Anales del Jardín Botánico de Madrid
Vol. 64(1): 7-25
enero-junio 2007
ISSN: 0211-1322

Taxonomic revision of *Ornithogalum* subgen. *Cathissa* (Salisb.) Baker (Hyacinthaceae)

by

Mario Martínez-Azorín, Manuel B. Crespo & Ana Juan

CIBIO (Instituto de la Biodiversidad), Universidad de Alicante, Apartado 99, 03080 Alicante, Spain. *mmartinez@ua.es*

Abstract

Martínez-Azorín, M., Crespo, M.B. & Juan, A. 2007. Taxonomic revision of Ornithogalum subgen. Cathissa (Salisb.) Baker (Hyacinthaceae). *Anales Jard. Bot. Madrid* 64(1): 7-25.

As a part of a taxonomic revision of the Iberian taxa of *Ornithogalum*, results corresponding to *O.* subgen. *Cathissa* are reported. Quantitative and qualitative characters are studied in detail, and they are evaluated for the taxonomic value of morphological characters of the three considered taxa: *O. concinnum*, *O. broteroi*, and *O. reverchonii*. A complete description is presented for all accepted species, and data on their biology, habitat, and distribution are also included. Moreover, a key is provided to facilitate identification.

Keywords: *Ornithogalum concinnum*, *O. broteroi*, *O. reverchonii*, *Cathissa*, taxonomy, distribution, habitat, western Mediterranean.

Resumen

Martínez-Azorín, M., Crespo, M.B. & Juan, A. 2007. Revisión taxonómica de Ornithogalum subgen. Cathissa (Salisb.) Baker (Hyacinthaceae). *Anales Jard. Bot. Madrid* 64(1): 7-25 (en inglés).

En el marco de una revisión de las especies ibéricas de *Ornithogalum*, se presentan los resultados correspondientes a los táxones de *O.* subgen. *Cathissa*. Se estudian con detalle y se evalúa cualitativamente y cuantitativamente el valor taxonómico de los caracteres morfológicos de los tres táxones considerados: *O. concinnum*, *O. broteroi* y *O. reverchonii*. Para cada especie se presenta una descripción completa, y datos sobre su biología, hábitat y distribución. Además, se aporta una clave para facilitar la identificación de los táxones aceptados.

Palabras clave: *Ornithogalum concinnum*, *O. broteroi*, *O. reverchonii*, *Cathissa*, taxonomía, distribución, hábitat, Mediterráneo occidental.

Introduction

Ornithogalum L. comprises about 120-130 species (Landstrom, 1989), or even 200 according to Obermeyer (1978). However, Müller-Doblies & Müller-Doblies (1996) recognized 123 species only for southern Africa, forty of which were described as new taxa. Therefore, the total number of species in the world could be higher than 200. The genus has a wide distribution, including Europe, Asia (reaching Afghanistan to the East), Africa (excepting the Tropic of Cancer band) and Madagascar (Zahariadi, 1965).

On the basis of floral and reproductive characters, 17 subgenera have been recognized (cf. Baker, 1873; Zahariadi, 1965, 1980; Obermeyer, 1978), many of them based on previously described genera (cf. Gray, 1821; Rafinesque, 1837; Parlatore, 1854; Salisbury, 1866). Among them, *O.* subgen. *Cathissa* includes plants with long and narrow, racemose or spiciform inflorescence; white concolour tepals –without maculae or green bands along its central nerve–, disposed in two whorls of similar morphology; stamens with filament from linear-lanceolate to tapering upwards, without abrupt expansions; ovary fusiform, with style slightly swollen and trigonous capitate stigma, which is well differenced from the style, bearing three decurrent lobes covered with long glands; seeds polygonal, with verruculose or smooth testa, and in the latter case usually formed by sinouse ridge cells, giving a puzzle-like appearance. In this subgenus three species are commonly included –*O. reverchonii* Lange ex Willk., *O. concinnum* Salisb. and *O. broteroi* M. Laínz–, whose distribution is restricted to the Iberian Peninsula (mainly in the western part) and northern Morocco.

Brief history of O. *subgen.* Cathissa *(Salisb.) Baker*

Salisbury (1866) reorganized the species previously placed in *Ornithogalum* L. in 13 different genera. One of them, –*Cathissa* Salisb.–, included *Scilla unifolia* L. –basyonym of the current *O. broteroi*– and *O. concinnum,* being the only two representatives of this group known by that time.

Later, Baker (1873) considered *Cathissa* as a subgenus of *Ornithogalum*, in which he included 10 species from different origins and with diverse morphological characters. On the one hand, *O. concinnum* Salisb. was regarded as a mere variety in *O. unifolium* (L.) Link (currently *O. broteroi*). That variety had *O. roccense* Link –species described from Cabo da Roca, Portugal (Link, 1799)– as a synonym. On the other hand, Baker extended *O.* subgen. *Cathissa* to include eight species from the Cape area (South Africa) –today referred to *O.* subgen. *Aspasia* Oberm. (cf. Obermeyer, 1978)–, and a Caucasian species –currently placed in *O.* subgen. *Eustachys* (Salisb.) Zahar. (cf. Zahariadi, 1980)–. The infrageneric arrangement of Baker (1873) has been widely accepted by most of authors and European monographers of the XXth century.

In the Iberian Peninsula and after Baker's proposal, two new taxa related to *O.* subgen. *Cathissa* were described. First, Rouy (1890) published *O. subcucullatum* Rouy & Coincy, which was illustrated by Coincy (1893), and was later considered as a mere synonym of *O. concinnum* (cf. Zahariadi, 1980). Secondly, Willkomm (1891) described *O. reverchonii* from Ronda (Málaga), and attributed its authority to J. Lange. Furthermore, this author pointed out that the new species seemed to be related to taxa of *O.* subgen. *Beryllis,* when considering characters of the inflorescence. However, Maire (1958) transferred *O. reverchonii* to *O.* subgen. *Cathissa* on the basis of floral features, an opinion accepted by Wittmann (1985), who also apported biogeographic data justifying that solution. On the contrary, Zahariadi (1980) placed *O. reverchonii* in *O.* subgen. *Beryllis*, giving priority to morphology of the inflorescence, but making an explicit reference to the controversy about its taxonomic position. Similarly, Moret & al. (1990) accepted Zahariadi's option, since ornamentation of seed testa of this species shows clear connections with other taxa in the latter subgenus. As a result of this, the position of *O. reverchonii* still remained uncertain.

Pfosser & Speta (1999) and Speta (2001) revived *Cathissa* following the initial concept of Salisbury (1866), after molecular, morphological and chemotaxonomic data. These authors included four species in that genus: *C. concinna* Salisb., *C. reverchonii* (Lange) Speta, *C. roccensis* (Link) Speta and *C. broteroi* (M. Laínz) Speta. Recently, Manning & al. (2004) presented a very synthetic treatment for the sub-Saharian species based on phylogenetic molecular studies. These authors extended considerably the circumscription of *Ornithogalum*, in which they proposed including most of genera described by Salisbury (l.c.) in "*Ornithogaleae*", plus *Albuca* L., *Dipcadi* L., *Galtonia* Decne., *Neopatersonia* Schönland and *Pseudogaltonia* Kuntze.

