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STUDY OF THE BIOGEOGRAPHY AND CENTRES OF DIVERSITY IN SECTION SIDERITIS (GENUS SIDERITIS, LABIATAE)

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Abstract

Section *Sideritis* is endemic to the Western Mediterranean Region. The Iberian Peninsula, with 47 species, of which 37 are endemic exclusive, is the major centre of diversity for this Section. In this territory the highest diversity is found in the South-eastern quadrant. Northwest Africa is also a relevant territory for this section, with about 20 endemic taxa.

Introduction

The recent revision of Section *Sideritis* (OBÓN & RIVERA, 1994) draw attention on many lesser known taxa and hence on unsuspected ecological issues of this group. The distribution range of Genus *Sideritis* is comprised from 20° W to 60° E and from 25° to 50° N. The main centre of diversity for this Genus is in the Macaronesic-Mediterranean Region. Section *Sideritis* is endemic to the Western Mediterranean Region. Two major centres have been recognised by OBÓN & RIVERA (1994), viz.: South-eastern Spain and Northwest Africa.

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Altitude

The altitudinal range for species included in section *Sideritis* is comprised between a few meters above the sea level in localities of *S. pusilla* subsp. *pusilla* and more than 3100 meters reached by *S. glacialis* subsp. *glacialis* in the Sierra Nevada and *S. gineslopezii* or *S. matrisfiliae* in the Atlas mountains. The average altitude calculated for the whole section is approximately 750 m, but in fact many taxa's ranges are above or below (Fig. 1). It should be noticed that major subsections in number of species include both low and high altitude taxa (Fig. 1). It seems that adaptation to specialised habitats, i.e. high mountain environments occurred after the major differentiation processes in this group. But it is also noteworthy the presence of minor subsections including exclusively taxa living in subalpine environments (viz. *Borgiae* or *Lurida*).

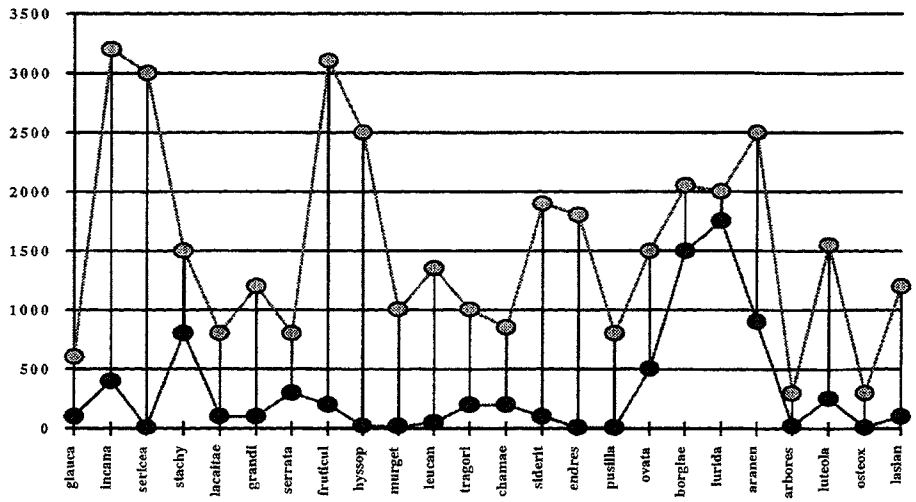

Fig. 1. Altitudinal range for each subsection or series (meters).

Climatic parameters

Climatic parameters considered in this paper were average temperature, average of minimal and maximal daily temperature of the coldest month, average rainfall, seasonal summer rainfall. The latter has been compared with the evapotranspiration calculated with the Thonthwaite system. Data were collected from dispersed sources, being relevant for the European range those given by RIVAS-MARTÍNEZ & al., (1987), FONT (1983) and ELÍAS & RUIZ (1977). The data by Prieto (1983) were consulted for the Sierra Nevada of Spain. North African climatic data were collected from BENDAANOUN (1991), LE HOUEROU (1969), QUEZEL (1957), QUEZEL & al. (1994), SAUVAGE (1961) and URRESTARAZU (1984).

