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Is *Allium ebusitanum* (Alliaceae) an endemic species from Ibiza?

by

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Abstract

An analysis of the qualitative and quantitative characters of *Allium sphaerocephalon* group in Western Mediterranean is presented. *Allium durandoi* is considered to be conspecific with *A. ebusitanum*, of which it becomes a synonym. A map of this species and a key to the group is provided.

Keywords: *Allium ebusitanum*, *Allium durandoi*, distribution, taxonomy.

Resumen

Se sinonimiza *Allium durandoi* a *A. ebusitanum.* Se compara esta especie con las restantes del grupo *Allium sphaerocephalon* en el Mediterráneo occidental, analizando los principales caracteres cuantitativos y cualitativos. Se prepara un mapa de *A. ebusitanum* y una clave de identificación del grupo.

Palabras clave: *Allium ebusitanum*, *Allium durandoi*, distribución, taxonomía.

Introduction

The genus *Allium* L. comprises 500-600 species, which are mainly distributed in the northern hemisphere (Wilde-Duyfjes, 1977). Section *Allium* encompasses those species of *Allium* which have a well developed bulb, leafy stem and staminal filaments in two whorls, the outer nearly always simple and the inner tricuspidate (Mathew, 1996). According to Mathew (1996), it is impossible to produce an infra-sectional classification of sect. *Allium* at the present state of knowledge. However, some informal groups of species can be recognized. The "Sphaerocephalon Group" could be recognized by bulbs with non reticulate-fibrous tunics hollow leaves and persistent spathe, with two segments. This group includes 12 species widespread around the Mediterranean from Portugal and Morocco to SE Ukraine, E Turkey and Egypt (Mathew, 1996). Four of these species are present in Western Mediterranean: *A. ebusitanum* Font Quer, *A. melananthum* Coincy, *A. pruinatum* Link ex Spreng., and *A. sphaerocephalon* L.

According to Mathew (1996), *A. sphaerocephalon* shows a considerable amount of variation, some of which can be correlated with geographical distribution. Stearn (1980) recognised three subspecies: *sphaerocephalon*, *arvense* (Guss.) Arcangeli [Sicily to S Turkey] and *trachypus* (Boiss. & Spruner) K. Richter [Greece and SW Turkey]. Wilde-Duyfjes (1977) synonymized subsp. *arvense* to subsp. *sphaerocephalon* and recognised other two subspecies: subsp. *durandoi* (Batt. & Trab.) Wilde-Duyfjes [Algeria and Tunisia] and subsp. *curtum* (Boiss. & Gaill.) Wilde-Duyfjes [S Turkey to Egypt]. Finally, Mathew (1996) accepted four subspecies: *sphaerocephalon*, *arvense, durandoi* and *trachypus* and preferred specific rank to subsp. *curtum.* According to Wilde-Duyfjes (1977) no authentic material of subsp. *arvense* has been located neither in NAP nor in FI. However, it was described as having white flowers, a subspherical to ovoid inflorescence, and stamens subequal to the tepals. These characters fall within the variability of subsp. *sphaerocephalon*. This view of Wilde-Duyfjes (1977) is here accepted and thus only two subspecies of *A. sphaerocephalon* are considered in Western Mediterranean: subsp. *sphaerocephalon* and subsp. *durandoi.*

The genus *Allium* has been monographied in NW Africa (Wilde-Duyfjes, 1977) and Iberian Peninsula and Balearic Island (Pastor & Valdés, 1982). Additionally, *A. ebusitanum* has been detailed studied in some aspects by Miceli & Garbari (1989), Rosselló & al. (1993) and Sáez & Rosselló (2001). However, this

rare species has not previously compared with those of NW Africa. The aim of this paper is to clarify the taxonomic status of *A. ebusitanum*, providing valuable characters to distinguish this species from its relatives of Western Mediterranean.

Materials and methods

This study is based on herbarium specimens from the following herbaria: ABH, BC, COI, G, HJBS, LISU, MA, P, SALA and private herbarium of N. Torres (Appendix 1). Besides the herbarium material, I have used some literature reports for mapping *A. ebusitanum* (Appendix 2).

Sixty six quantitative characters were measured and recorded using a Mitutoyo CD-15CD digital caliper. The matrix of crude data is available at http://www.rjb.csic.es/floraiberica/PHP/asociados.php. Some well-preserved specimens of each species were selected as OTUs: 10 specimens of *A. ebusitanum,* 6 of *A. durandoi,* 10 of *A. melananthum,* 9 of *A. pruinatum* and 15 of *A. sphaerocephalon* (Appendix 1). To represent the variability of each descriptor within species, box-plots containing medians and percentiles were prepared using the Statistica package. The parameters used as descriptors were: ratio bulb width / bulb length, spathe length, inflorescence length, pedicel length, outer and inner tepal length, outer and inner filament length, central branch of inner filament length, lateral branch of inner filament length, anther length and capsule length. Principal Components Analysis (PCA) were carried out with the matrix of standarized descriptors. For PCA a correlation matrix was obtained from the initial matrix, eigenvectors were extracted, and the OTU's were plotted. This method was used to detect primary patterns among all the OTU's, because this method requires no a priori knowledge of the origins of the OTU's and will reveal any groups. Separation of the taxa was also tested by means of Discriminant Analysis (DA). This method (Sneath and Sokal, 1973), which requires a priori assignment of OTU's to groups, indicates whether the recognized groups are statistically definable entities or whether there is too much variation within groups to allow separation. For DA, the raw matrix was obtained, the results sorted in discrete groups, and calculations carried out using the Statistica package version 6 (www.statsoft.com).

Results and Discussion

Box-plot of the most discriminat quantitative characters are shown in Fig. 1 and 2. *Allium sphaerocephalon, A. ebusitanum* and *A. durandoi* overlap in the ratio width bulb /length bulb, spathe length, inflorescence length, pedicel length, flower number, outer and inner tepal length, outer and inner filament length, central and lateral branch of inner filament length, anther length and capsule length. *Allium sphaerocephalon* shows inner filaments with a central branch longer than lateral ones, whereas *A. ebusitanum* and *A. durandoi* have usually shorter central branches. Additionally, *A. sphaerocephalon* has more exerted stamens than *A. ebusitanum* and *A. durandoi*. *Allium melananthum* has short spathes, inflorescence, tepals, filaments, anthers, and capsules. Tepals and filaments length are also short in *A. pruinatum*. However, *A. melananthum* shows shorter tepals and longer filaments than *A. pruinantum*. Thus its stamens (including anthers) are clearly exerted whereas in *A. pruinatum* they are included. Additionally, the lateral branch of the inner filament is longer in *A. pruinatum* than in *A. melananthum*.

