	1	.	2	2	.	.	.	.	.	.	.	.	1	1	1	+	.	+
Erica vagans	.	.	.	.	.	.	1	+	.	1	1	2	.	.	.	1	2	2	2	.	.	+	.	+	.	.	.	.	+	3	1	1	1	.	+	.	1	+	1	.	+	.	.	.	.	.	1	.	.	1	.	.
Genista occidentalis	.	.	1	.	.	.	.	.	.	.	+	.	.	+	.	+	.	.	.	.	.	.	.	.	.	+	1	.	.	1	1	.	+	1	.	+	1	1	2	1	+	+	.	.	.	.	.	+	.	+	.	.
Stachys officinalis	.	.	.	+	.	.	.	.	.	.	1	1	1	1	.	.	1	2	.	+	.	.	.	.	.	.	.	.	1	1	+	.	.	.	.	1	.	1	.	.	.	.	.	1	.	.	.	.	.	1	1	+
Carex flacca	.	2	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	+	.	.	.	2	1	.	2	+	.	1	.	.	+	.	.	.	3	1	+	.	1	.	1	1	.	.
Helictotrichon cantabricum	.	.	1	.	.	1	2	.	.	.	1	3	.	1	.	.	.	.	.	+	.	.	.	1	.	.	.	.	.	.	.	.	.	1	.	.	+	.	.	+	.	.	.	+	1	.	.	.	1	.	.	.
Rubus fruticosus	.	.	2	1	.	.	.	1	2	.	1	.	2	3	.	.	1	2	.	1	.	.	2	.	.	.	3	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vicia sepium	.	.	.	.	.	1	.	.	.	.	+	.	1	2	1	.	.	1	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	2	.	.	.	.	+	.	+	+
Pteridium aquilinum	1	.	.	1	1	1	+	.	.	.	.	.	2	3	.	.	1	1	2	1	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Potentilla montana	.	+	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	1	2	+	1	.	.	.	1	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.
Ruscus aculeatus	.	+	.	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.
Quercus rotundifolia	.	1	.	.	.	.	.	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1	.	.	.	.	.	+	.	.	.	.	.
Thymelaea ruizii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	1	+	1	.	.	.
Iris xiphiodes	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	+	+	.	.	+
Geum sylvaticum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	1	1	+	+	.	.
Vicia incana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	1	.	.	+	+	.	+
Thalictrum tuberosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	1	.	+	+	.	.	1	.	.	.
Trifolium montanum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	+	+	.	.	.	.	.	.
Lathyrus montanus	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
Rhamnus alaternus	.	.	.	.	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.