In the present paper, we follow provisionally Baker's (1873) arrangement, as it is the option fitting better the naturalness of every morphological group. Furthermore, this treatment has been widely followed in most of the Iberian floras. However, our preliminary phylogenetic results on *Ornithogalum* (*sensu lato*), based on sequencing of plastid (*trn*L-F and *rbc*L) and nuclears (ITS) regions, in addition to morphological and anatomical studies, point out to the monophyly of *O.* subgen. *Cathissa* as a sister group of a clade formed by *O.* subgen. *Beryllis* plus *O.* subgen. *Ornithogalum*. Thus, considering *Cathissa* as an independent genus would be perhaps a good future choice, following the initial proposal of Salisbury (1866), and recently corroborated by Speta (2001).

Material and methods

Morphological studies have been usually undertaken on living material from natural populations, and within the few hours after collection. However, they were complemented with data from dried material conserved at the herbaria ABH, BIO, GDA, K, LISU, MA, MACB, OVI, P, RAB, SALA, SANT, SEV, and VAL (Holmgren & al., 1990; Holmgren & Holmgren, 1993).

As some of the herbarium materials are not complete, several morphological characters were not measured. Fragments on vouchers commonly proved to be problematic, since some important structures were lacking –e.g. bulbs, fruits, or seeds, among others–, or measuring certain structures –e.g. dimensions of the filaments of the stamens or ovary– would imply serious damages to materials. Therefore, such characters were mainly measured on fresh plants. For these reasons, the number of data for some characters had to be lower in some cases.

Length and diameter of the bulb: Length was considered as the vertical distance from bulb base to its apex. Diameter was expressed as the maximum width of the bulb. Both measurements were shown in millimetres.

Leaf length and width: Maximum length and width of leaves were measured in each specimen, and expressed in centimetres.

Total number of leaves: Recounts of the total number of basal sheaths were carried out in each specimen. Fragmented or dried leaves were also included in the counts.

Stem length: It corresponded to the length in millimetres from the apex of the bulb up to the first flower (base of the inflorescence).

Inflorescence length and width: The distance from the point where the lowermost floral pedicel starts to the apex of the completely developed inflorescence was considered as the inflorescence length, whilst the maximum horizontal distance between the apexes of the longest pedicels (without considering tepals) was regarded as its width. Both measurements were expressed in millimetres.

Height of the plant: It corresponded to the total length in centimetres of the stem and the inflorescence.

Number of flowers: The total number of flowers was counted, including those at the tip of the immature inflorescence or prior to the anthesis.

Floral pedicels length: Three kind of flowers were distinguished in each inflorescence: lowermost, middle and uppermost. The middle flower was that whose pedicel is on the nearest point to the middle of the inflorescence. Measurements were expressed in millimetres.

Floral and fruiting pedicels insertion angle: Average angles of insertion of the pedicels on the inflorescence axis were measured and expressed in degrees. Floral and fruiting pedicels were annotated separately.

Bract maximum length and width: After identification of the biggest bract of the inflorescence (usually the lowermost), its maximum length and width were measured. Both results were expressed in millimetres.

Flower diameter: Length between the apexes of two opposite tepals was measured, and expressed in millimetres. Only the biggest flower of the inflorescence was considered.

Tepal length and width: Both characters were measured on the biggest flower of the inflorescence, differentiating between outer and inner tepals. All measures were expressed in millimetres.

Length and width of stamen filaments and ovary at the anthesis: Maximum length and width of stamen filaments and ovary of the biggest flower were measured and expressed in millimetres.

Length of the style and morphology of the stigma: Style length was annotated in millimetres. The aspect of the stigma was described according to its morphology and glandulosity. In all cases, the biggest flower was selected for measuring.

Capsule length and width: Maximum length and width of the biggest capsule were measured and expressed in millimetres.

Number of seeds per capsule: Seeds were counted in 4 to 40 randomly selected capsules from different individuals and/or populations. In some cases, individuals collected in the wild were transferred into pots until capsules ripened. Then, they were cut off and isolated until they opened spontaneously.

Seed length and width: Maximum length and width of seed were measured and expressed in millimetres. Measurements were made on 40 seeds per population, repeating it in different populations when possible. A binocular Leyca® MZ6, with incorporated micrometer was used.

Seed weight: Each seed measured was also weighted with an analytical balance HM-202 (AND®). Results were expressed in milligrams.

Scanning Electron Microscope (SEM)

Images of seeds were taken with a SEM JEOL 840. As the material was dried, no special treatment was required prior to observation. Samples were directly glued on metallic stubs. Afterwards, samples were coated with about 30 nm gold. Seed testa classification follows Moret & al. (1990).

Scanning of fresh plants

After the morphological study of specimens collected in the wild, scannings were carried out of every living plant and their different vegetative and floral structures. For this purpose, an Epson Perfection 1250 scanner was used. General figures of each species were composed with those images.

Statistic analyses

Every morphologic characters studied are accompanied by the rank of the maximum and minimum values. Those data were measured in different specimens from several populations, in order to achieve the maximum morphological variation of each taxon. For *O. broteroi*, 32 specimens from 4 populations were studied; for *O. concinnum*, 36 plants from 3 populations; and for *O. reverchonii*, 13 specimens from 1 population (Table 1).

With regard to the morphologic variables, two Principal Component Analyses (PCA) were conducted. In the first analysis, all morphological characters have been considered for the three species in the subgenus. The number of samples per character varied depending on the availability of fresh material (*O. broteroi*: n = 32; *O. concinnum*: n = 36; *O. reverchonii*: n = 13). In the second analysis, only characters connected to seed (length, width and weight) were included, due to their paramount importance to segre-

gate taxa in that group (see also Martínez-Azorín & al., 2006). In the second analysis, data came from 40 seeds per taxon, mostly from the same populations as in the previous analysis. In both cases, the software SPSS v. 10 was used.

Analysis of characters

Bulb

Bulb size is different in the three considered taxa. *O. reverchonii* presents the biggest one, whilst the smallest corresponds to *O. broteroi*. As regards to *O. concinnum*, it shows intermediate values, much overlapping with *O. broteroi* (Table 2).

Leaves

Number and morphology of leaves show notable differences among the considered species, being therefore important features to separate them. *O. broteroi* presents only one leaf per stem, which is broadly sheathing at the base, and ends in a long cylindrical appendix, almost as long as the blade, which withers soon. The rest of the species have more than one leaf per flowering stem. Those leaves are linear to linear-lanceolate or tapering, lack any cylindrical appendix, and usually wither only at the tips. Furthermore, maximum length and width of leaves are also useful for taxonomy (Table 3).

