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COMPARED IBERIAN DISTRIBUTION OF *TETRAMORIUM CAESPITUM* (LINNÉ, 1758) AND *TETRAMORIUM SEMILAEVE* ANDRÉ, 1881 *(HYM., FORMICIDAE)*

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RESUMEN

Distribución ibérica comparada de *Tetramorium caespitum* **(Linné, 1758)** *y Tetramorium semilaeve* **André, 1881** *(Hym., Formicidae).*

A partir de material de *T. caespitum* y *T. semilaeve* procedente de toda la península ibérica se compara la distribución geográfica de ambas especies considerando una división del temtono en zonas climáticas, y la distribución altitudinal empleando las tres grandes áreas de concentración de la información existentes. El grado de ubicuidad y las tendencias de distribución de estas dos especies difieren en el área geográfica considerada. Asimismo, existen evidencias que parecen apoyar estos hechos a una escala geográfica mayor, a partir del conocimiento que se tiene sobre su distribución en la región paleártica occidental.

Por otra parte, los resultados del estudio morfológico de ejemplares procedentes de diferentes altitudes parecen contradecir las hipótesis de convergencia y variación morfológica en relación con la altitud, propuestas para estas dos especies.

Palabras clave: *Formicidae, Tetramorium caespitum, Tetramorium semilaeve,* Distribución, Península Ibérica, Región Paleártica.

SUMMARY

Based on *T. Caespitum* and *T. Semilaeve* material from the whole Iberian peninsula, the geographical distnbution of both species is compared, taking into account the territory division in climatic zones. The altitudinal distribution is compared using the three large areas of information concentration that exist. The degree of ubiquity and distribution trends of these two species difer in the geographical area considered. Moreover, there exist evidences that seem to support these facts at a greater geographical scale, from the knowledge about their distribution in the occidental palaeartic region.

On the other hand, the results of the morphological study of specimens from different altitudes seem to contradict the hypothesis of convergence and morphological variation in relation with altitude, proposed for these two species.

Key words: *Formicidae, Tetramorium caespitum, Tetrarnorium semilaeve,* Distnbution, Iberian Peninsula, Palaearctic Region.

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INTRODUCTION

The genus *Tetramorium* Mayr, 1855, has colonized almost the whole world, with exception of the neotropical region (BOLTON, 1976 and 1980). For *Tetramorium caespitum* (LINNÉ, 1758) the distribution is limited to the holarctic region (POLDI, 1980) and is more restricted in the case of *Tetramorium semilaeve* André, 1881: mediterranean area, Balkans and central Asia (BERNARD, 1968; BARONI URBANI, 1971; AGOSTI & COLLINGWOOD, 1987).

In the Iberian peninsula, over the historical basis of CEBALLOS (1956) and COLLINGWOOD & YARROW (1969), and the proposed criteria for the identification of COLLINGWOOD (1978), both species have been recorded many times (reviewed in LÓPEZ, 1988).

In previous works (LÓPEZ, in press a and b) some discrepancies were manifested with those differential criteria, which are believed to conduct sometimes to misidentifications of the taxa treated here, and new taxonomical images (i. e., redenfinitions of the criteria for the diagnosis) of them were offered. Obviously, it is interesting to compare these images (based on morphological characters) with the distribution of the two species, in order to determine wether or not the distribution supports the new taxonomical conception. This is the object of this work.

MATERIAL AND METHODS

Both the taxonomical criteria followed for T. *caespitum* and *T. semilaeve* and all the specimens (with their records) used for the present study are included in the previous works cited (LÓPEZ, 1988, in press a & b.).

The unit considered for the comparison of the geographical distributions is the 100 Km^2 UTM square —called «plot»— in such a manner that two different plots are considered more significant than two different localities in the same plot to reflect the discrepancies or similarities on the scale used (the whole Iberian peninsula). To quantify this, the geographical division of the Iberian peninsula in four zones according to climatic conditions of aridity or humidity offered by LAUTENSACH & MAYER (1960) is considered. The number of plots in each zone divided by the total of each species is the relative abundance in a given climatic region, and it is expressed as a percentage.