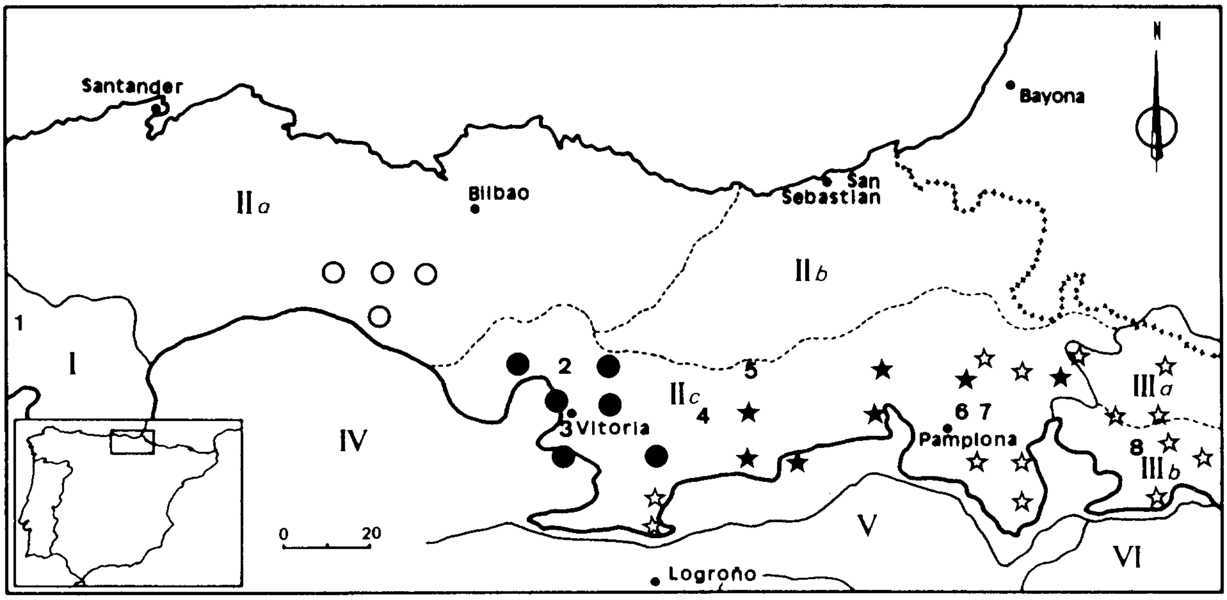
<u>Characteristics of class</u>: Rel. 1: *Prunus avium* +, *Acer pseudoplatanus* +; rel. 3: *Stachys sylvatica* 1; rel. 7: *Euonymus europaeus* +; rel. 11: *Viburnum opulus* +; rel. 14: *Quercus pyrenaica* +; rel. 15: *Frangula alnus* 1 , *Euonymus europaeus* +; rel. 16: *Sorbus aucuparia* +; rel. 17: *Quercus robur x faginea* 1; rel. 18: *Acer pseudoplatanus* 1, *Quercus pyrenaica* 3, *Quercus robur* 2;rel. 19: *Tilia platyphyllos* 2; rel. 20: *Polygonatum multiflorum* +; rel. 22: *Deschampsia flexuosa* +, *Polygonatum multiflorum* 1; rel. 23: *Bromus ramosus* 2; rel. 24: *Rosa canina* 2; rel. 25: *Bromus ramosus* 1; rel. 26: *Rosa micrantha* +, *Rhamnus catharticus* +, *Arum maculatum* 1; rel. 27: *Rosa micrantha* +; rel. 28: *Rhamnus catharticus* 1; rel. 31: *Deschampsia flexuosa* 1; inv 32: *Anemone nemorosa* 2; rel. 33: *Luzula forsteri* +; rel. 34: *Sorbus aucuparia* +; rel. 38: *Sorbus aucuparia* +; rel. 40: *Prunus avium* +, *Ulmus minor* +,*Cephalanthera damasonium*; rel. 41: *Populus tremula* 1, *Castanea sativa* +; rel. 43: *Poa nemoralis* +; rel. 44: *Frangula alnus* +, *Euonymus europaeus* +, *Spiraea hispanica* +; rel. 46: *Ulmus minor* +; rel. 47: *Quercus x subspicata* 1; rel. 51: *Rhamnus catharticus* +; rel. 52: *Malus sylvestris* +, *Scilla lilio-hyacinthus* +.

<u>Accompanying</u>: Rel. 2: *Rosa pimpinellifolia* +, *Polypodium vulgare* +; rel. 4: *Ajuga reptans* +, *Aquilegia vulgaris* +, *Agrostis capillaris 1*; inv 10: *Lathyrus pratensis +*, *Origanum vulgare* 1, *Dorycnium pentaphyllum* +; rel. 11: *Rosa pimpinellifolia* 1; rel. 13: *Viola odorata* +, *Poa trivialis* 2,*Prunella grandiflora* 1; rel. 14: *Hypericum pulchrum* 1, *Cirsium filipendulum* +, *Cruciata laevipes* 1; rel. 16: *Daboecia cantabrica* 2; rel. 19: *Teucrium pyrenaicum* 1; rel. 21: *Thalictrum minus* 1; rel. 24: *Agrostis capillaris* +, *Geranium robertianum* 1, *Conopodium majus* 1, *Quercus rotundifolia* +, *Arenaria montana* +, *Ranunculus ficaria* +; rel. 25: *Aquilegia vulgaris* +; rel. 26: *Geranium robertianum* +, *Ribes alpinum* +; rel. 27: *Euphorbia nicaensis* +, *Teucrium chamaedrys* +, *Festuca rubra* 1, *Bromus erectus* 1; rel. 29: *Hypericum pulchrum* +, *Agrostis capillaris* 2; rel. 30: *Ajuga reptans* 1, *Serratula tinctoria* 1, *Genista tinctoria* 2, *Anthoxantum odoratum* 1, *Potentilla erecta* +; rel. 31: *Helianthemum nummularium* +, *Veronica chamaedrys* +; rel. 32: *Scilla verna* 1, *Cardamine pratensis* +; rel. 34: *Veronica chamaedrys* +, *Pinus sylvestris* +; rel. 36: *Bromus erectus* +, *Pinus sylvestris* +, *Iris graminea* +, *Hieracium murorum* 1, *Hippocrepis comosa* 1, *Phyteuma spicatum* subsp. *pyrenaicum* +; rel. 38: *Conopodium vulgare* +, *Juniperus oxycedrus* +, *Trifolium ochroleucon* +; rel. 40: *Bupleurum rigidum* 1; rel. 41: *Daboecia cantabrica* +,*Pinus sylvestris* 1, *Moehringia trinervia* +, *Calluna vulgaris* : rel. 42: *Cardamine pratensis* +, *Polypodium cambricum* +; rel. 43: *Prunella grandiflora* +, *Lathyrus pratensis* 1, *Polygala vulgaris* +, *Phyteuma Spicatum* subsp. *pyrenaicum*, *Hieracium* gr. *pilosella* +, *Agropyron caninum* +, *Coronilla minima* +. *Platanthera bifolia* +; rel. 44: *Festuca rubra* +, *Anthoxantum odoratum* +, *Veronica chamaecrys* 1, *Hieracium* gr. *pilosella* +; rel. 4 *Teucrium pyrenaicum* +, *Teucrium chamaedrys* +, *Bromus erectus* 2, *Dorycnium pentaphyllum* +, *Genista scorpius* 2, *Helianthemum nummularium* 1; rel. 46: *Genista scorpius* +, *Silene nutans* +, *Hieracium murorum* +, *Galium mollugo* 1; rel. 47: *Festuca rubra* +, *Filipendula vulgaris* 1; rel. 50: *Dorycnium pentaphyllum* +; rel. 52: *Prunella grandiflora* +, *Hieracium murorum* +.