Plant height and inflorescence

In *O.* subgen. *Cathissa*, height of plants usually can help to discriminate between *O. reverchonii* and both *O. broteroi* and *O. concinnum*. The former species includes the highest individuals in the subgenus, (26)40-70(80) cm, whilst both latter others the smallest. Individuals of *O. broteroi* are similar in height to those of *O. concinnum*, though commonly they are slightly smaller. *O. concinnum* is very variable in size and can overlap some specimens of *O. broteroi* or even *O. reverchonii*.

Similarly, inflorescence length is a diagnostic character for identification of the species in the subgenus. In *O. broteroi*, they are spiciform and usually short and thin, with subsessile or briefly pedicellate flowers (pedicel: 0.1-5 mm long). Inflorescences of *O. concinnum* show a similar appearance, but they are usually bigger, many-flowered, and the floral pedicels are slightly longer (1-8 mm). On the contrary, inflorescences of *O. reverchonii* are racemose, being the longest in the group and having long pedicellate flowers (pedicel: 6-25 mm long). Insertion angle of floral pedicels on the inflorescence axis allows easy differentiation of both *O. concinnum* and *O. broteroi* from *O. reverchonii* (Table 4). However, fruiting pedicels are always appressed to the inflorescence axis in all three taxa. The different pattern of inflorescences led some authors (Willkomm, 1891; Zahariadi, 1980; Wittmann, 1985) to place *O. reverchonii* in *O.* subgen. *Beryllis*.

Perianth

Tepal size allows easy separation of *O. reverchonii* from the rest of species (*O. concinnum* and *O. broteroi*) (Table 5). In all cases, *O. reverchonii* shows the highest length and width values, being the diameter of the flower around 35-40 mm. Contrarily,

Table 1. Studied specimens of *Ornithogalum* subgen. *Cathissa* used in the statistic analyses.

Taxon	Locality	UTM	Number of specimens	Voucher
O. broteroi	Spain, Huelva, La Nava, sierra de las Herrumbres	29SPC9506	18	ABH 50131
O. broteroi	Spain, Huelva, Aroche, El Naranjero	29SPC8012	3	—
O. broteroi	Spain, Pontevedra, Cangas, Vilanova, Area Brava	29TNG1283	7	ABH 51024
O. broteroi	Spain, A Coruña, Muros, Louro	29TMH9334	4	ABH 51025
O. concinnum	Spain, Ávila, Hoyocasero, sierra de Gredos	30TUK3274	20	ABH 47141
O. concinnum	Spain, Zamora, Torregamones	29TQF3397	10	ABH 47140
O. concinnum	Portugal, Estremadura, Cabo da Roca	29SMC5792	6	ABH 51026
O. reverchonii	Spain, Cádiz, Grazalema, Tajo de los Pajaritos	30STF8871	13	ABH 47138

Table 2. Size of bulb.

	Length (cm)	**Width** (cm)
O. broteroi	(1.3)1.5-2.1	(1)1.1-1.5(1.6)
O. concinnum	1.6-2.5(3)	(1)1.3-2.5(2.8)
O. reverchonii	5-6	2.5-4

Table 3. Characteristics of leaves.

	Number	**Maximum length** (cm)	**Maximum width** (cm)
O. broteroi	1	(6)13-35(40)	(0.3)0.4-0.9(1.2)
O. concinnum	2-3(5)	(9)15-30(45)	(0.4)0.6-1.5(2)
O. reverchonii	4-6	50-80(100)	(1)1.5-2.5

O. broteroi and *O. concinnum* produce smaller tepals, which are very similar in size. As a result, flower diameter is similar in both taxa, and reaches around 25-30 mm. For that reason, differentiation between *O. concinnum* and *O. broteroi* is usually difficult regarding only to floral characters.

Androecium

Stamen filaments of both whorls show valuable characters to identify the three taxa, though not in an absolute way. In *O. broteroi*, they are constantly shorter –(5)6-8 mm–, whilst they are longer in *O. reverchonii* –(8)9-10(11) mm–, and present medium, slightly overlapping values in *O. concinnum* –(6)8-9-(10) mm–. However, shape and width of filament show notable differences between taxa. In *O. reverchonii*, filaments of both whorls are broad, about 2-3 mm wide in all their length. In both *O. broteroi* and *O. concinnum*, they are narrower (1-1.3 mm width), though the inners are slightly broader than the outers, and all of them taper progressive and notably to a point in the upper third.

Gynoecium

Size and morphology of gynoecium also allow separation among all three taxa. The biggest ovary appears in *O. reverchonii*, being oblong-ovoid and obtuse at the apex. The medium values correspond to *O. concinnum*, which produces a narrowly ovoid-fusiform or lanceolate ovary with an attenuate apex. Finally, *O. broteroi* shows the smallest ovary, which is obovoid and rounded to truncate at the apex (cf. Franco & Rocha Afonso, 1994). Considering the style, it is long and narrow in all three taxa, being slightly longer in *O. reverchonii* (Table 6). Generally, the stigma is usually slightly capitate and trigonous, always bearing three decurrent rows of glands.

Fruit and seeds

Size of capsule and seeds allow a clear differentiation, being one of the best discriminating characters among species in the subgenus (Table 7). The biggest capsule is found in *O. reverchonii*, which has an ellipsoid to ovoid outline and a blunt apex. In *O. concinnum*, it has medium size and is ovoid-elliptic in outline with acute or slightly apiculate apex. In *O. broteroi*, the capsule is smaller and narrower, with lanceolate-elliptic outline and with acute and slightly apiculate apex.

Seeds of taxa in *O.* subgen. *Cathissa* are blackish and more or less polygonal or subglobose. They are often pointed in a short beck around the funicular end, and are usually somewhat flattened and angulose, with more or less winged edges, and with irregularly rugose or slightly crested surface. Size, weight and shape of seeds, as well as testa ornamentation are characteristics with a very high diagnostic value (Martínez-Azorín & al., 2006) (Table 8). Regarding the seed testa features, Moret & al. (1990) described three morphological types for the North African species of *Ornithogalum*. Within *O.* subgen. *Cathissa*,

Table 4. Characters of the inflorescence.

	Length (cm)	**Width** (cm)	**Number of flowers**	**Insertion angle of pedicels**
O. broteroi	(1.5)3-8(11)	0.3-0.4(0.6)	3-7	10°-20°
O. concinnum	(2)3-12(16)	(0.3)0.4-0.6(0.7)	(4)7-20(33)	10°-20°
O. reverchonii	(6)10-20(25)	(1)1.5-2.5(3.5)	(9)10-15(18)	40°-70°

Table 5. Characters of tepals.

	Length inner tepal (mm)	**Length outer tepal** (mm)	**Width inner tepal** (mm)	**Width outer tepal** (mm)
O. broteroi	(11)13-18(19)	(11)13-18(19)	(3)3.5-5.5	(3)3.5-5
O. concinnum	(12)13-16(18)	13-16(18)	4.5-5(6)	(3.5)4-5(6)
O. reverchonii	(18)20-23(25)	(17)21-24(26)	(7)8-10	(7)8-10(11)

Table 6. Characters of the gynoecium.