It is important to point out that there exists a lack of spatial homogeneity in the available information about records over the temtory studied, because of the investigators' limited mobility, as it often occurs. Nevertheless, in all the plots where samples were taken (in an intensive manner or not) the same probability of finding one or the other species is assumed, because the nesting habits and the conspicuousness of both are similar and because one of them has never been searched for with preference over the other.

Another fact is the different size of the climatic zones, which affects the number of plots falling into each one. But the goal of the comparison is the relative abundance of the two species for a same zone.

For the confrontation of the altitudinal distributions, only (and separately) the main focuses in which the information is concentrated are used. This use of restricted areas dominated by mountain systems allows the comparisons of altitude within each one of them. Moreover, due to the greater intensity of samplings in these areas, the complete altitudinal range is covered, with an acceptable detail scale of 100 meter intervals (unit in the analysis) and with an altitude record accuracy better than in any other place.

RESULTS AND DISCUSSION

COMPARED GEOGRAPHICAL DISTRIBUTION

The resulting distributions of the species can be seen in the maps of fig. 1. Each circular point represents a plot.

An inmediate observation is the existence of three zones of concentration of information in the northeast, center and south of the territory (as previously noted), which correspond basically to the recent faunistic studies of a certain spread (ESPADALER, 1979; ACOSTA, 1980; TINAUT, 1981; MARTÍNEZ, 1984; ORTIZ, 1985; PASCUAL, 1986). Nonetheless —as occurs in a bigger geographical scale (world-wide or occidental palaearctic)— *T. caespitum* shows itself to be more ubiquitous in the Iberian peninsula than *T. semilaeve*, which seems to abound more in the southern zone. In relation to climatic conditions (table 1 and figure 2), the former is more abundant than the latter in zones 1 and 2 (wetter) and the contrary occurs in zones 3 and 4 (drier). Furthermore, if these zones are grouped into the two large bioclimatic regions of the pensinsula —eurosiberian and mediterranean— the contrasts are even more marked: a fourth of the plots of *T. caespitum* fall within the first of these regions while only 1 of the 87 *T. semi-*