Quantitative characters provide significative differences for *A. pruinatum*, *A. melananthum* and the subgroup of *A. sphaerocephalon, A. ebusitanum* and *A. durandoi.* Among the species of this subgroup, *A. sphaerocephalon* is weakly differentiated from the other two, and there are not noticeable differences between *A. ebusitanum* and *A. durandoi.*

Among qualitative characters tepal color is very useful to identify *A. melananthum*. This species has dark-purple to blackish-purple tepals (Fig. 3a) which are evident even in herbarium specimens. The remaining species studied here show pink to purple tepals (Table 1; Fig. 3b-d). *Allium sphaerocephalon* has bulblets stalked and enclosed within a sheath on the lower part of the stem, which have the appearance of a second bulb (Table 1; Fig. 4c). *Allium pruinatum*, and *A. melananthum* have 1-3 bulblets, are stalked or sessile (Table 1; Fig. 4a, b). However, these bulblets are never enclosed within sheath on lower part of the stem. Finally, *A. ebusitanum* and *A. durandoi* have no basal bulblet (Table 1; Fig. 4d, e). Thus, no significative differences have been found among quantitative and qualitative characters between *A. ebusitanum* and *A. durandoi*.

A Principal Component Analysis (PCA) reveals that 77.24 % of the observed variation is explained by three factors (53.43, 12.59 and 11.22 %, respectively). The characters that contribute considerably to the three first axes are as follows: Factor 1: inner tepal length, outer and inner filament length, and central branch of inner filament length; Factor 2: spathe length and inflorescence length; Factor 3: ratio bulb width / bulb length. The scatterplot for the first and

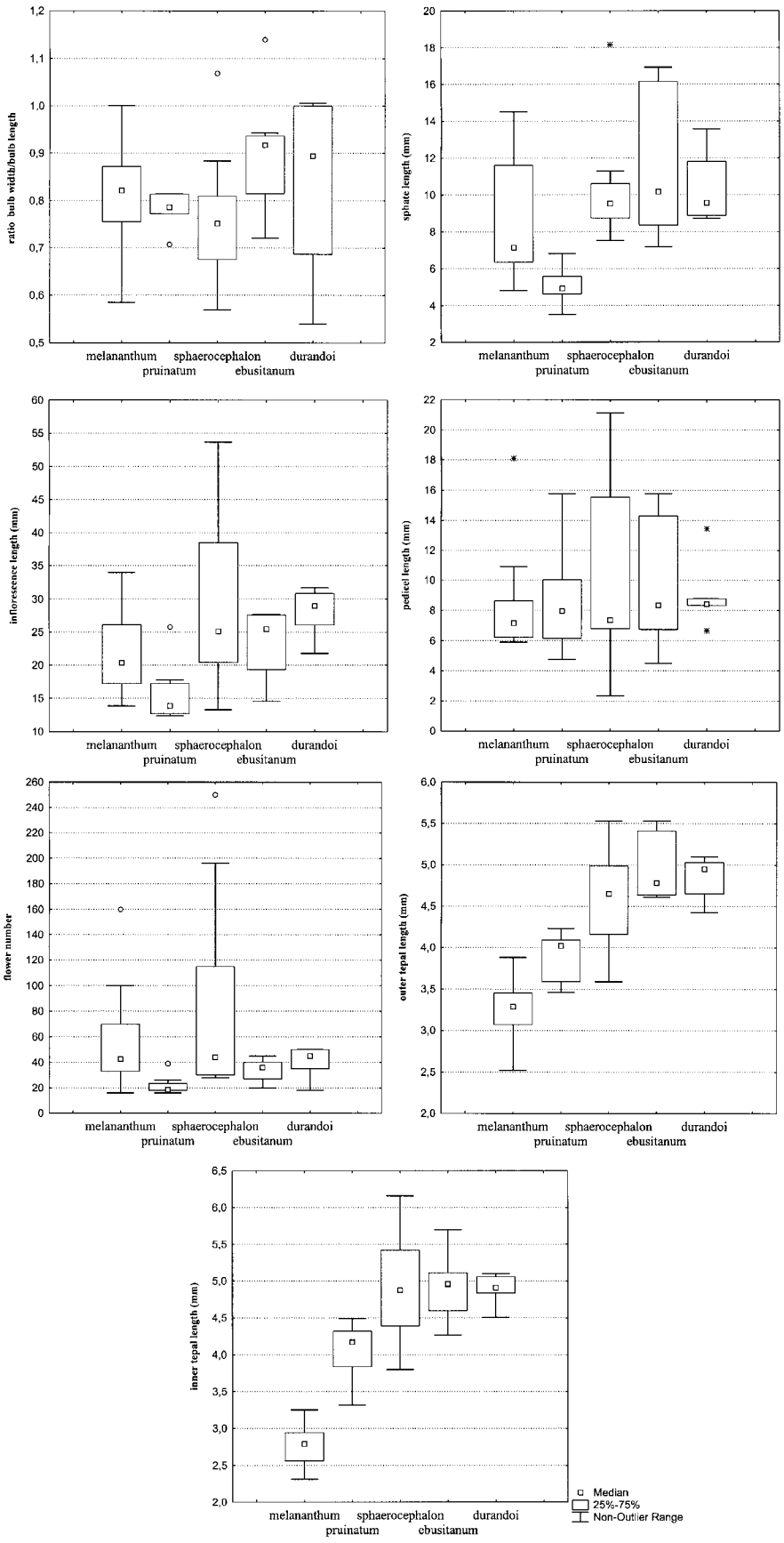

Fig. 1. Box-plot of the most discriminant quantitative characters of *Allium sphaerocephalon* group in Western Mediterranean.