	Lenght of the ovary (mm)	**Width of the ovary** (mm)	**Lenght of the style** (mm)
O. broteroi	3-3.5(4)	2-3	4-5
O. concinnum	4-5(6)	2	4-5
O. reverchonii	6-7	2.5-3	(4)5-6

Table 7. Characters of the capsule.

	Lenght of the capsule (mm)	**Width of the capsule** (mm)	**Number of seeds** (mm)
O. broteroi	(6)7-9(11)	3-4(5)	(3)12-25(28)
O. concinnum	(9)11-14(16)	(5)6-9(10)	(6)15-40(43)
O. reverchonii	20-25	12-13	15-25

only two of those types have been identified. First, *O. reverchonii* produces very big and notably heavy seeds, dull coloured, markedly flattened and angulose, with slightly winged edges, and with a granulate testa (Type 2), which is similar to some species of *O.* subgen. *Beryllis* (Fig. 1). Secondly, seeds of *O. concinnum* are medium sized, lighter and dull coloured, flattened and angulose, with winged edges and ruminate or puzzle-like testa (Type 3), in which cells are flat with almost smooth or slightly rugulose surface and delimited by deep furrows (Fig. 1). Finally, in *O. broteroi* seeds are small, much lighter and with a metallic shine, subglobose, somewhat apiculate, with blunt edges, not winged, and a ruminate or puzzle-like testa (Type 3), in which cells are flat and sunk, delimited by small, rounded and sinuate ridges (Fig. 1).

Though seed types could be thought to characterize different subgenera of *Ornithogalum*, a direct relationship has not been demonstrated, as shown by Coskuncelebi & al. (2000) and Moret & al. (1990), who found more than one seed type in various Eurasian sections of the genus. Preliminary results of the phylogenetic studies we are carrying out, based on sequences of plastid and nuclear DNA regions (Martínez-Azorín & al., inéd.), place all three studied species in a monophyletic clade clearly apart from other Mediterranean subgenera, such as *Beryllis* or *Ornithogalum* (= *Heliocharmos*). This supports the fact that testa ornamentation can be used as an absolute diagnostic character among species but not for higher taxonomic levels.

Table 8. Seed characteristics.

	Length (mm)	**Width** (mm)	**Weigth** (mg)
O. broteroi	1.6-1.9	0.9-1.2	0.4-0.7
O. concinnum	2.8-3.9	1.7-2.3	1.8-4.9
O. reverchonii	4.5-4.9	2.5-2.9	6-11

Table 9. Studied morphological characters and values obtained in the Principal Component Analysis (PCA) of all morphological characters.

Character	**Component 1**	**Component 2**
Length of the stem	0.886	–0.044
Number of flowers	0.427	–0.450
Length of the inflorescence	0.748	–0.230
Width of the inflorescence	0.868	–0.104
Length of the bract	0.724	–0.042
Width of the bract	0.432	–0.158
Length of the lowermost floral pedicel	0.866	–0.204
Length of the middle floral pedicel	0.888	–0.173
Length of the uppermost floral pedicel	0.769	–0.174
Insertion angle of the floral pedicels	0.926	0.028
Insertion angle of the fruiting pedicels	–0.152	0.549
Length of the outer tepal	0.867	0.311
Length of the inner tepal	0.880	0.296
Width of the outer tepal	0.874	0.278
Width of the inner tepal	0.868	0.204
Length of the outer filament	0.748	0.314
Length of the inner filament	0.751	0.334
Width of the outer filament	0.823	0.380
Width of the inner filament	0.750	0.356
Length of the ovary	0.838	0.206
Width of the ovary	0.701	0.415
Length of the style	0.529	0.397
Width of the capsule	0.688	–0.341
Length of the capsule	0.715	–0.265
Number of leaves	0.923	–0.221
Maximum length of leaves	0.846	–0.009
Maximum width of leaves	0.862	–0.180
Diameter of bulb	0.559	–0.356
Length of bulb	0.585	–0.242
Length of seed	0.873	–0.217
Width of seed	0.864	–0.199
Weight of seed	0.887	–0.094

Principal Component Analyses (PCAs)

In the PCA of all studied morphological characters (Fig. 2), all three taxa in the subgenus appear rather clearly separated. Five principal components have been obtained, which explain together 81.5% of the variance, though the first two components explain 67.3% of the variance (59.7% and 7.5%, respectively). The first one allows *O. reverchonii* to be separated easily from *O. broteroi* and *O. concinnum*. This fact is mainly based on certain characters, such as the inflorescence length, the insertion angle of floral pedicels, the tepal size, the leaf dimensions, or fruit and seed features, among others (Table 9). In that analysis, *O. broteroi* and *O. concinnum* show a weak overlap, since both species are similar in the overall morphology. The second principal component was not effective to distinguish taxa. In fact, the obtained values and percentages of variance explained were very low in all cases.

Regarding the PCA conducted with only seed characters (Fig. 3), it was crucial to differentiate among all three species, namely between *O. concinnum* and *O. broteroi*. Two principal components were obtained, which explained together 97% of the variance (91.9% and 5.2%, respectively). The first one was the most effective to separate taxa. Every morphological character considered in the analysis presents a high importance for

Table 10. Seed morphological characters studied and values obtained in the Principal Component Analysis in *O.* subgenus *Cathissa*.

Character	**Component 1**	**Component 2**
Length	0.967	–0.122
Width	0.962	–0.195
Weight	0.946	0.322