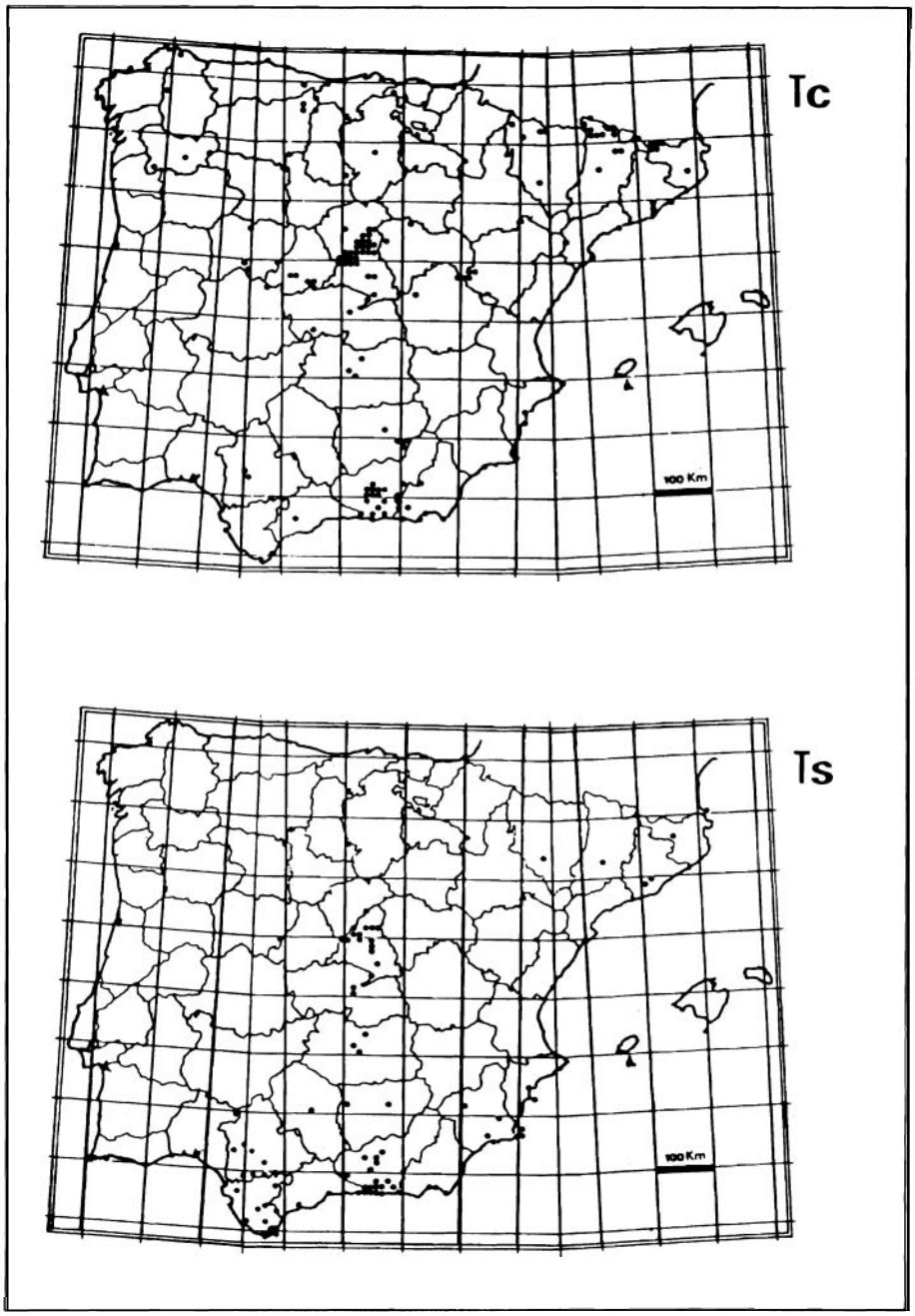

FIGURE 1. Geographical **distribution of T. *caespitum* (Tc) and *T. semilaeve* (Ts) in the Iberian peninsula. Each circular point represents a plot (100 Km² UTM square).**

Distribución geográfica de *T. caespitum* (Tc) *y T. semilaeve* (Ts) en la península ibérica. Cada punto representa una cuadrícula UTM de 100 Km².