<u>Localities</u>: 1. Pto. Peña Angulo (BU), 30TVN86. 2 y 3. Caniego (BU), 30TVN77. 4. Izoria (VI), 30TVN97. 5. Retes de Llanteno (VI), 30TVN97. 6. Lorcio (BU), 30TVN87. 7. Aloria (BU), 30TVN77. 8. Cantonad (BU), 30TVN77. 9. Gordélegui, Pto de Vitoria (VI), 30TWN24. 10. Pantano de Zadorra (VI), 30TWN35. 11. Maturana (VI), 30TWN34. 12. Murguía (VI), 30TWN15. 13. Berrosteguieta (VI), 30TWN24. 14. Puerto de Vitoria (VI), 30TWN23. 15. Entre Ascarza y Argandoña (VI), 30TWN34. 16. Entre Antoñana y Maestu (VI), 30TWN24. 17. Azaceta (VI), 30TWN43. 18. De Azaceta a Virgala Mayor (VI), 30TWN43. 19. De Cicújano a Arenaza (VI), 30TWN43. 20. Olazagutia (NA), 30TWN64. 21. De Alsasua a Urbasa (NA), 30TWN64. 22. Larraona (NA), 30TWN63. 23. De Urbasa a Estella (NA), 30TWN73. 24. Santiago Lóquiz , Amezcoa (NA), 30TWN63. 25. Irurzun, cruce hacia Goñi (NA), 30TWN95. 26. Azanza, cerca de Aizpún (NA), 30TWN94. 27. Arteta (NA), 30TWN94. 28. Entre Goñi y Aizpún (NA), 30TWN94. 29. Entre Olagüe y Egozcue (NA), 30TXN15. 30. Sarasate, de Irurzun a Pamplona (NA), 30TWN94. 31. Leazcue (NA), 30TXN15. 32. Viscarret-Gerendain (NA), 30TXN35. 33. De Olagüe a Egozcue (NA), 30TXN15. 34. Leranoz (NA), 30TXN25. 35. Setuain, cerca de Larrasoaña (NA), 30TXN15. 36. Leoz (NA), 30TXN22. 37. Generilla, cerca de Sta Cruz de Campezo (NA), 30TWN42. 38. Puerto Cabredo hacia Aguilar de Kodes (NA), 30TWN41. 39. La Población (NA), 30TWN41. 40. Zabalceta, valle de Unciti (NA), 30TXN23. 41. Entre Erro y Esnoz (NA), 30TXN25. 42. Saragüeta, valle de Urrobi (NA), 30TXN35. 43. Igal (NA), 30TXN54. 44. Entre Puerto de Isu y Navascues (NA), 30TXN53. 45. De Burgui a la muga de Huesca (NA), 30TXN63. 46. Esparza, valle de Salazar (NA), 30TXN54. 47. Tajonar (NA), 30TXN13. 48. Góngora (NA), 30TXN23. 49. Ayechu, Urraul Alto (NA), 30TXN44. 50. De Escaroz a Jaurrieta (NA), 30TXN55. 51. Puerto de Isu a Bigüezal (NA), 30TXN52. 52. Navascues, Recas Alto (NA), 30TXN53.

we have built up regression lines by means of a Program Statview 512 (Abacus Concepts Inc., 1986). We have selected those of them which show a significant positive correlation ($R \geq 0.5$) with the geographical longitude, a parameter which is directly related to the floristic gradient.