Temperature

The annual average temperature is extremely diverse for taxa included in this section (Fig. 2). It ranges from 1° to 3° of the *S. glacialis* subsp. *glacialis* stations to above or near 19° in localities of several species viz. Subects. *Arborescens* or *Leucantha.* The average temperature value for the whole of taxa is about 15.7° corresponding with the meso-Mediterranean circle.

Rainfall

The range of annual rainfall vary from 180 mm (arid) in some stations of *S. lasiantha* (Barranco de Caballar, Almería) to above 1800 mm (perhumid) in stations

of *S. lurida*, *S. hyssophifolia* subsp. *caureliana* or *S. hyssopifolia* subsp. *eynensis* (Fig. 3). The average taxon is a plant living in dry zones (app. 540 mm). It seems that different groups were able to colonize habitats under extreme ombroclimates, although subsection *Arborescens* is presumably the better represented in arid zones.

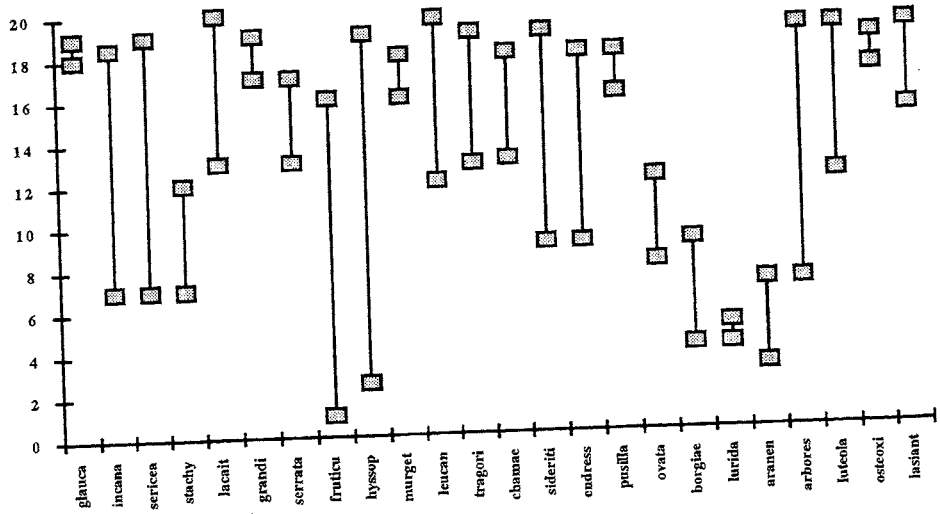

Fig. 2. Range of variation of average temperatures within the area of each subsection or series (Celsius).

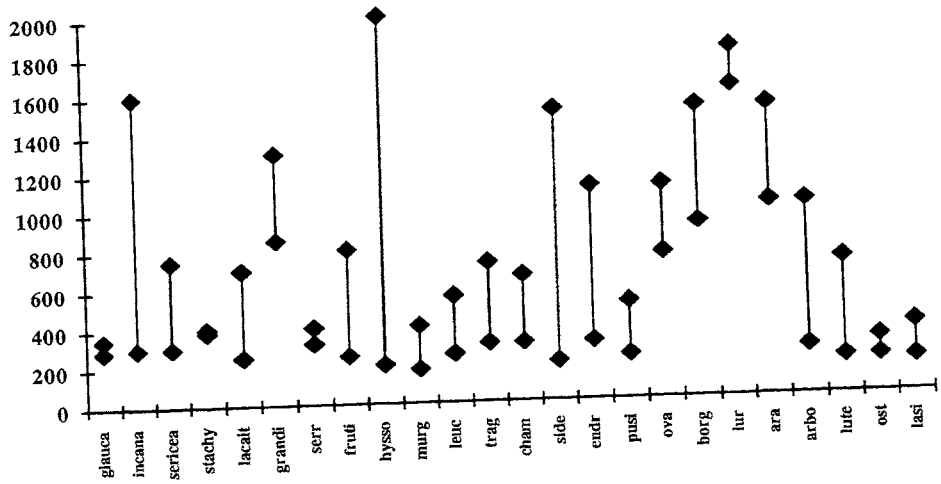

Fig. 3. Rainfall range within the area of each subsection or series (mm).