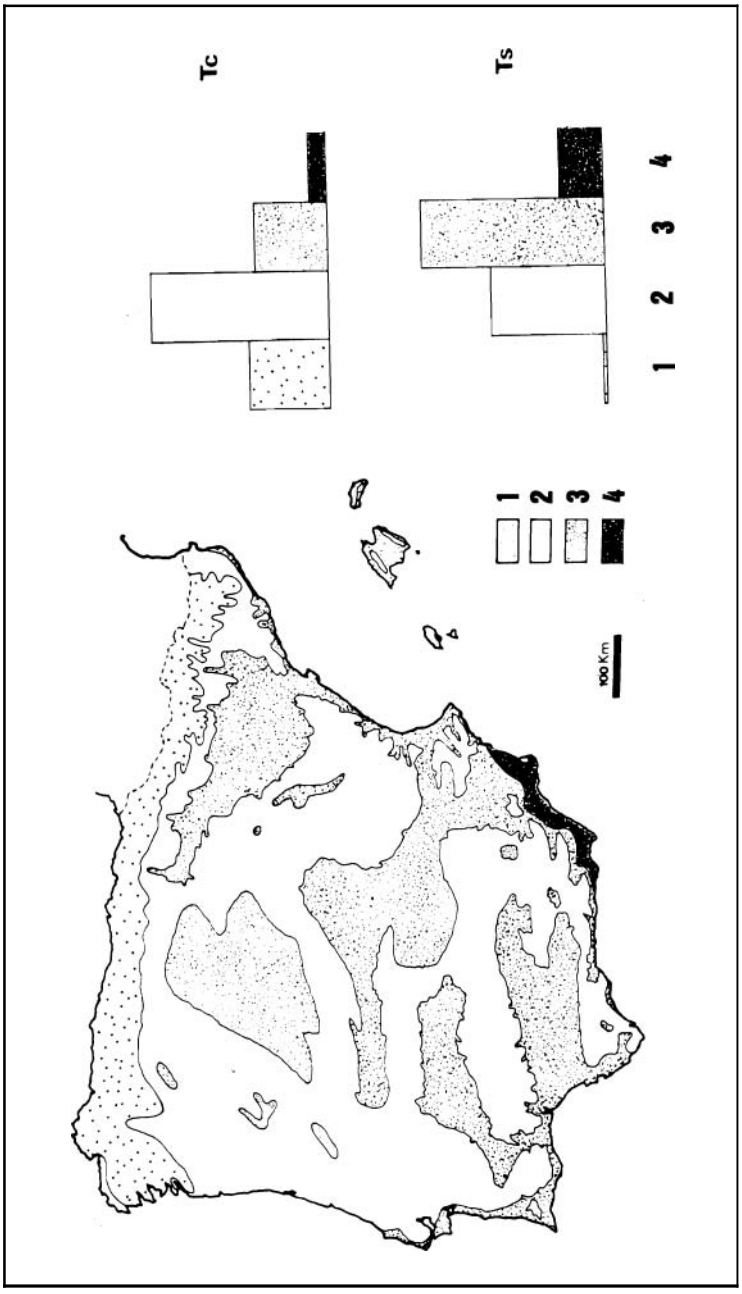

FIGURE 2. Left./Climatic zones of the Iberian peninsula according to humidity and aridity (redrawn from LAUTENSACH & MAYER, 1960). 1 = Holohumid; 2 = Semihumid; 3 = Semiarid; 4 = Extreme semiarid. Right. Relative abundance of plots (UTM squares) with presence of each species in the four zones considered. Tc = T. *caespitum*; Ts = T. semilaeve.

Izquierda: Zonas climáticas de la península ibérica según la humedad y la aridez (redibujado de LAUTENSACH & MAYER, 1960). 1 = Holohúmeda; 2 = Semihúmeda; 3 = Semiárida; 4 = Semiárida extremada. Derecha: Abundancia relativa de cuadrículas UTM con presencia de cada especie en las cuatro zonas consideradas. Tc = T. caespitum; Ts = T. semilaeve.

TABLE 1. **Numbers and percentage (relative abundance) of plots (UTM squares) in each climatic region considered (see text) and grouped into the two large bioclimatical regions of the Ibenan peninsula. Tc = T. *caespitum;* Ts = *T. semilaeve.***

Números y porcentajes (abundancia relativa) de cuadrículas UTM en cada región climática considerada (ver texto) y agrupados en las dos grandes regiones bioclimáticas de la península ibérica. Tc = *T. caespitum;* Ts = *T. semilaeve.*

	HOLOHUMID (1)	SEMIHUMID (2)	SEMIARID (3)	EXTREMATE SEMIARID (4)	TOTAL
Tc	32 / 23 %	70 / 51%	29 / 21%	7 / 5%	138 / 100%
Ts	1 / 1%	29 / 33%	46 / 53%	11 /13%	87 / 100%
	EUROSIBERIAN		MEDITERRANEAN		
Tc	32 / 23%		106 / 77%		138 / 100%
Ts	1 / 1%		86 / 99%		87 / 100%

laeve squares is on it. Thus, both species seem to exhibit different trends in their distribution. Though they are not in different and sharply disjointed areas, their preferences are unequal.

COMPARED ALTITUDINAL DISTRIBUTION

As table 2 and fig. 3A show, a first remarkable fact is the presence of T. ***caespitum*** in the whole altitude range, which is a sign of its adaptability. The absences (-) are undoubtedly due to the insufficience of the data. There is no reason to suppose that this species can be absent at 200,500 or 1.300 meters high while appearing in all of the other intervals between 0 and 2.500.