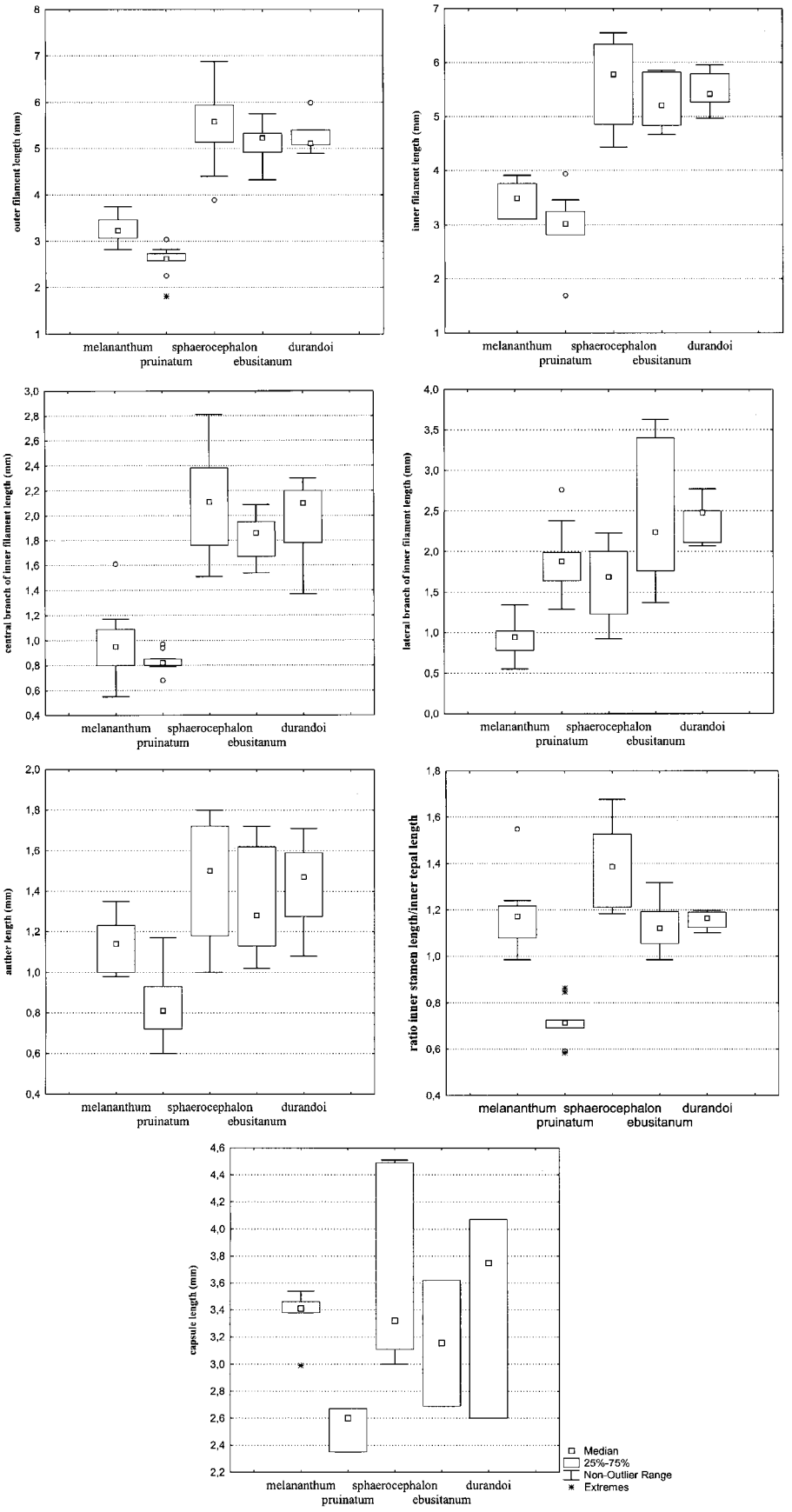

Fig. 2. Box-plot of the most discriminant quantitative characters of *Allium sphaerocephalon* group in Western Mediterranean.