Vegetation circles and horizons and thermicity index

An index of thermicity based in the average temperature and the range of temperature of the coldest month (Fig. 4) has been used as a tool for defining vegetation circles and horizons (Rivas-Martìnez & al., 1987). The hypothetical average taxon inhabits the lower horizon of the meso-Mediterranean circle (average annual temperature of 15.7° and thermicity index app. 310) (Figs. 2, 4). Within the Mediterranean Region taxa of this section are found from the upper horizon of the infra-Mediterranean circle (>19° and 470 to 510) (*S. antiatlantica*) up to the upper horizon of the crioro-Mediterranean circle (<4° and < -70) (*S. glacialis* subsp. *glacialis*). The Atlantic-mid-European taxa are found from the middle horizon of the coline circle (>10° and 241 to 320) (with minor irradiation into the lower horizon or thermo-coline) (*S. brachycalyx, S. hyssopifolia* subsp. *vizcaina*) up to the upper horizon of the sub-Alpine circle (3° to 6° and -49 to -10) (*S. aranensis*).

Biogeographical provinces

The synthesis of RIVAS-MARTÍNEZ & al. (1987) was followed for the biogeographical typology of Europe, whereas a synthetic approach was taken for the North African biogeography, mainly based in the sectors recognised by BRAUN-BLANQUET & MAIRE (1924), Emberger (1939) and QUEZEL & SANTA (1963).

Limits of the Mediterranean species and use of the index of mediterraneity

It has been suggested the use of the mediterraneity index (RIVAS-MARTÍNEZ & al., 1987) for delimiting the borders of the Atlantic-Mideuropaean and the Mediterranean

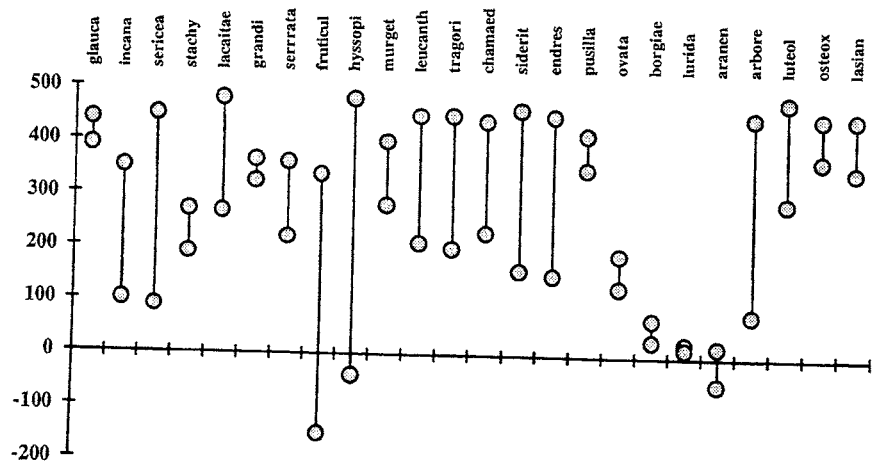

Fig. 4. Thermicity index range within the area of each subsection or series. It = 10(Tm+Mc+Mc)

Region. The value is calculated as an index of the summer drought, expressed in terms of the rate evapotranspiration / rainfall. Values of 2.5 and above are interpreted as a good indicator of mediterraneity. The average value calculated for the whole of taxa is about 22.6, hence corresponding to a typically Mediterranean locality. Some taxa are exclusive of the Atlantic-Mideuropaean Region, with index values comprised between 1.1 and 2.3 (*S. lurida, S. brachycalyx, S. hyssopifolia* subsp. pl). Most taxa are exclusively Mediterranean (Fig. 5), although several overlap their areas in both regions (*S. hyssopifolia* subsp. *castellana*).