On the other hand, ***T. semilaeve*** has an altitude upper limit, different in each zone. This maximum point increases from north to south: 1.100, 1.500 and 1.900, repectively. It seems logical to suppose that its absences below this maximum are also due to a lack of data. And the probability of insufficient data being the cause at altitudes above this limt is indeed much smaller. The tops reached by ***T. semilaeve*** correspond to the *«montano»* bioclimatic level in the northern zone (eurosiberian) and to the *«supramediterráneo»* level in the central and southem zones (mediterranean) (RIVAS-MARTÍNEZ, 1963 and 1987; SOLER i SABARIS ***et al.,*** 1968; VALLE & DE LA GUARDIA, in press; MOLERO-MESA & PÉREZ-RAYA, 1987). The environmental conditions are similar in the three cases, because the decrease in latitude is compensated with an increase in altitude. These seem to be the limit conditions for ***T. semilaeve,*** which is concordant with the assumption of its being a more xeric species than ***T. caespitum.***

The altitudinal image exposed is reinforced taking into account the quantitative data of findings abundance, at different altitudes, of the material used in the Iberian faunistic works (see references above). T. ***caespitum*** is more and more dominant when going up in altitude. And the same occurs for ***T. semilaeve*** when altitude decreases. Thus, though the altitudinal limits for both species are relatively broad, it seems that a limiting zone exists for each one, where the conditions are not propitious. These results are concordant with all the known data about altitudes in the occidental palaearctic region for ***T. caespitum*** (BERNARD, 1946; BARONI URBANI, 1969 and 1971; COLLINGWOOD, 1971,1974 and 1979) and ***T. semilaeve*** (BARONI URBANI, 1964; BERNARD, 1973). All of them lead to a general model of distribution directed by the tendencies of searching for an optimum or preferential zone (with broad limits), which is different for each species despite of the large overlapping between them, because of the greater or smaller ubiquity of each one. In the graphic representation of this model (figure 3B) ***T. caespitum*** occupies all the altitudes in the southem zone of the region, has a limit in the central zone, and only occupies

TABLE 2. Pressence (+) / absence (-) data of T. *caespitum* and *T. semilaeve* in the Iberian peninsula mountain systems. The lack of symbols in an interval corresponds to a lack of information for it (there is such a lack in the 0-500 meter interval of the central zone because these altitudes do not exist). Alt. = Altitude (meters above the sea level); N = North; C = Center; S = South; Tc = T. *caespitum; Ts = T. semilaeve.*

Datos de presencia (+) / ausencia (-) para T. *caespitum* y *T. semilaeve* en los sistemas montañosos de la península ibérica. La ausencia de símbolos en un intervalo corresponde a una carencia de información (existe una carencia tal en el intervalo 0-500 metros de la zona centro debido a que estas altitudes no existen). Alt. = Altitud (metros sobre el nivel del mar); N = Norte; C = Centro; S = Sur; Tc = T. *caespitum*; Ts = *T. semilaeve.*

ALT.	N		C		S	
	Tc	Ts	Tc	Ts	Tc	Ts
2500					+	-
2400	+	-				
2300	+	-	+	-	+	-
2200	+	-	+	-	+	-
2100	+	-	+	-	+	-
2000	+	-	+	-	+	-
1900	+	-	+	-	+	+
1800	+	-	+	-	+	-
1700	+	-	+	-	+	-
1600	+	-	+	-	+	-
1500	+	-	+	+	+	-
1400	+	-	+	+	+	+
1300	+	-	+	-	-	+
1200	+	-	+	+	+	+
1100	+	+	+	+	+	-
1000			+	+	+	+
900			+	+	+	-
800	+	-	+	+	+	-
700			+	+	+	+
600			+	+	+	+
500	-	+	+	+		
400	+	-				
300	+	+			+	+
200	+	+			-	+
100					+	+
0	+	+			+	+

the lowest altitudes in the northern zone. At upper latitudes, the species can disappear (BARONI URBANI & COLLINGWOOD, 1977).