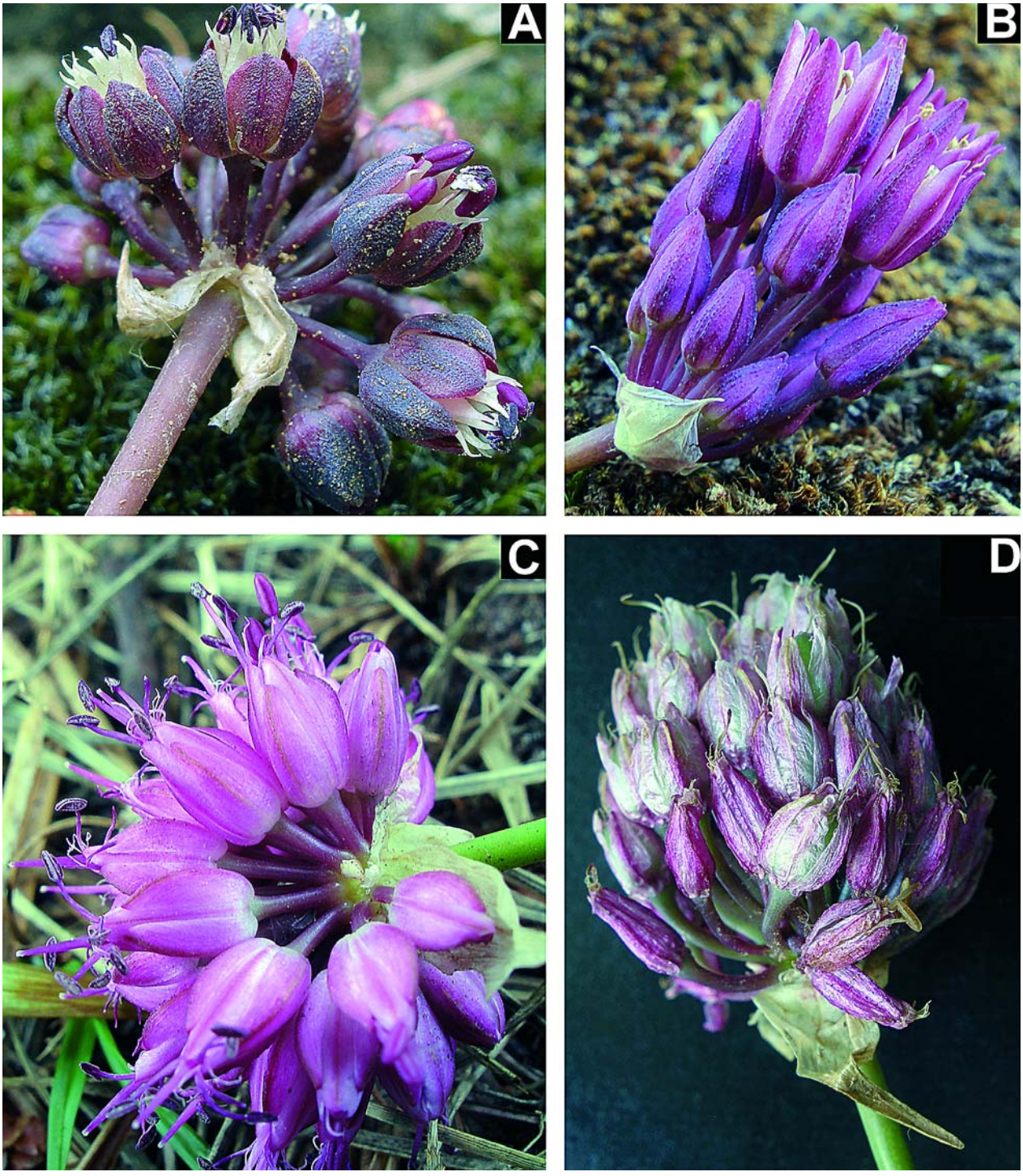

Fig. 3. Photographs of flowers of: **a,** *Allium melananthum* [based on *Aedo 12872* (MA)]; **b,** *A. pruinatum* [based on *Aedo 12853* (MA)]; **c,** *A. sphaerocephalon* [based on *Aedo 12882* (MA)]; **d,** *A. ebusitanum* [based on *Torres s.n.* (MA)].

second PCA axis (Fig. 5) shows three groups. The first group contains specimens determined as *A. melananthum*, the second group includes the OTUs identified as *A. pruinatum*, and the third group comprises the specimens determined as *A. sphaerocephalon* mixed with those of *A. ebusitanum*. The same groups are shown in the scatterplot for the second to third PCA (plot not show), although *A. sphaerocephalon* and *A. ebusitanum* are more clearly separated.

Table 1. Qualitative characters in *Allium sphaerocephalon* group.

	A. sphaerocephalon	***A. melananthum***	***A. pruinatum***	***A. ebusitanum***	***A. durandoi***
basal bulbets	1-5, stalked and enclosed within sheath on lower part of the stem	1-2, stalked but not enclosed within sheath	1-3, stalked or sessile but not enclosed within sheath	no bulbets	no bulbets
inflorescence shape	spheric or hemispheric	spheric	spheric or hemispheric	spheric	spheric
inflorescence bulbets	sometimes present	no bulbets	no bulbets	rarely present	not seen
tepal shape	elliptic	elliptic	elliptic	elliptic	elliptic
tepal color	pink to purplish	dark-purple to blackish purple	purplish	pink	pink
anther color	purplish	dark-purple	pale-purple	purplish	purplish