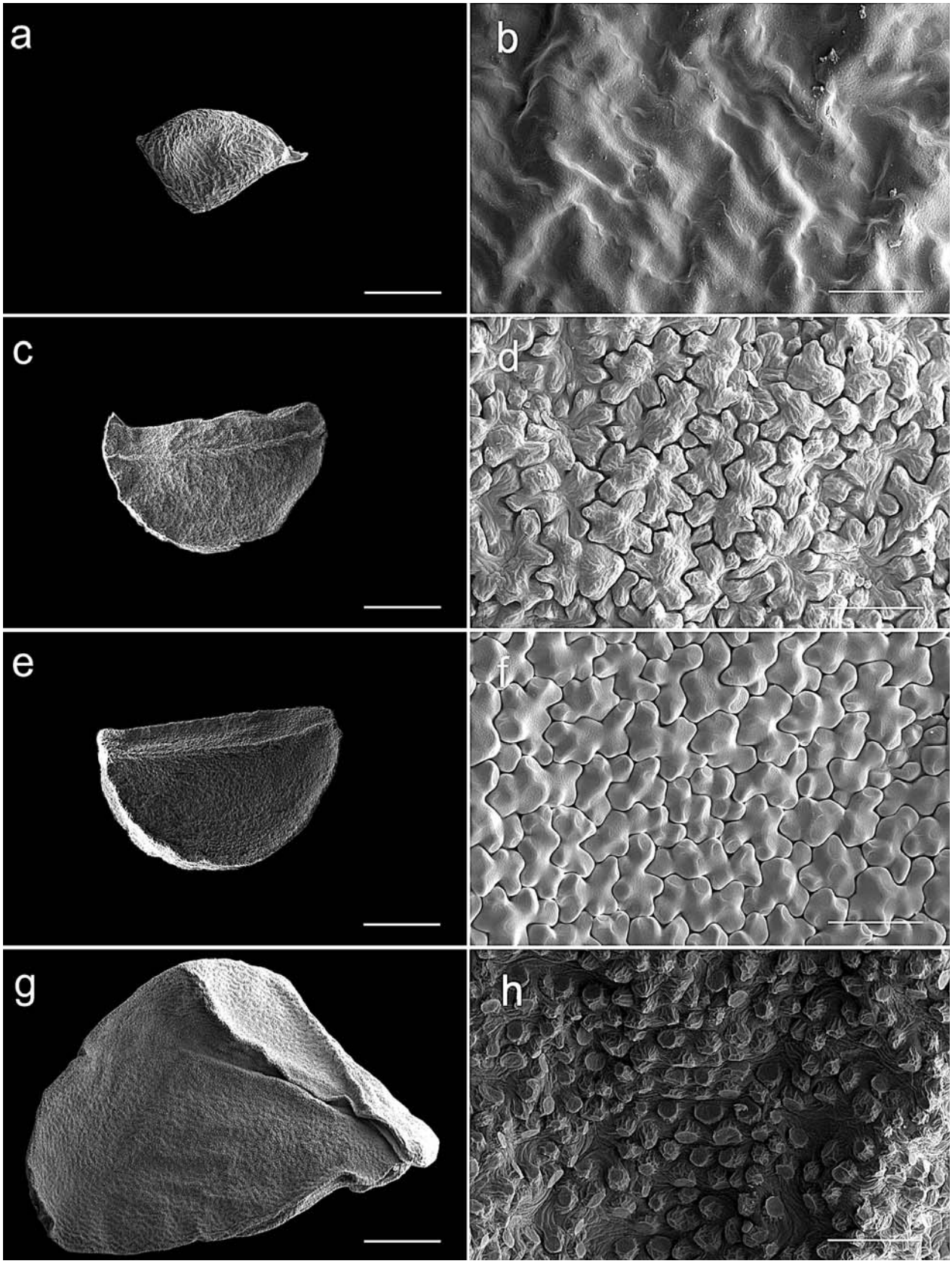

Fig. 1. Seeds of the species of *Ornithogalum* subgen. *Cathissa:* **a, b,** *O. broteroi* [*A. Rodríguez s.n.* (MA 21869)]; **c, d,** *O. concinnum* [*M. Martínez-Azorín, M.B. Crespo & C. Pena s.n.* (ABH 51026)]; **e, f,** *O. concinnum* [*M. Martínez-Azorín s.n.* (ABH 47141)]; **g, h,** *O. reverchonii* [*M. Martínez-Azorín s.n.* (ABH 47138)]. Scale: a, c, e, g = 1 mm; b, d, f, h = 100 µm.

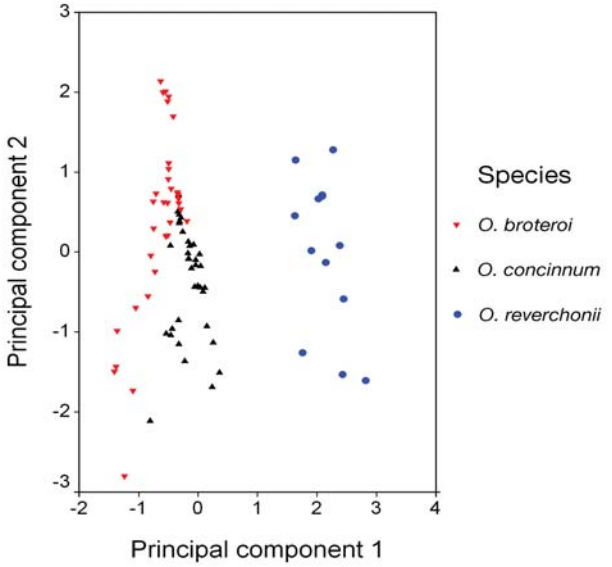

Fig. 2. Plot of the first two axes of the Principal Component Analysis (PCA) of all morphological characters.

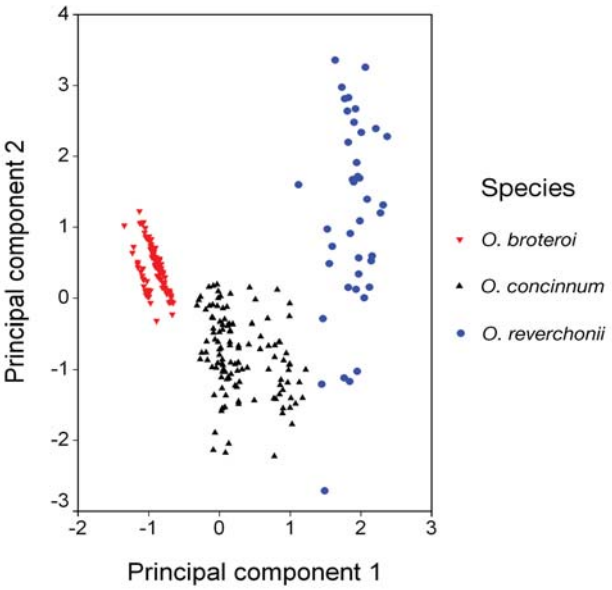

Fig. 3. Plot of the two axes of Principal Component Analysis (PCA) of seed characters: length, width and weight.

distinguishing among taxa (Table 10). The second principal component did not give resolution enough to segregate all three taxa, due to the low variance it explained. Only the seed weight could allow a weak segregation between *O. broteroi* and *O. concinnum*, though both taxa were not clearly separated from *O. reverchonii*, a species that shows a high variability in this character.

Taxonomic treatment

KEY TO *ORNITHOGALUM* SUBGEN. *CATHISSA* SPECIES

1. Plant (26)40-70(80) cm. Tepals (17)20-24(26) mm long. Capsule 20-25 mm long. Seed 4.5-4.9 mm long. Testa irregularly granulate, never puzzle-like ..... **3. O. reverchonii**
1. Plant (9.5)12-32(42) cm. Tepals (11)13-18(19) mm long. Capsule (6)7-14(16) mm long. Seed 1.6-3.9 mm long. Testa puzzle-like (with smooth or weakly granulate surface) 2
2. Flowering stem 1-leaved. Ovary 3-3.5(4) mm long. Capsule (6)7-9(11) mm long. Seed 1.6-1.9 mm long .. **1. O. broteroi**
2. Flowering stem 2 or more leaves. Ovary 4-5(6) mm long. Capsule (9)11-14(16) mm long. Seed 2.8-3.9 mm long .... **2. O. concinnum**

Description of the species

1. Ornithogalum broteroi M. Laínz, Aport. Conocim. Fl. Gallega 7: 30. 1971

Cathissa broteroi (M. Laínz) Speta in Stapfia 75: 171. 2001. *Scilla unifolia* L., Sp. Pl.: 309. 1753 [basion.]. *O. unifolium* (L.) Link in J. Bot. (Schrader) 1(2): 320. 1799, nom. illeg. [non Retz., Obs. 2: 17. 1781]. *Cathissa unifolia* (L.) Salisb., Gen. Pl.: 34. 1866. *O. nanum* Brot., Fl. Lusit. 1: 529. 1804, nom. illeg. [non (L'Hér.) Thunb., Prod. Pl. Cap.: 62. 1794]. *Ind. loc.*: "Habitat in Lusitania". TYPE: [Icon in] Bauhin & Cherler, Hist. Pl. 2: 622. 1651, "Bulbus monophyllos flore albo" (lectotype, designated by Stearn, 1983).