Lithology

Although it has been recognised as a calcicole group, section *Sideritis* groups plants able to colonize a wide range of substrats, from marine limestone to granites. Several taxa are specialised in dolomites, others in micacites, sand dunes or even gypsum rich substrats.

Distribution by provinces

A summary of the distribution of taxa and relative abundance in the different provinces is given in Table 1. The Betic Province is the more rich in taxa (23, being 10 of these endemic exclusive). The Murcian-Almerian Province is second in order with 15 taxa, of which 9 are endemic. The Valencian - Catalonian - Provenzal Province is

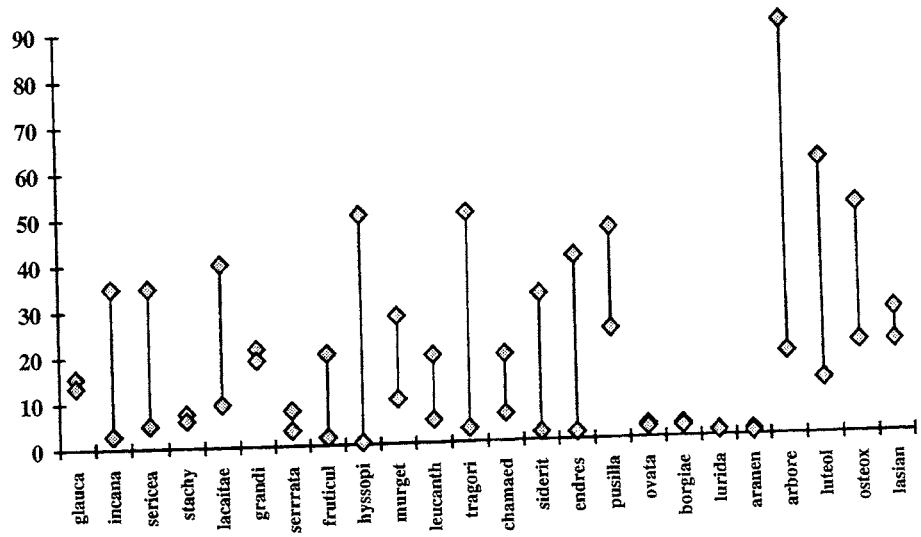

Fig. 5. Variation range of the mediterraneity index within the area of each subsection and series
Im_3 = ETP (Thornthwaithe) (June, July, August) / PP (June, July, August).