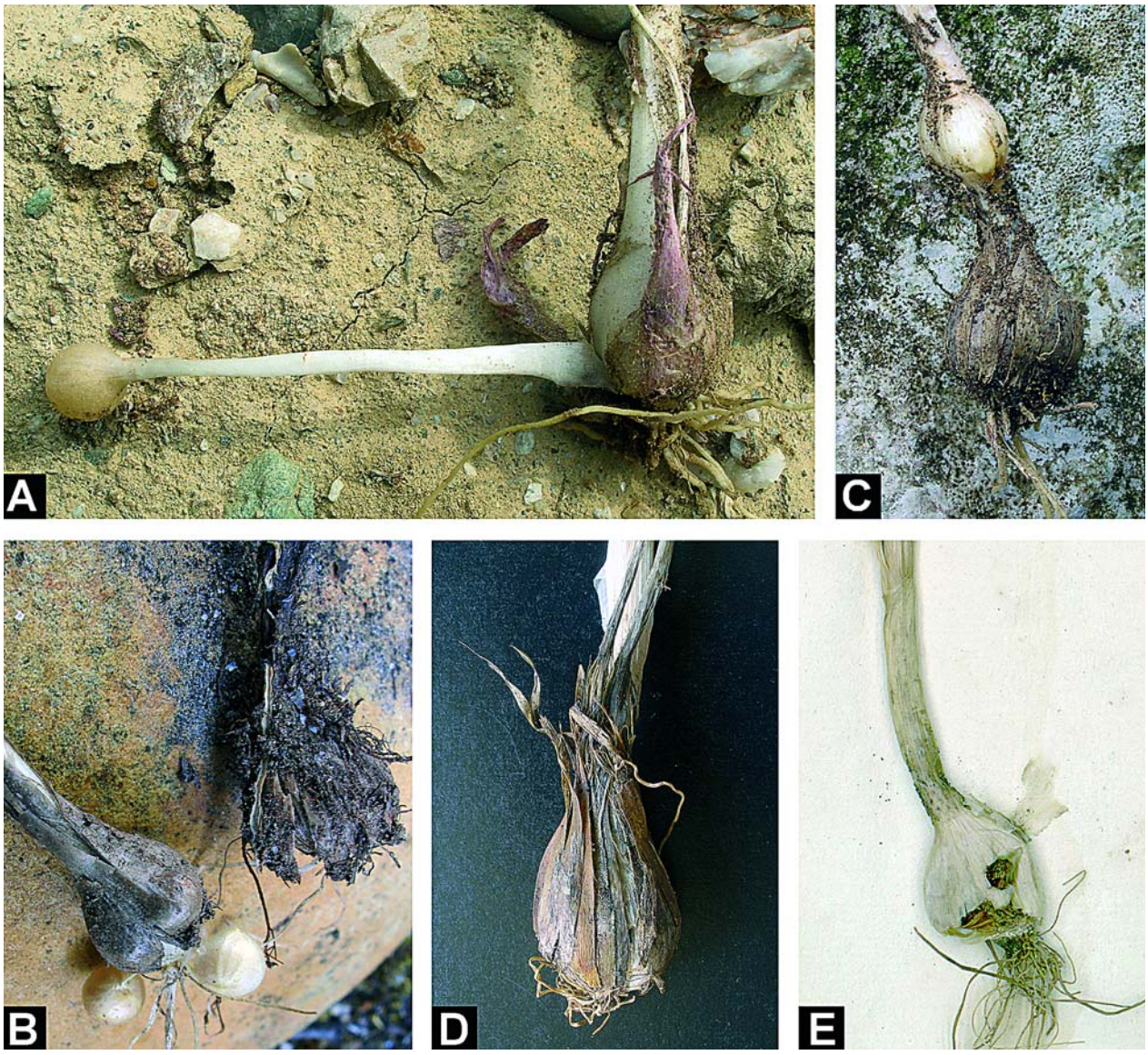

Fig. 4. Photographs of bulbs of: **a,** *Allium melananthum* [based on *Aedo 12790* (MA)]; **b,** *A. pruinatum* [based on *Aedo 12853* (MA)]; **c,** *A. sphaerocephalon* [based on *Aedo 12882*(MA)]; **d,** *A. ebusitanum* [based on *Torres s.n.* (MA)]; **e,** *A. durandoi* [based on *Maire s.n.* (P)].

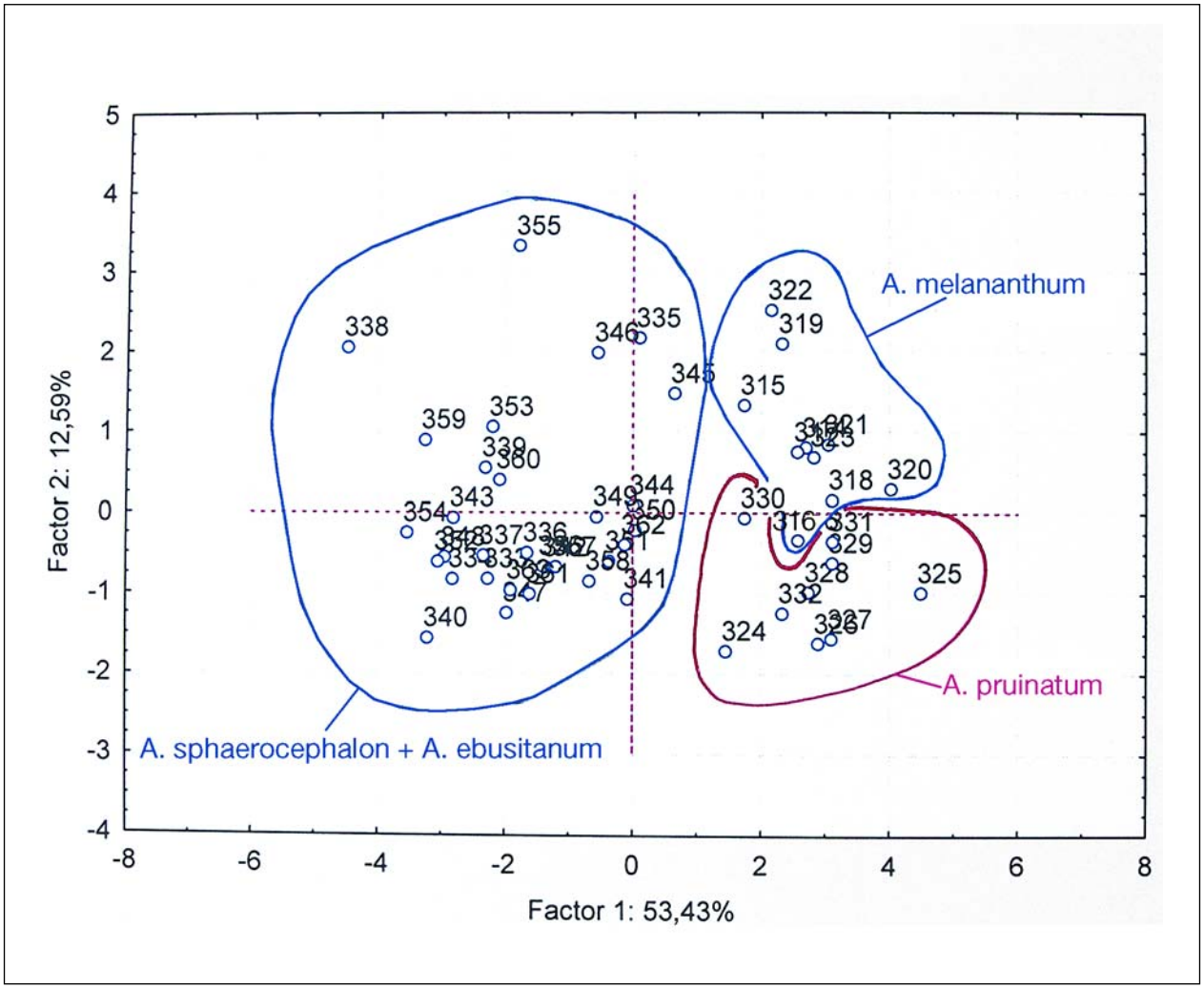

Fig. 5. Plot of the first two axes of Principal Component Analysis (PCA) of *Allium sphaerocephalon* group in Western Mediterranean.

A discriminant analysis (DA) including specimens of *A. durandoi* into *A. ebusitanum* showed a 100% of corrected classified cases (Fig. 6; Table 2). On the contrary, if *A. ebusitanum* and *A. durandoi* are separated a priori in different groups, DA corrected classified 40% of specimens of *A. durandoi* including the remaining in *A. ebusitanum* and *A. sphaerocephalon* (plot not shown).