O. spicatum Plan., Ens. Fl. Gallega: 381. 1852, nom. illeg. [non Gaterau, Descr. Pl. Montaub.: 72. 1789, nom. illeg., ≡ *Scilla italica* L., Sp. Pl.: 308. 1753]. *Ind. loc.*: "Común en las Colinas del Paraiso [sic] y del valle de Viso"[Galicia, Spain]. TYPE: not extant at BCN [synonym from description].

Illustrations: Ker Gawl. in Bot. Mag. 24: 935. 1806; Willk., Ill. Fl. Hispan. 2(17) tab. CLIII. 1890; Fig. 4.

Geophyte, (9.5)12-24(30) cm high; bulb (1.3)1.5-2.1 × (1)1.1-1.5(1.6) cm, ovoid-spherical, with contractile roots, usually without or with few (2-3) offsets; outer tunics pale brown to pale orange. Leaf synanthous, solitary or rarely 2 (in this case, each one on a flowering stem), (6)13-35(40) × (0.3)0.4-0.9(1.2) cm, linear-lanceolate, flat, widely sheathing at the base, glaucous-green, glabrous, erect-patent, ending in a cylindrical appendix almost as long as the blade, that withers soon and falls down. Floral stem (8)9-16(19) × 0.2-0.3 cm, shorter than leaf, erect, glaucous-green, smooth and glabrous. Inflorescence racemose-spiciform, dense, (1.5)3-8(11) × 0.3-0.4(0.6) cm (excluding flowers but not their pedicels), with (2)3-7(9) flowers; bracts (7)8-20(25) × (3)4-8(9) mm, longer than the accompanying pedicel, triangular, membranous, whitish-hyaline with setose acuminate greenish apex, pale brown when dry, sometimes toothed at the basal part; floral pedicels erect or slightly patent, lower ones 1-4(5) mm, middle ones 1-2(3) mm, and upper ones 0.1-1 mm; fruiting pedicels 2-5 mm, erect and

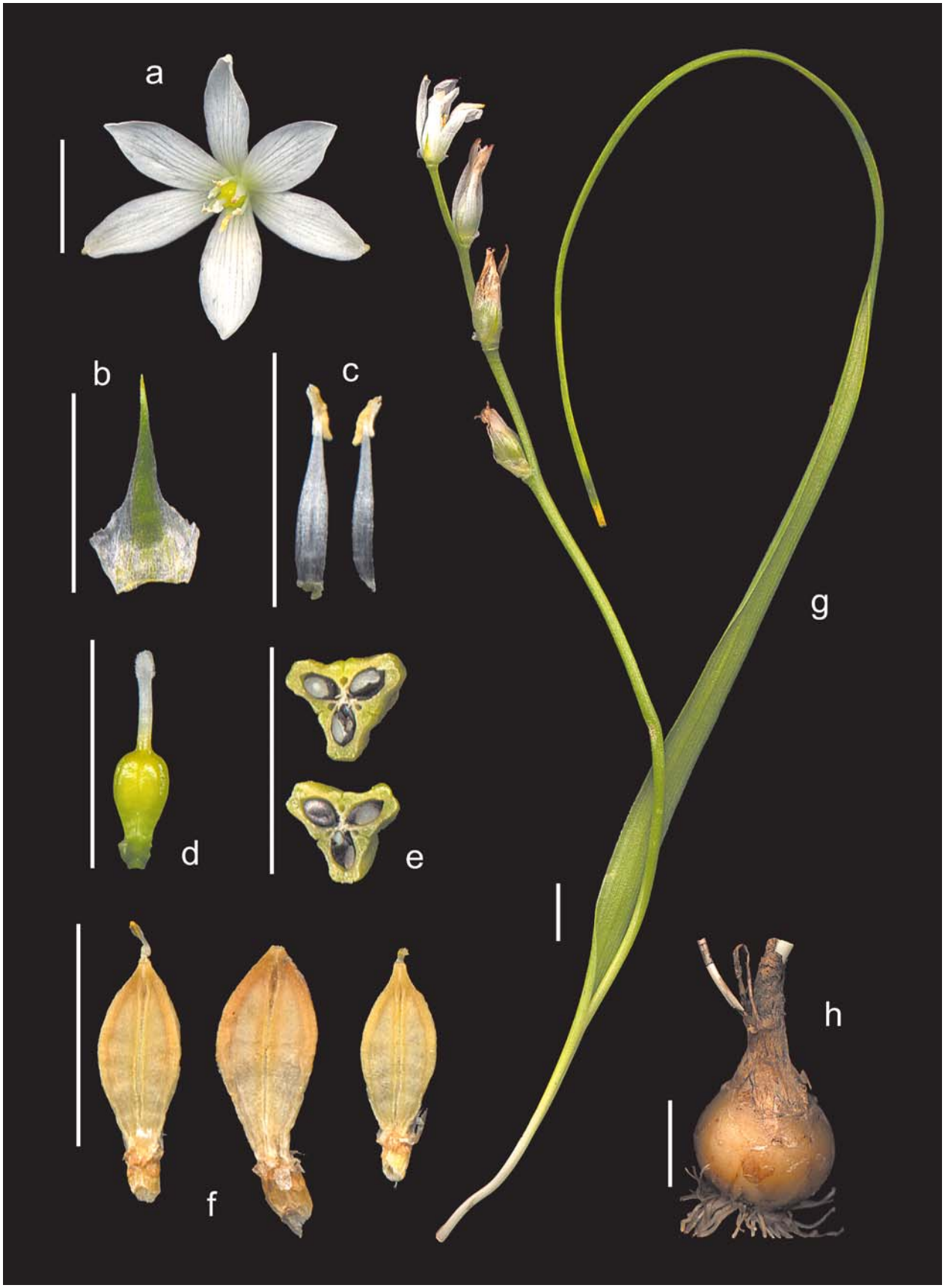

Fig. 4. *Ornithogalum broteroi* [Spain, Huelva, La Nava, *Martínez-Azorín & al. s.n.* (ABH 50131)]: **a,** flower; **b,** bract; **c,** inner stamen (left) and outer (right); **d,** gynoecium; **e,** sections of the mature capsule; **f,** capsules before dehiscence; **g,** inflorescence and leaf; **h,** bulb. Scale = 1 cm.