TAXA/PROVINCES	PIR	CAA	ORC	ARA	CPV	CMM	MUA	CIL	LEX	GOA	BET	ALP	LRC	SIC	RIF	OAR	KNU	HPL	MOA	HAA	MAA	AAT	ASA
I. Subsection *Glauca* Rivera and Obón	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
II. Subsectión *Gymnocarpae* Font Quer	–	–	–	–	3	2	–	–	–	–	2	–	–	–	3	4	4	5	6	5	–	–	3
Series *Incana* Obón and Rivera	–	–	–	–	1	2	–	–	–	–	2	–	–	–	2	2	3	4	5	5	–	–	2
Series *Sericea* Obón and Rivera	–	–	–	–	2	–	–	–	–	–	–	–	–	–	1	2	1	1	1	–	–	–	1
III. Subsection *Stachydioides* Rivera and Obón	–	–	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–
IV. Subsection *Lacaitae* Rivra and Obón	–	–	–	–	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	1	–	–
V. Subsection *Grandiflora* Rivera and Obón	–	–	–	–	–	–	–	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–	–
VI. Subsection *Serrata* Rivera and Obón	–	–	–	1	2	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
VII. Subsection *Fruticulosa* Obón and Rivera	1	–	–	2	3	3	–	–	–	–	3	–	–	–	–	–	–	–	1	1	–	–	–
VIII. Subsection *Hyssopifolia* Obón and Rivera	5	6	6	3	–	2	–	1	–	2	3	1	1	1	–	1	–	–	–	–	–	–	2
IX. Subsection *Leucantha* Rivera and Obón	–	–	–	–	2	3	5	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–
Series *Murgetana* Rivera and Obón	–	–	–	–	–	–	3	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Series *Leucantha* Rivera and Obón	–	–	–	–	1	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Series *Tragoriganum* Rivera and Obón	–	–	–	–	1	1	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–
X. Subsection *Chamaedryfolia* Rivera and Obón	–	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
XI. Subsection *Sideritis*	1	–	–	2	5	1	4	3	4	2	7	1	1	–	5	2	–	–	1	1	–	–	–
Series *Sideritis*	–	–	–	1	2	1	1	2	3	1	2	1	1	–	2	1	–	–	1	1	–	–	–
Series *Endressii* Rivera and Obón	1	–	–	1	3	–	–	1	1	1	3	–	–	–	2	–	–	–	–	–	–	–	–
Series *Pusilla* Rivera and Obón	–	–	–	–	–	–	3	–	–	–	2	–	–	–	1	1	–	–	–	–	–	–	–
XII. Subsection *Ovata* Rivera and Obón	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
XIII. Subsection *Borgiae* Obón and Rivera	–	–	1	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
XIV. Subsection *Lurida* Obón and Rivera	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
XV. Subsection *Aranensis* Obón and Rivera	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
XVI. Subsection *Arborescens* Rivera and Obón	–	–	–	–	–	–	4	–	1	2	3	–	–	–	3	1	–	1	1	–	1	1	–
Series *Arborescens* Rivera and Obón	–	–	–	–	–	–	1	–	–	2	1	–	–	–	–	–	–	1	1	–	–	1	–
Series *Luteola* Rivera and Obón	–	–	–	–	–	–	–	–	1	–	1	–	–	–	3	1	–	–	–	–	1	–	–
Series *Osteoxylla* Rivera and Obón	–	–	–	–	–	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Series *Lasiantha* Rivera and Obón	–	–	–	–	–	–	1	–	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–

Table 1. Number of taxa present in the different biogeographical units. Explanation of codes and total number of taxa for each province or unit: PIR (Pirenáica, 9), CAA (Cantabro-Atlántica, 7), ORC (Orocantábrica, 8), ARA (Aragonesa, 9), CPV (Catalano-Provenzal-Valenciana, 16), CMM (Castellano-Maestrazgo-Manchega, 12), MUA (Murciano-Almeriense, 15), CIL (Carpetano-Ibérico-Leonesa, 6), LEX (Luso-Extremadurense, 6), GOA (Gaditano-Onubo-Algarviense, 6), BET (Bética, 23), ALP (Alpina, 2), LRC (Liguro-Romano-Calábrica, 2), SIC (Sícula, 1), RIF (Rifaine, 12), OAR (Orano-Algérienne, 8), KNU (Kabylo-Numídique, 4), NPL (Hauts Plateaux, 6), MOA (Moyen Atlas, 9), HAA (Haut Atlas, 7), MAA (Maroc Atlantique, 2), AAT (Antiatlas, 2) and ASA (Atlas Saharien, 5).

third, because although having 16 taxa only 6 of these are endemic exclusive for this province. Eastern Rif is inhabited by 11 different taxa of this section, being 5 endemic exclusive. Finally in the group of relevant biogeographical units may be noticed the Pyrenaean Province (9 and 5) and the Castillian - Maestrazgoan - Manchegoan Province (12 and 4).

Minor subsections are easily localised in relation with certain provinces. The major subsections relatively widespread, although several centres could be recognised. The Atlas Region is a very important centre for the study of diversity within Subsection *Gymnocarpae* (6 taxa living in the Middle Atlas, of which 1 is endemic exclusive, and 5 taxa in the High Atlas of which 2 are endemic exclusive). A centre of diversity can be detected in the Murcian-Almerian Province for the Subsection *Leucantha* (6 taxa of which 4 are endemic exclusive).

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