A reduced version of this phenomenon is that found in the different altitudes reached in opposed slopes of a mountain system orientated in the east-west direction (DU MERLE, 1978; PASCUAL, 1986).

MORPHOLOGICAL PROBLEMS RELATED TO ALTITUDE

From the study of the material used in this work arguments arise in favour of rejecting the two different phenomena described for *T. caespitum* and *T. semilaeve* in the Iberian peninsula.

The first is the phenomenon opposed to the character displacement (BROWN & WILSON, 1956) exposed by ACOSTA (1980), based in the supposed morphological convergence of both species in the co-occurence localities. The use of the identification characters offered in LÓPEZ (in press b) shows that they are misidentifications of the samples and that there does not exist a variable T. *semilaeve* approaching to *T. caespitum*, but rather that it is the proper *T. caespitum*. In a careful study of the specimens of both species for the same locality of 34 different places all over the peninsula (table III) no morphological convergence was observed in any case, the species being clearly differentiated by their morphology.

The second question, though not independent of the preceding one, is the rugosity and coloration variation with altitude. Both ESPADALER (1979) and MARTÍNEZ (1984) talk about altitudinal zones where *T. caespitum* is «typical», using this term for those individuals without diluted rugosity and which are not light-coloured. Such a relation with altitude has been impossible to detect in the material studied (including that used by these authors). The rugosity and coloration variations appear in very diverse localities and it seems possible that other factors, such as the individual or colonial degree of maturity or the possible taxonomical heterogeneity of T. *caespitum* (LÓPEZ, in press a), could influence these morphological characters in a decisive way.

As a general conclusion, it can be affirmed that both species keep themselves clearly differentiated in all places of the distribution area certain diagnostical characters remaining constant.