According to Rosselló & al. (1993) some previously reported differences between *A. ebusitanum* and *A. sphaerocephalon* are too variable to discriminate between taxa. These authors mentioned that flower number, inflorescence shape and perigon shape are not useful to differentiate between *A. ebusitanum* and *A. sphaerocephalon*, which are in accordance with the results of this study. Thus these authors considered *A. ebusitanum* as a subspecies of *A. sphaerocephalon*. PCA and DA showed a close similarity between *A. ebusitanum* and *A. sphaerocephalon*, since there are few quantitative differences among these taxa. However, an important qualitative feature permits the second species to be distinguished from the first, which is the presence of bulblets that are stalked and enclosed within a sheath on the lower part of the stem. This character is never present in *A. ebusitanum* a fact carefully checked in the field by N. Torres (*pers. com.*), and corroborated using the available herbarium specimens in this study. Considering that no intermediate specimens have been found, and that qualitative and quantitative characters are similar to others used to differentiate other species of this group, the specific rank seems to be more appropriate. Consequently, *A. durandoi* is included in the synonymy of *A. ebusitanum* as follow:

Allium ebusitanum Font Quer in Butll. Inst. Catalana Hist. Nat. 24: 145 (1924). *A. sphaerocephalon*

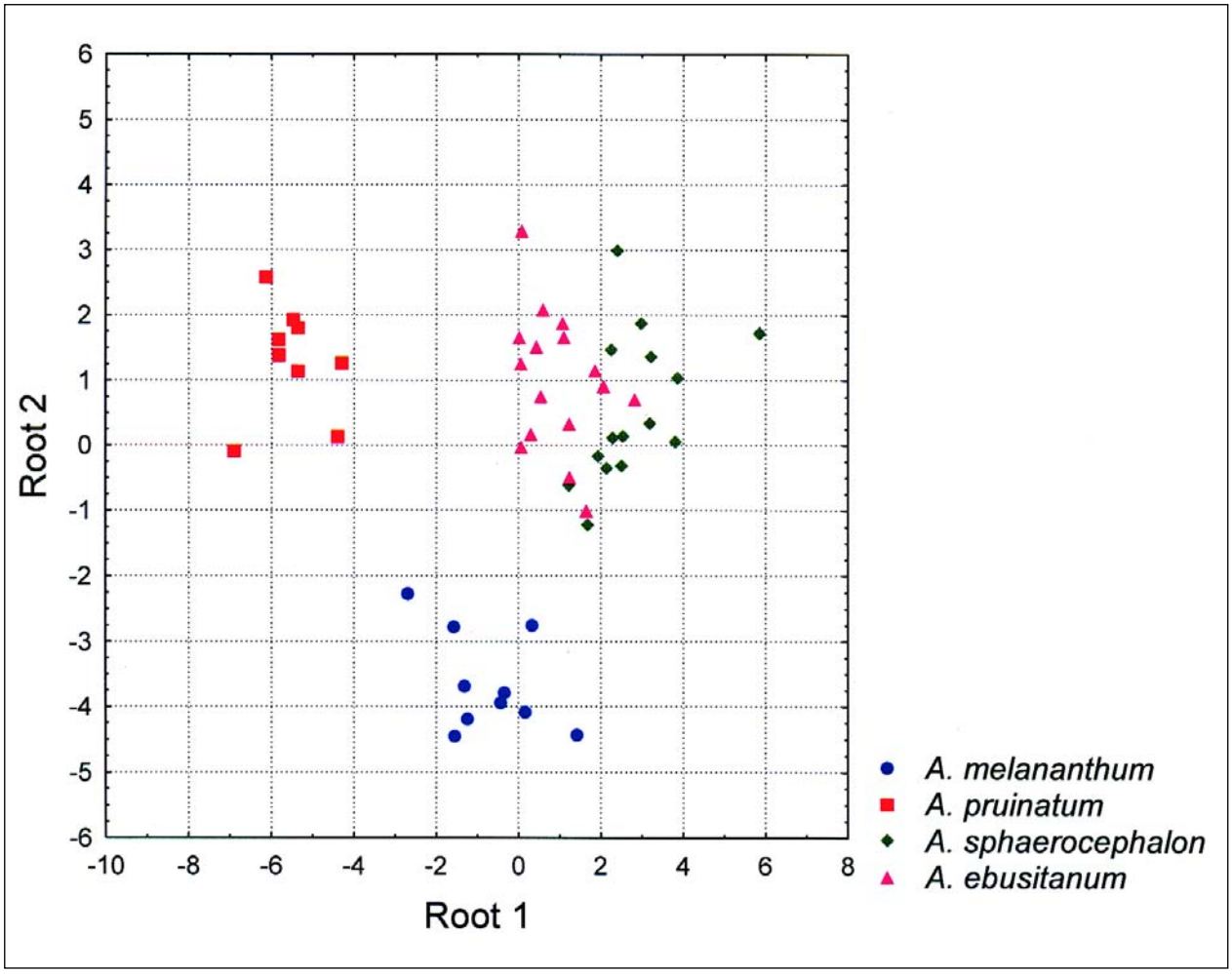

Fig. 6. Plot of the first two axes of Linear Discriminant Analysis (DA) of *Allium sphaerocephalon* group in Western Mediterranean.

Table 2. Standardized coefficients higher to 0,5 obtained in DA for canonical variables (mm).

	Root 1	Root 2	Root 3
pedicel length	0.548175	–0.102255	–0.26595
inner tepal length	0.850394	–0.970209	–1.36070
outer filament length	–0.730731	0.094906	–0.15281
inner filament length	–0.686270	0.134214	0.47445
lateral branch of inner filament length	0.410739	–0.532521	0.59038
capsule length	0.121118	0.510537	–0.27628

subsp. *ebusitanum* (Font Quer) Rosselló & al. in *Candollea* 48(2): 598 (1993). TYPE: Spain. Ibiza, Cala de les Torretes, 13 Jun. 1918, *Gros s.n.* (lectotype, designated by Pastor & Valdés 1982: 60, BC digital image!).

Allium sphaerocephalon var. *durandoi* Batt. & Trab., Fl. Alger: 155 (1884). *A. sphaerocephalon* subsp. *durandoi* (Batt. & Trab.) Wilde-Duyfjes in Belmontia, N.S. 7: 50 (1976). *Allium durandoi* (Batt. & Trab.) Seregin in Novosti Sist. Vyssh. Rast. 36: 101 (2004). TYPE: Algeria. Teniet-el-Haâd, 1852, *Durando s.n.* (lectotype, designated by Wilde-Duyfjes 1977: 51, G!).