The graphics show the variation of these parameters in relation to geographical longitude and altitude, aiming to establish some parallelism between some of these variations and the floristic gradient.



Map 1. Distribution of localities of forest relevés; meteorological stations (Number 1–8 correspond to Table 1) and Biogeography of the Basque Country area (Rivas-Martínez 1987, modified).

● *Pulmonario longifoliae-Quercetum fagineae quercetosum fagineae*
○ *Pulmonario longifoliae-Quercetum fagineae smilacetosum asperae*
☆ *Buxo-Quercetum pubescentis quercetosum pubescentis*
★ *Buxo-Quercetum pubescentis crataegetosum laevigatae*

Eurosiberian region

I. Orocantabric Province, Campurriano-Carrionés Sector

II. Cántabro-Atlántica Province, Cántabro-Euskaldún Sector
1a Santanderino-Vizcaíno subsector
1b Euskaldún oriental subsector
1c Navarro-Alavés subsector

III. Pirenaica Province, Pirenaico central Sector
2a Pirenaico occidental subsector
2b Jacetano-Guarense subsector

Mediterranean region (Aragonesa Province)

IV. Castellano-Cantábrico Sector
V. Riojano-Estellés Sector
VI. Bárdenas-Monegros Sector
VII. Somontano-Aragonés Sector

Discussion of the results of the bioclimatic analysis

The regression lines for the bioclimatical parameters being significant to the geographical longitude (in minutes) are shown in Figure 1. Pv, Imv, IM3, and C have the greatest regression coefficients. The summer rains (Pv) and the continentality index (C) decrease towards the west, while the mediterraneity indexes Im3 and Imv behave just the opposite.

In fact, it is possible to observe that, towards the Pyrenees, the climate has a more continental character, with colder winters and warmer summers showing a higher proportion of summer rainfall in the whole year amount. On the other hand, the cantabric part shows a stronger summer-drought stress and significantly lower continentality. Notice that P, M, and the other parameters analysed show no significant variation along the east-west strip.

Discussion of the vegetation tables

The relevés taken in the field are shown in Table 2. They have been arranged from west to east and grouped according to their floristic affinities. The locations are shown in map 1. One of the first things that can be observed is the presence of certain species, such as *Acer monspessulanum*, *Viburnum lantana*, *Sorbus torminalis*, etc., which are more or less common to all these forests, and allow their inclusion in the Alliance Quercion *pubescenti-petraeae*, inside the great Order *Quercetalia pubescentis*.

The first set of species in Table 2 is made up with those plants which allow us to distinguish between different groups of relevés, which help us in defining the forest types of this area. In this way four relevés groups can be distinguished:

a) In the first group of relevés (1–8) there are forests of *Quercus faginea* including a significant number of thermophilic plants; some of them, as *Smilax aspera*, *Rosa sempervirens* or *Arbutus unedo*, show mediterranean character. This type of forest is found in those cantabrian valleys having a relative summer drought stress, which are the upper valleys of the rivers Nervión and Cadagua.

b) The second group of relevés (9–19) shows an impoverishment of the former one, as the mentioned thermophilic taxa are now lacking, although the dominant species is still *Quercus faginea*. *Pulmonaria longifolia* and *Melampyrum pratense* are two species still present with a western distribution. From the relevé No. 16 on the presence of the hybrid between *Q. faginea* and *Q. pubescens* (*Q. subpyrenaica*) starts to be significant, a fact which points to a clear influence from the forests dominated by *Q. pubescens*.

c) The third group (20–33) is characterised by the abundance of *Q. pubescens* and the almost absolute lack of 'pure' individuals of *Q. faginea*; *P. longifolia* and *M. pratense* are also absent. Moreover, the presence and important fidelity of *Crataegus laevigata* is characteristic of this third type of forest.

d) The last type (34–52) is found in the eastern end of the studied area, inside the Pirenaica Province or very near to it, and is markedly characterised by *Buxus sempervirens* and *Coronilla emerus*.