appressed to stem. Flowers 25-30 mm in diameter, slightly fragrant; tepals white, rarely with a small and weak dorsal greenish band at the apex, lanceolate-elliptic, patent or erect-patent, with papillate-glandulose acute apex; outers (11)13-18(19) × (3)3.5-5 mm; inners (11)13-18(19) × (3)3.5-5.5 mm, being somewhat wider than the outers. Stamens 6, ½ to ⅔ of the tepal length; filaments white, lanceolate, progressively tapering in a point in the upper third, (5)6-8 × 1-1.3 mm, inners somewhat wider; anthers dorsifixed, pale yellow to whitish, 2 × 1 mm. Ovary 3-3.5(4) × 2-3 mm, pale green, obovoid, rounded at the apex, trigonous, with three obtuse ridges, bearing nectariferous septals; style whitish, filiform, 4-5 mm; stigma capitate, trigonous, with decurrent glandulose ridges. Capsule (6)7-9(11) × 3-4(5) mm, lanceolate-elliptic, acute, slightly apiculate, trigonous, pale brown, with late trivalvar dehiscence, usually only through the upper third. Seeds (3)12-25(28) per capsule (n = 16), 0.4-0.7 mg, 1.6-1.9 × 0.9-1.2 mm, blackish with metallic shine, subglobose, with blunt edges, not winged, usually apiculate at the apex; testa ruminate or puzzle-like (Type 3), with cells flat and sunk, delimited by small rounded sinuate ridges.

Number of chromosomes: $2n = 34$ (Neves, 1950, 1973). $2n = 34 + 0\text{-}1B$ (Neves, 1952, 1973; Darlington & Wylie, 1955).

Biology: This species flowers from the end of February to June (exceptionally to August). It usually does not produce offsets, though usually splits up into two equal parts, each of them generating a contiguous mature plant. Therefore, sometimes individuals of this species seem to generate more than one leaf, though indeed each floral stem bears only one leaf. The reproduction of this species is mainly by seeds. Dehiscence of capsules occurs late (several weeks after the complete drying), and it takes place through the apical third.

Habitat: Open forests, scrubs and grasses, usually on siliceous soil, mainly on littoral areas. It seems to avoid the excessive continentality. It grows between 0 to 1300 m altitude.

Distribution: Western half of the Iberian Peninsula and northwestern Africa (Fig. 5). Maire (1958) placed near to Marrakech the southern distribution limit of this species, though we have confirmed its presence only until the surroundings of Casablanca. According to Merino (1909), this species would spread north to Vivero (Lugo), though we could not study any collections from that area.

Observations: Living materials of *O. broteroi* are easy to distinguish from *O. concinnum* by the number of leaves, usually shorter and few-flowered inflorescences, and the truncate apex of the ovary as well as the fruit features. Sometimes herbarium materials of *O. broteroi* lacking leaves have been misidentified as *O. concinnum*. However, the much smaller seeds and capsules are diagnostic for an unequivocal identification. *O. broteroi* is abundant in the sites it grows, therefore it is not endangered nowadays, though its predilection for littoral areas could place this taxon in an uncertain future position. UICN (2001) category: LR lc.

Fig. 5. Distribution of *Ornithogalum broteroi*. Dots correspond to studied herbarium sheets; triangles indicate bibliographic data.

Selected material

SPAIN. **A Coruña**: Muros, Louro, 27-IV-2006, 29TMH9334, *A. Juan s.n.* (ABH 51025). Agromaior, 30-V-1994, *J. Giménez s.n.* (SANT 28001). Alrededores de Santiago, 1-V-1944, *J. Figueroa Agea s.n.* (SANT 02900). Camariñas, 20-IV-1950, *Bellot s.n.* (SANT 05538). Carnota, entre Lira y Lariño, 20-VI-1996, 29TMH9036, *R.I. Louzán 235* (SANT 36966). Carnota, Montes do Pindo, por debajo de Peñafiel, 14-V-1995, 29TMH9050, *R. I. Louzán 2558* (BIO 22977, MA 565083, OVI 23299, SANT 32457). Carnota, Montes do Pindo, subida a Moa, 28-V-1994, 29TMH9049, *R.I. Louzán 2000* (SANT 36965). Curtis, Monte Corda, 23-VI-1967, *J. Dalda González s.n.* (MACB 01308). Fisterra, Punta Alba, al este de la playa de Langosteira, 12-V-1996, *J. Amigo & M. Romero s.n.* (SANT 35413). Lariño, Playa Seiriños, 14-VI-1959, *R. Álvarez s.n.* (MACB 27372). Louro, 24-IV-1970, *R. Álvarez & M. Horjales s.n.* (MACB 4403). Lousame, Aldarís, Outeiro dos Gatos, 29-V-1997, 29TNH1833, *V. Rial Ces s.n.* (SANT 43915). Malpica, cabo San Adrián, 29TNH1499, *S. Castroviejo, Silva & Valdés-Bermejo s.n.* (MA 433666). Prope Amés (Bertamiráns) en la carretera de Santiago a Negreira, 1-V-1944, *Bellot s.n.* (SANT 02899). Ribeira, Vixan, Corrubedo, 5-V-1983, *J. & P. Guitián s.n.* (SANT 29640). Santiago de Compostela, 29-VIII-1854, *J. Lange*

s.n. (K). **Badajoz**: Puebla de Obando, subida al puerto del Zángano, 1-V-1973, *M. Ladero & S. Rivas Goday s.n.* (SALA 34302). **Cáceres**: Valencia de Alcántara, 19-V-1987, 29SPD3471, *M. Ladero & A. Amor s.n.* (SALA 76589); ibid., Sierra Fría, 1-VI-1984, *E. Rico s.n.* (MA 560845, SALA 57193, SALA 58364). **Cádiz**: Pinar del Rey, prope San Roque, IV-1984, *G.C. Churchill 644* (K). Tarifa, Sierra de Salaviciosa, cortijo de Salaviciosa, 28-IV-1989, *Z. Díaz & B. Valdés s.n.* (SEV). **Huelva**: La Nava, sierra de las Herrumbres, Pto. de los Arrumiados, 23-V-2004, 29SPC9506, *I. Pérez Núñez, M. Martínez-Azorín, M.B. Crespo & C. Pena s.n.* (ABH 50131). **Málaga**: Cortes de la Frontera, Cortijo las Alegrías, 30-IV-1983, TF8455, *A. Aparicio & S. Silvestre s.n.* (SEV). Cortes de la Frontera, cerro del Rubio, 3-V-1990, TF8556, *Aparicio & Silvestre s.n.* (SEV). **Ourense**: Coto de Novelle, Castrelo de Miño (Barral), 19-VII-1935, material con cápsulas, *A. Rodríguez s.n.* (MA 21869). Sierra del Paraño, 29-VI-1986, *X. Giráldez s.n.* (SALA 43978). **Pontevedra**: Cangas, Vilanova, prox. Area Brava, 27-IV-2006, 29TNG1283, *A. Juan s.n.* (ABH 51024). Beamil, 8-V-1955, *F. Bellot & B. Casaseca s.n.* (MA 183184). Bueu, entre Donón y Cabo de Home, 9-IV-1986, 29TNG1178, *M.J. Toimil s.n.* (GDA 24549, MA 406692, MACB 26843, SALA 44643, SALA 80601, SANT 17585). Covelo, Lamosa, 24-V-1998, 29TNG5575, *Amigo, Ortíz, Louzan, Quintanilla & San León s.n.* (SANT 39777). Dozón, Maceiras, 15-VI-1982, 29TNH71, *M. Horjales & N. Redondo s.n.* (MA 432863). Entre Carril y Catoria, 8-V-1953, *Bellot & Casaseca s.n.* (GDA 37612). Entre Puentecesures y Cataisor, 5-V-1957, *F. Bellot & B. Casaseca s.n.* (SANT 09497). Isla de la Toja, 10-V-1954, *A. Rodríguez s.n.* (MA 199768). La Lanzada, El Grove, 25-IV-1954, *Bellot & Casaseca s.n.* (SANT 08981). Near Vigo, 19-VI-1935, *B. Schafer s.n.* (K). Os Chans, Cela, Bueu, 6-VI-1971, *S. Castroviejo s.n.* (MA 197926). Puentecesures (Infesta), 23-V-1948, *Viéitez s.n.* (SANT 02901). Vila de Cruces, Berredo, frente a Mourazos y Santiso, riberas del río Ulla, 10-VI-1999, 29TNH7843, *J. Amigo, R.I. Louzán & al. s.n.* (ABH 42990, MA 634461, SANT 41853, SALA 100115).