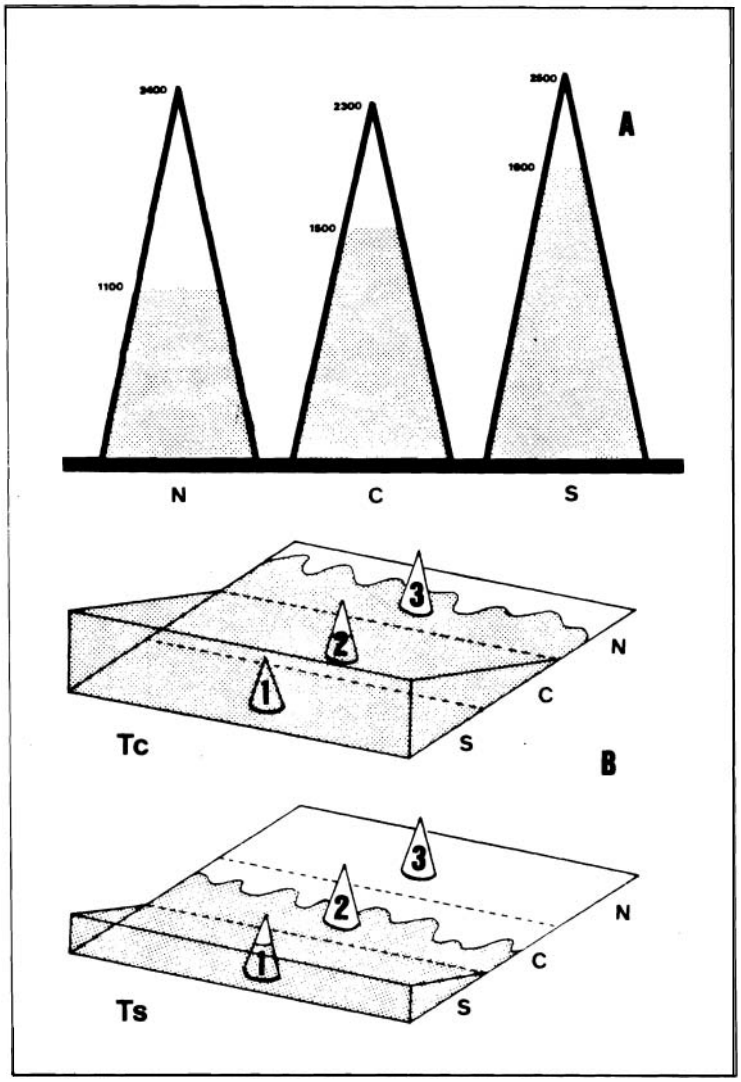

FIGURE 3. A. Altitudinal distribution of T. ***caespitum*** and ***T. semilaeve*** in the zones considered (see text) of the north (N), center (C) and south (S) of the Iberian peninsula. The altitude marked in the top of each mountain system represents the maximum point for T. ***caespitum,*** and that indicated by the shaded area, the correspondent to T. ***semilaeve.*** Numbers indicate meters above sea level. B. Graphical distribution model for T. ***caespitum*** (Tc) and ***T. semilaeve*** (Ts) in the occidental palaearctic region. Each of the elevations represents an hypothetical mountain systems group. The horizontal plane level corresponds to that of the sea (0 meters). «1» includes all of the Iberian peninsula mountain systems. Tc = T. ***caespitum; Ts = T. semilaeve;*** **1, *2*, 3** = Mountain systems; N, C, S = North, center and south of the occidental palaearctic region.

A. Distribución altitudinal de T. *caespitum* y ***T. semilaeve*** en las zonas consideradas (ver texto) del norte (N), centro (C) y sur (S) de la península ibérica. La altitud marcada en la cima de cada sistema montañoso representa la cota máxima alcanzada por T. *caespitum*, y la indicada por el área sombreada la correspondiente a T. *semilaeve*. Las cifras indican metros sobre el nivel del mar. B. Modelo gráfico de distribución para T. caespitum (Tc) y T. semilaeve (Ts) en la región paleártica occidental. Cada una de las elevaciones representa un hipotético grupo de sistemas montañosos. El nivel del plano horizontal se corresponde con el del mar (0 metros). En «1» se incluyen todos los sistemas montañosos de la península ibérica. Tc = ***T. caespitum;*** Ts = ***T. semilaeve;*** 1, 2, 3 = Sistemas montañosos; N, C, S = Norte. centro y sur de la región paleártica occidental.

TABLE 3. Localities (with their altitudes) where T. ***caespitum*** and ***T. semilaeve*** have been found in co-occurrence.

Localidades (con sus altitudes) donde T. *caespitum* y *T. semilaeve* han sido halladas en co-ocurrencia.

PROVINCE	LOCALITY	ATITUDE
ALICANTE	Alicante	0
	Playa de Urbanova (Alicante)	0
ALMERÍA	Almería	0
	Cabo de Gata	0
BARCELONA	Bellaterra	200
	Sant Cugat del Vallés	200
CÁDIZ	Sierra Ojén	500-700
CIUDAD REAL	Ciudad Real	600
	Pozuelo de Calatrava	600
	Tablas de Daimiel	600
GRANADA	Cázulas (Otívar)	300
	Dilar	700
	Motril	0
	Salobreña	0-100
	Sierra Alfagüara	1400
HUESCA	Sariñena	200
JAÉN	Sabiote	600
MADRID	Aranjuez	500
	Barranca de Navacerrada	1500
	El Escorial	1100
	Embalse de El Vellón	800-900
	Hoyo de Manzanares	1000
	Madrid	700
	Manzanares El Real	900
	Miraflores de la Sierra	1100
	Navacerrada	1200
	Pinares de Navafría	1200
	Puerto de Malagón	1500
	Redueña	800
	Sta. María de la Alameda	1400
MURCIA	Bolnuevo	0
PALENCIA	Monte de Tabanera	800
SEVILLA	Dos Hermanas	200
TOLEDO	Toledo	600

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