These four types, two western ones dominated by *Q. faginea* and two eastern ones dominated by *Q. pubescens*, can be grouped in two different units having the rank of association, and the four types get the rank of subassociation.

In order to clarify the nomenclatural and syntaxonomical questions we have built up the synthetic table (Table 3), which allows us to compare similar forest types from nearby areas. Each column represents a table taken from literature, except numbers 5, 6, 7 and 8, which represent the four types described above. The analysis of this table shows us that the types 5 and 6 bear floristic similarities with the columns 1 to 4, and that the types 7 and 8 with the columns 9 to 11.

Columns 2, 3 and 4 belong to one association named *Spiraeo obovatae-Quercetum fagineae*, and 9, 10 and 11 to another with Pyrenaean distribution named *Buxo-Quercetum pubescentis*. The assimilation of types 7 and 8 to the latter presents

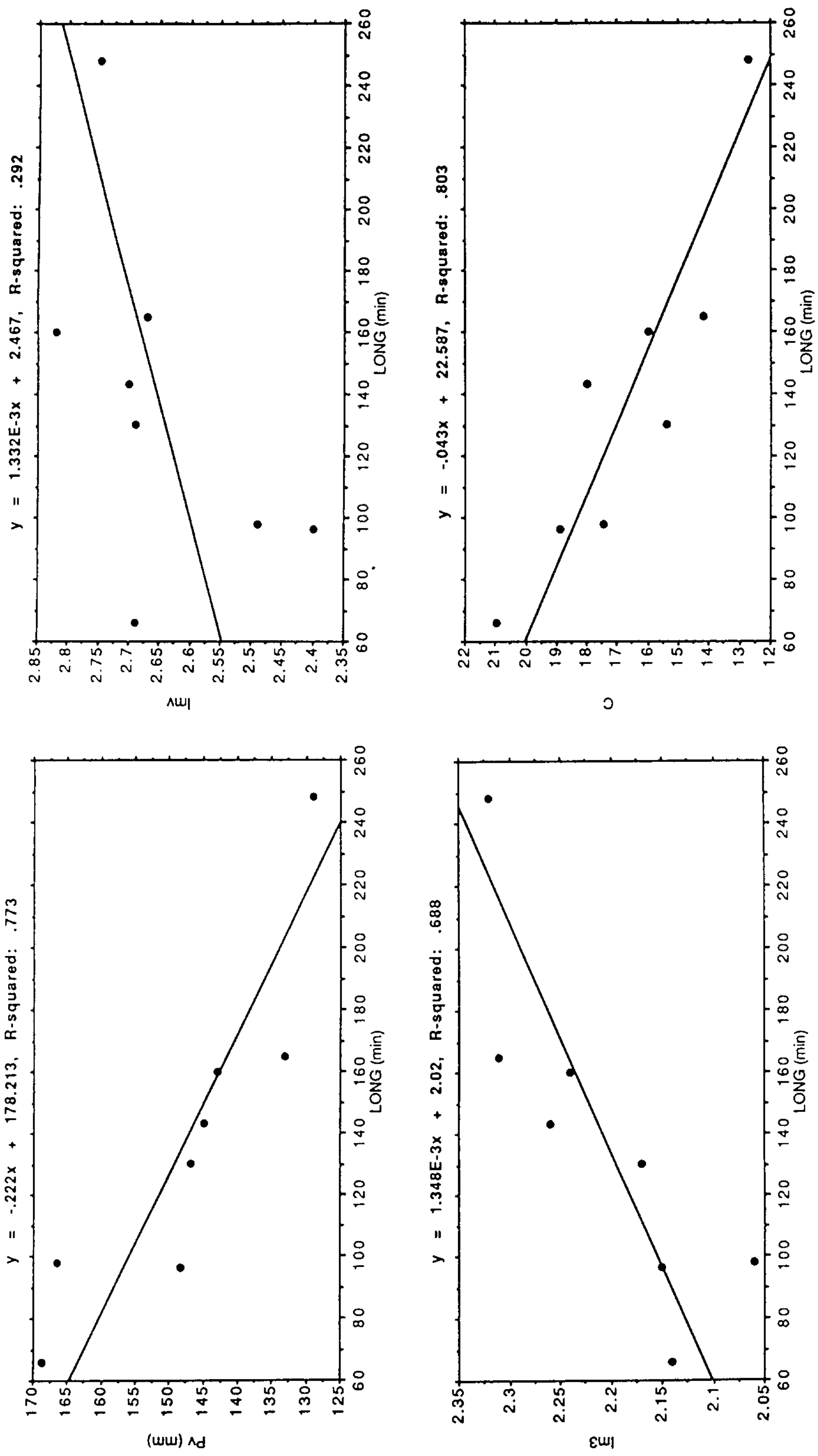

y = 1.332E-3x + 2.467, R-squared: .292
lmv
LONG (min)
y = -.043x + 22.587, R-squared: .803
C
LONG (min)
y = -.222x + 178.213, R-squared: .773
Pv (mm)
LONG (min)
y = 1.348E-3x + 2.02, R-squared: .688
lm3
LONG (min)

Fig. 1.

Table 3.

No. of column	1	2	3	4	5	6	7	8	9	10	11
No. of releves	5	6	12	3	8	11	14	19	8	10	11
Char. and differ. species of the assoc.and subass.											
Quercus faginea	V	V	V	3	V	V	.	.	.	.	.
Spiraea obovata	.	I	II	2	.	.	.	+	.	.	.
Pulmonaria longifolia	.	.	.	.	IV	V	II	I	.	.	.
Melampyrum pratense	.	.	I	.	I	II	.	.	.	.	.
Smilax aspera	.	.	.	.	V	.	.	.	.	.	.
Rosa sempervirens	.	.	.	.	IV	.	.	.	.	.	.
Arbutus unedo	.	.	.	.	II	.	.	.	.	.	.
Hypericum androsaemum	.	.	.	.	I	.	.	.	.	.	.
Laurus nobilis	.	.	.	.	I	.	.	.	.	.	.
Crataegus laevigata	.	.	.	.	.	.	IV	I	.	.	.
Quercus subpyrenaica	.	.	.	.	.	I I	IV	II	V	.	II
Quercus pubescens	.	.	.	.	.	.	V	V	.	V	I