Distribution of this species includes Ibiza island, North of Algeria and Tunisia (Fig. 7). This peculiar

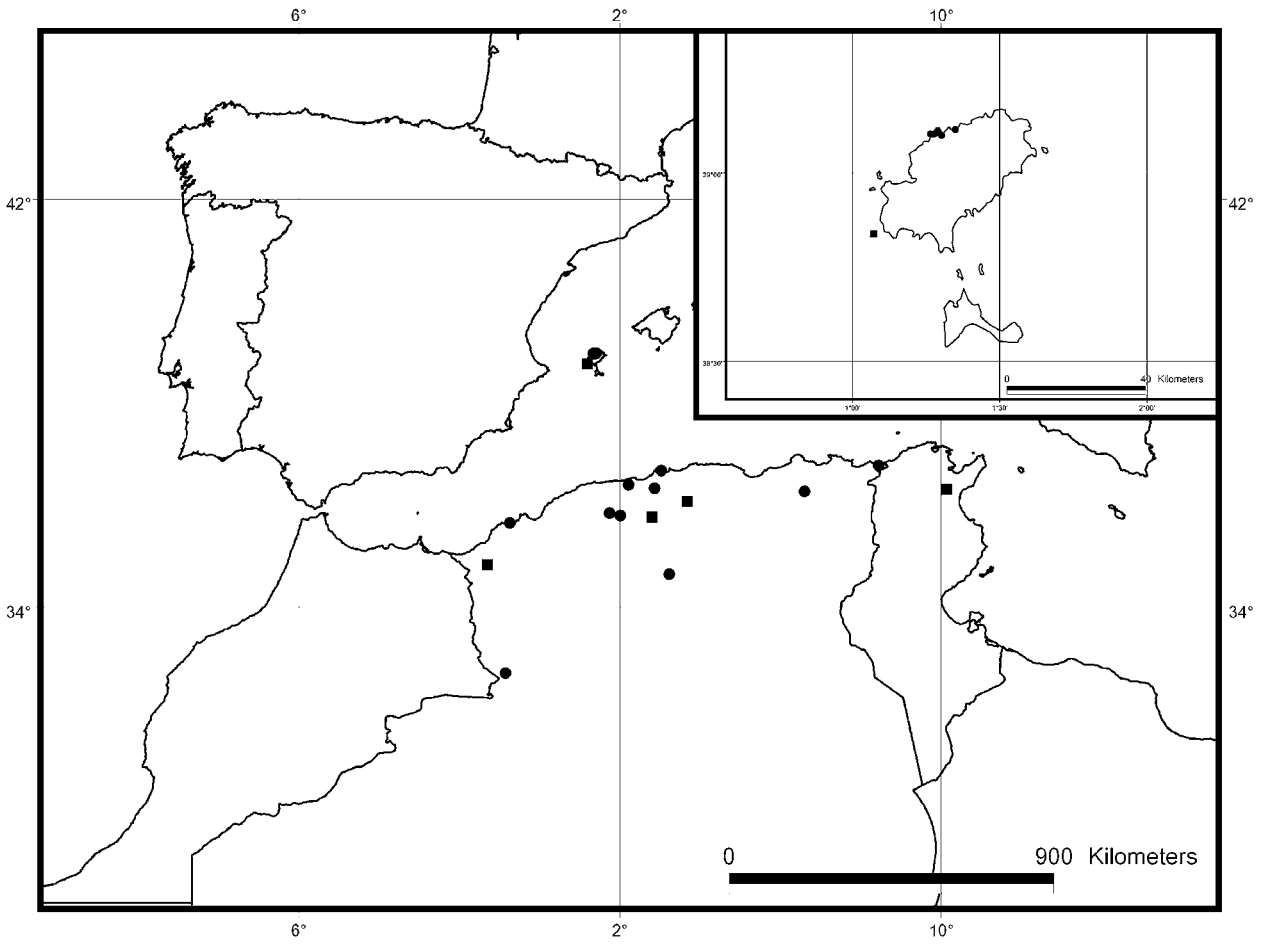

Fig. 7. Distribution of *Allium ebusitanum*. Points indicate studied specimens and squares literature records.

disjunction is similar to species such as *Scilla numidica* Poir. (Guerau D'Arellano & Torres, 1981; Puget & al., 1995) or *Convolvulus suffruticosus* Desf. (Kuhbier & Finschow, 1976).

Chromosome number is $2n = 16$ in the four species of this group (Pastor & Valdés, 1982; Cardona & Contandriopoulos (1983); Miceli & Garbari, 1988).

Allium ebusitanum is found in Ibiza in rocky areas of sea falls, between 0-350 m, whereas in Algeria and Tunisia it is located in hills and rocky steppes between 0-1500 m. In NW Africa, *A. sphaerocephalon* does not share distribution area with *A. ebusitanum* because it is only found in Morocco (Wilde-Duyfjes, 1977). On the contrary, *A. sphaerocephalon* is present in Ibiza although it grows on open scrubland where *A. ebusitanum* is not found.

KEY TO *A. SPHAEROCEPHALON* GROUP IN WESTERN MEDITERRANEAN

1. Stamen included [ratio stamen length/tepal length = (0.6)0.8-0.9(1.03)] ..... **A. pruinatum**
1. Stamen exerted [ratio stamen length/tepal length = (1)1.3-1.8] 2
2. Tepals dark-purple to blackish-purple ..... **A. melananthum**
2. Tepals pink to purple 3
3. Bulblets stalked and enclosed within sheath on lower part of the stem, which have the appearance of a second bulb .... **A. sphaerocephalon**
3. Without basal bulblets ..... **A. ebusitanum**

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Appendix 1

Representative specimens examined. A comprehensive list of studied specimens is available at http://www.anthos.es.

A. ebusitanum

ALGERIA. Oran, à Santa Cruz, 35° 43' N, 00° 44' W, *Faure s.n.* (MA); Teniet-el-Haad, 35° 52' N, 02° 01' E, *Durando s.n.* (G); Alger, mt. Bouzar, 36° 46' N, 03° 02' E, *Cosson s.n.* (P); mt. Ouarsenis, 35° 55' N, 01° 45' E, *Cosson s.n.* (P); Chréa, 36° 25' N, 02° 52' E, *Gombault s.n.* (P); Djebel Zaccar, pres Milianah, 36° 20' N, 02° 13'E, *Cosson s.n.* (P); Constantine, 36° 21' N, 06° 36' E, *Bové s.n.* (P); Alger, environs de Djelfa, 34° 40' N, 03° 14' E, *Reboud s.n.* (P); Constantine, La Calle, 36° 52' N, 08° 27' E, *Durieu de Maisonneuve s.n.* (P); Oran, Ben-Ikrou, 32° 37' N, 00° 51' W, *Maire s.n.* (P).