Buxus sempervirens	I	.	I	.	.	.	.	V	V	V	III
Coronilla emerus	.	.	.	.	.	.	.	III	IV	V	V
Char. and differ. of Ord. & All.											
Viburnum lantana	III	.	IV	2	V	V	IV	IV	II	III	.
Primula veris columnae	II	.	I	1	II	.	+	III	III	II	II
Amelanchier ovalis	III	.	II	2	I	+	I	I	II	.	V
Sorbus terminalis	I	.	.	1	I	.	I	III	II	.	II
Lonicera etrusca	I	.	III	3	.	+	II	I	.	.	II
Helleborus foetidus	.	V	II	.	.	.	I	I	II	V	IV
Prunus mahaleb	I	II	.	.	.	+	+	+	II	.	II
Acer monspessulanum	II	II	II	.	.	I	II	II	.	.	.
Epipactis helleborine	I	IV	I	.	.	.	.	II	IV	.	.
Viola alba	.	.	.	2	.	.	I	II	.	III	II
Melittis melisophyllum	.	.	.	.	I	.	+	I	I	III	.
Tanacetum corymbosum	III	.	.	2	.	.	.	I	.	.	II
Lathyrus latifolius	.	I	.	.	.	+	+	I	.	.	.
Acer opalus	.	.	.	.	.	I	.	+	.	.	IV
Cephalanthera rubra	IV	IV	.	.	.	.	.	.	.	.	.
Lathyrus filiformis	III	II	.	.	.	.	.	.	.	.	.
Cytisus sessilifolius	II	.	.	.	.	.	.	.	.	.	.
Primula canescens	.	V	.	.	.	.	.	.	.	.	.
Epipactis microphylla	.	II	.	.	.	.	.	.	.	.	.
Cephalanthera damasonium	.	II	.	.	.	.	.	.	.	.	.
Cephalanthera alba	.	.	I	.	.	.	.	.	.	.	.
Lathyrus niger	.	.	.	.	.	.	.	I	.	.	.
Epipactis atrorubens	.	.	.	.	.	.	.	.	II	.	.
Char. of Class											
Crataegus monogyna	IV	V	V	1	III	V	V	IV	IV	III	II
Prunus spinosa	I	V	V	2	IV	IV	V	III	III	II	II
Hedera helix	I	.	IV	2	V	V	IV	IV	III	III	V
Tamus communis	.	I	III	2	IV	III	IV	III	II	II	III
Hepatica nobilis	II	I	I	.	I	+	II	II	V	III	V
Ligustrum vulgare	II	.	IV	3	V	III	III	II	III	III	.
Viola gr. sylvatica	II	II	I	.	II	II	II	II	II	.	III
Clematis vitalba	I	.	I	.	II	+	II	.	II	II	II
Lonicera xylosteum	.	II	I	.	.	I	I	III	II	III	V
Corylus avellana	.	I	.	.	IV	III	III	II	I	III	IV
Cornus sanguinea	.	.	II	2	V	IV	IV	IV	II	II	.
Acer campestre	.	.	II	1	II	IV	IV	III	II	II	.
Rubus ulmifolius	.	.	I	1	I	III	II	II	II	II	.
Lonicera periclymenum	.	III	I	1	II	I	I	I	.	.	.
Brachypodium sylvaticum	.	.	.	1	III	.	+	I	II	II	II

Table 3. (continued).

	1	2	3	4	5	6	7	8	9	10	11
Sorbus aria	.	.	I	1	I	.	II	I	II	.	V
Euphorbia amygdaloides	.	.	.	.	IV	+	II	II	.	IV	III
Ilex aquifolium	.	.	.	.	II	I	II	+	.	III	V
Geum sylvaticum	IV	IV	.	.	.	.	.	II	II	.	II
Fagus sylvatica	.	II	.	.	II	II	+	I	.	.	.
Rosa squarrosa	.	.	III	.	I	III	III	II	.	.	.
Rosa arvensis	.	.	.	.	IV	V	IV	III	.	.	.
Ranunculus nemorosus	.	.	.	.	I	+	+	I	.	.	.
Hypericum montanum	.	.	.	.	.	+	II	+	II	.	.
Rosa micrantha	.	IV	I	1	.	.	.	.	.	.	.
Rosa agrestis	.	III	.	.	.	.	+	I	.	.	.
Stellaria holostea	.	I	.	.	.	.	II	I	.	.	.
Mercurialis perennis	.	I	.	.	.	.	II	+	.	.	.
Rosa canina	.	.	II	.	.	.	.	.	IV	II	.
Fraxinus excelsior	.	.	.	.	II	I	+	.	.	.	.
Helleborus occidentalis	.	.	.	.	II	I	+	.	.	.	.
Melica uniflora	.	.	.	.	.	.	+	II	II	.	.
<u>Accompanying:</u>											
Rubia peregrina	II	I	V	3	V	IV	III	IV	II	III	III
Juniperus communis	I	II	IV	3	III	III	III	III	IV	IV	III
Stachys officinalis	II	.	I	.	I	III	II	II	.	V	II
Erica vagans	.	I	III	3	II	IV	III	II	.	.	.
Genista occidentalis	.	V	III	2	I	II	II	III	.	.	.
Brachypodium rupestre	.	V	III	.	III	V	V	IV	.	.	.
Quercus rotundifolia	I	.	II	2	II	+	II	I	.	.	.
Potentilla montana	.	I	I	.	I	I	II	I	.	.	.
Helictotrichon cantabricum	.	.	I	1	II	II	I	II	.	.	.
Carex flacca	.	.	I	.	I	+	II	III	II	.	.
Vicia sepium	.	.	.	.	I	III	I	II	II	II	.
Thymelaea ruizii	.	I	I	1	.	.	+	II	.	.	.
Rhamnus alaternus	.	.	II	2	II	.	+	+	.	.	.
Pteridium aquilinum	.	.	I	.	IV	III	I	.	.	II	.
Thalictrum tuberosum	.	III	I	.	.	.	.	II	I	.	.
Genista scorpius	.	V	II	+	.	.	.	.	.	.	.
Rubus fruticosus	.	.	.	.	II	III	II	.	.	.	.
Ruscus aculeatus	.	.	.	.	II	.	+	I	.	.	.
Lathyrus montanus	.	.	.	.	.	I	+	+	.	.	.