SPAIN. Ibiza, St. Miquel, Penyal de s'Aguila, 39° 04' 41''N, 1° 24' 37''E, *Torres s.n.* (MA, herb. Torres); Cala d'Albarca, 39° 04' 00'' N, 1° 22' 31''E, *Fernández Casas & al. 2890* (MA); St. Mateu, Cingles, sa punta oest Cala d'Albarca, 39° 04' 33'' N, 1° 21' 20'' E, *Torres s.n.* (MA, herb. Torres); Es Cingle de Recó, 39° 04' 10'' N, 01° 21' 20'' E, 16-VI-1990, 17-VI-1990, *Mus s.n.* (HJBS); Cala de las Torretas, 39° 04' 09'' N, 01° 20' 48'' E, *Fernández Casas & al. 2907* (BC, MA, SALA).

A. melananthum

SPAIN. **Alicante**. Orihuela, 25-V-1997, *Espinosa & al. s.n.* (ABH); 4-VI-1996, *Serra s.n.* (ABH); 6-VII-1996, *Espinosa & Espinosa s.n.* (ABH); Sierra de Callosa, 31-V-1993, *Torre s.n.* (ABH); 19-VI-1992, *Baeza & Torre s.n.* (ABH); Beneferri, 19-V-1996, *Espinosa & Martínez s.n.* (ABH). **Almería**. Castala, 17-VI-1984, *Segura Zubizarreta s.n.* (MA); San Juan de los Terreros, 30-V-1978, *Devesa & al. s.n.* (MA); 22-V-2006, *Aedo 12790* (MA). **Murcia**. Águilas, Cala Cerrada, 22-V-2006, *Aedo 12791* (MA); Mazarrón, 31-V-1978, *Devesa & al. s.n.* (BC); Cartagena, *Ibañez & al. s.n.* (MA); Peña del Águila, 4-VI-1994, *Crespo & al. s.n.* (ABH); falda oriental de Sierra Espuña, 18-VI-2006, *Aedo 12872* (MA).

A. pruinatum

PORTUGAL. **Algarve**. Olhão, 17-VI-1988, *Costa 977* (LISU); Ferreiras, VI-1887, *Moller s.n.* (COI). **Alto Alentejo**. Serra de Ossa, 22-VI-1960, *Raimondo 5065* (MA); Gavião, 26-VI-1952, *Silva & Fontes 5209* (MA); Castelo da Vide, 18-VI-1953, *Malato 269* (MA). **Estremadura**. Entre Setubal e Palmella, VII-1900, *Luisier s.n.* (MA); Abrigada, VII-1941, *Vasconcelos 16471* (LISU); cementerio Caranguejeira, 10-VII-1973, *Fernandes & al. 12587* (COI). **Baixo Alentejo**. Mil-Fontes, VIII-1905, *Sampaio s.n.* (MA); Sines, hacia Santiago de Cacem, 13-VII-1965, *Mendes s.n.* (COI). **Ribatejo**. Vale de Cavalhos, 11-VI-2006, *Aedo 12857* (MA); Santa Margarida de Coutada, 11-VI-2006, *Aedo 12853* (MA).

SPAIN. **Huelva**. El Portil, Punta Umbría, 26-VI-2006, *Sánchez Gullón s.n.* (MA).

A. sphaerocephalon

SPAIN. **Alicante**. playa de los Arenales del Sol, 14-VI-1986, *Pedrol 1447* (MA). **Badajoz**. Mengabril, 9-VI-1988, *Pedrol & al. 3269* (MA). **Cádiz**. Grazalema, 5-VII-1984, *Aparicio s.n.* (MA). **Cantabria**. Santander. La Magdalena, 1-VIII-1999, *Pardo de Santayana 1037* (MA); Espinosa de Bricia, 12-VIII-1988, *Moreno s.n.* (MA). **Ciudad Real.** Tablas de Daimiel, 15-VI-1994, *Cirujano s.n.* (MA); Fuencaliente, 5-VII-1997, *García s.n.* (MA). **Cuenca**. Solán de Cabras, 13-VII-1941, *Caballero s.n.* (MA). **Ibiza.** Es Ports des Torrent, *Mus & al. s.n.* (HJBS). **Jaén**. Cazorla, Fuente del Oso, 20-VII-1975, *González Rebollar & al. s.n.* (MA). **Orense**. embalse de Peñarrubia, 19-VI-1980, *Fernández 3451* (MA). **Palencia**. Velilla del Río Carrión, Peña Lampa, 12-VII-1995, *Álvarez & al. 850* (MA); puerto de Piedrasluengas, 21-VI-1976, *Fuertes & Ladero s.n.* (MA). **Soria**. Vinuesa, 14-VIII-1977, *Segura Zubizarreta s.n.* (MA). **Valladolid**. Canillas de Esgueva, 12-VII-1983, *Fernández Alonso 537* (MA). **Zamora**. Tábara, 3-VII-1996, *Bariego s.n.* (MA).

PORTUGAL. **Baixo Alentejo**. Pinhel, 10-VI-2006, *Aedo 12843* (MA)

Appendix 2

Literature reports for mapping *Allium ebusitanum*.

ALGERIA. Tlemcen, 34° 52'N, 01° 18' W, *Munby s.n.* (K); Boghari, 35° 50'N, 02° 48' E, *Cosson s.n.* (P); Aumale, 36° 09'N, 03° 41' E, *Charoy 637* (P) [cf. Wilde-Duyfjes 1977].

SPAIN. Ibiza, islote Vedrà, 38° 52' 08''N, 1° 11' 59''E [cf. Sáez & Rosselló, 2001].

TUNISIA. Djebel Zaghouan, 36° 23'N, 10° 09' E, *Kralik s.n.* (P) [cf. Wilde-Duyfjes, 1977].

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