1.- *Cephalanthero-Quercetum fagineae* Rivas-Martinez in Rivas Goday & col. 1959 (G. LOPEZ 1976: 68)
2.- *Spiraeo obovatae-Quercetum fagineae* O. Bolós & P. Montserrat 1984 (G. NAVARRO 1986: 174)
3.- " " (J. LOIDI & J.A. FERNANDEZ PRIETO 1986: 344)
4.- *Spiraeo obovatae-Quercetum fagineae* O. Bolós & Montserrat 1984 (BOLOS & MONTSERRAT 1984: 95)
5.- *Pulmonario longifoliae-Quercetum fagineae smilacetosum asperae* subas. nova (TABLE 2: 1-8)
6.- *Pulmonario longifoliae-Quercetum fagineae* as. nova (TABLE 2: 9-19)
7.- *Buxo-Quercetum pubescentis* Br.-Bl. (1931) 1932 *crataegetosum laevigatae* subas. nova (TABLE 2: 20-33)
8.- *Buxo-Quercetum pubescentis* Br.-Bl. (1931) 1932 *quercetosum pubescentis* (TABLE 2: 34-52)
9.- " " (J. M. MONTSERRAT 1986: 300)
10.- " " (O. DE BOLOS & R.M. MASALLES 1983: 66)
11.- " " (O. DE BOLOS 1967: 147)

no problems; only type 7 can be isolated as a local subassociation with *Crataegus laevigata*: *crataegetosum laevigatae* subas. nova (holotypus: Table 2, rel. 28).

However, the assimilation of types 5 and 6 to *Spiraeo-Quercetum fagineae* is more problematic because of *Pulmonaria longifolia* shows a high frequency of occurrence in our forests. This may be explained since our research area is completely included in the Eurosiberian Region, where this plant is common in several forest types, but very scarce in the neighbour Mediterranean Region. For this reason we consider it convenient to propose a new association for this two columns (5 and 6) named *Pulmonario longifoliae-Quercetum fagineae* ass. nova (holotypus: Table 2, rel. 11).

The differences between types 5 and 6 can be expressed by means of the description of a subassociation mainly characterised by the presence of *Rosa sempervirens*, *Smilax aspera* and *Arbutus unedo* in type 5: *Smilacetosum asperae* subass. nova (holotypus: Table 2, rel. 5).

As a result of this discussion, the syntaxonomy of these types of forests would be as follows:

QUERCO-FAGETEA Br.-Bl. & Vlieger in Vlieger 1937

Quercetalia pubescenti-petraeae Klika 1933

Quercion pubescenti-petraeae Br.-Bl. 1931

Pulmonario longifoliae-Quercetum fagineae as. nova

quercetosum fagineae
smilacetosum asperae subas. nova

Buxo-Quercetum pubescentis Br.-Bl. 1931

quercetosum pubescentis
crataegetosum laevigatae subas. nova

Conclusions

As a result of this study we can conclude that:

1. The floristic analysis of the forests in the studied area allows us to distinguish between four different types, characterized by the presence or lack of different taxa: the first one is a *Quercus faginea* forest with thermophilic plants as *Smilax aspera*, *Rosa sempervirens* and *Arbutus unedo*, typical of the eucolline stage of the cantabrian area: the second one is characterised by *Pulmonaria longifolia* and *Melampyrum pratense*; the third one shows the presence of *Quercus* × *subpyrenaica* and *Quercus pubescens* in the tree canopy and *Crataegus laevigata* in the shrub layer, pure stands of *Quercus faginea* are already absent. The last one is a *Q. pubescens* forest with typical pyrenaical plants such as *Buxus sempervirens* and *Coronilla emerus*, and lacks of all western taxa which are present in the other three types.
2. The independence of the first type is due to the lower altitude and less severe climate in which it develops, so it will not be considered in the relationships between forest types and longitude.
3. The other three types, which live under hypothetically similar conditions: comparable altitude, rainfall and substratum, show a specific distribution pattern. The first one extend themselves on the western parts of the studied area, the second, the central and the third ones on the eastern parts, which means the existence of a distributiontal pattern correlated with longitude.
4. Based on the data of eight meteorological stations located within the studied area, we have taken 14 parameters into account in order to study their variation along the geographical longitude. The results show that only four of them show a significant variation from west to east: P_v, Im_3, Im_v and C. This points to the existence of a sort of correlation between these indices and longitude (i.e. forest type). The western part of the studied area shows a higher mediterranean degree and the eastern one a higher continental one.
5. These results suggest that, in the cantabrian-pyrenaean transition, the floristic changes follow a climatic gradient in which the cantabrian region shows a higher mediterranean (higher summer drought) and a more oceanical character in its climate. On the other hand, in the pyrenaean part the climate has a less mediterranean (lower summer drought) and higher continental character. Other parameters such as total amount of rainfall and temperatures are not relevant.

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