MOROCCO. **Region of Tanger-Tétouan:** Tánger, Yebel, Kibir, VI, *Broussonet s.n.* (MA 21576). Draa-el-Aleff, V-1928, *Vidal & López s.n.* (MA 21886). In fruticetibus tingitanus, VIII-1825, *Salzmann s.n.* (K). Tetouan, (Tetouan N), Ksar-es-srhir, Ed diki, 18-IV-1988, *Silvestre, G. Rowe & Vilches s.n.* (SEV). Montis Dersa, juxta Tetauen, 16-IV-1928, *Font Quer s.n.* (GDA 37613). Tanger, herb Broussonet, 1821, *Bourchet Doumerg s.n.* (K). Tanger, 1854, *Bentham s.n.* (K). Tanger, 1867, *Hooker s.n.* (K). Djabel Kebir, Tangier, IX-1916, *Rony* 1089 (K). Tangier & Tetuan, IV-1871, *Hooker s.n.* (K). Tangier to Meknes, IV-1980, *Drumond-Hay s.n.* (K). Tangiers, IV-1931, *A.W. Trethewy 377* (K). Tetuán, 16-IV-1928, *Mas Guindal s.n.* (MA 21887). Tánger, Cap Spartel, côte atlantique, 4-III-1995, 35º46´51"N 5º56´11"W, *J. Lambinon & G. Van Den Sande s.n.* (MA 581730). Region de Tanga: c. 16 km W of Tanger, near Cap Spartel Lighthouse, 25-II-1994, 30S 235098 3964046, *S.L. Jury 13298* & al. (K, SEV). Chefchaouen, Bab Taza, vertiente oriental del Jbel Khizana, pista de Fifi, despues del primer collado, 19-VI-1993, *J. Molero, J.M. Montserrat, J. Pallàs, J. Vicens & M. Veny JMM4139/1* (SEV). Prox. El Ksar-el-Quebir, 27-III-1930, *Font Quer s.n.* (GDA 37614, MA 21885). **Region of Casablanca**: Boulhaut Root, near Casablanca, II-1930, *A.W. Trethewy 130* (K).

PORTUGAL. **Algarve**: Algarve, 22-IV-1981, *M. Ladero & cols.* s.n. (SALA 62059). Barranco Velho, 14-IV-1996, 29SNB92, *Camuñas, Cristóbal, Juan, Crespo & Serra s.n.* (ABH 30977). Broussailles à Faro, 30-III-1853, *E. Bourgeau s.n.* (K). Caldeirao, 24-IV-1968, *A. Segura Zubizarreta s.n.* (MA 355429). Faro, IV-1889, *A. Moller s.n.* (MA 21883). Loulé, entre Porto Nobre e o cruzamento para Querenca, cabeço xistoso com sombreira, a norte da Riba das Merces, 25-IV-1979, *J. Malato-Beliz & J.A Guerra 15564* (MA 285495). Monchique, Fojo de Baixo, 12-V-1952, *M.N.P. Silva s.n.* (LISU). Prox. de Alportel nos matos, 22-IV-1956, *J. Malato-Beliz & al. s.n.* (MA 285489). Quarteira, 22-IV-1981, *B. Casaseca, M. Ladero & Navarro s.n.* (MA 258899, SALA 24790). Serra de Monchique, 24-IV-1956, *J. Malato-Beliz & al.* 3067 (MA 285488). Serra de Monchique, estrada Monchique-Saboia, 500 m antes do cruzamento para o Barranco da Maceisa, 30-V-1979, *J. Malato-Beliz & J.A. Guerra 16005* (MA 285494). Serra do Caldeirao, Miradouro, no monte, 24-IV-1968, *A. Rozeira, J. Alte, G. Costa & A. Serra s.n.* (MA 258900). **Alto Alentejo**: Freg. de Crato e Martires, Herdade do Murtal, 30-IV-1956, *J. Gama Matertino* (LISU). Serra de Ossa, en costa S de Saô Gens, 28-IV-1983, *C. Antunes & J.A. Guerra s.n.* (LISU). Serra de Ossa, prox. do Bomemto, 8-V-1956, *J. Malato-Beliz & J. Guerra 3377* (MA 285487). Serra de S. Mamede, prox. de Marvao: entre o Jardim e Rabaca, 27-IV-1957, *J. Malato-Beliz & al. 4116* (MA 285485). Transtagan, ericetis prope Vendas, 30-V-1851, *Welwitsch s.n.* (K). Vendas Novas, Pinhal das Odegas, 10-IV-1949, *R. Fernandes & Sousa s.n.* (MA). **Baixo Alentejo**: Cadaval, Cercal, Fontainhaes (sierra de Montejunto), 19-V-1989, *D. Espírito Santo & J.C. Costa s.n.* (LISU). Cercal, Serra da Moina, Sobreiral de encosta a NW, 25-IV-1984, *J. Malato-Beliz & J.A Guerra 18531* (MA 420864). Ferreira do Alentejo, Peroguarda, Serra do Mira, 3-V-1996, *I. Moreira & E. Sousa s.n.* (LISU). Odemira, S. Luis, Serra de S. Luis (Serra do Cercal), 15-IV-1995, *J.C. Costa s.n.* (LISU). Praia da Zambujeira, 19-IV-1968, *J. Malato-Beliz & al. 5666* (MA 285484). Torrao, 1-V-1980, *F. Amich, E. Rico & J. Sánchez s.n.* (SALA 42119). Vila Nova de Milfontes, margem esquerda do Rio Mira, 26-IV-1984, *M. Beliz & J.A Guerra 18573* (LISU). **Beira Alta**: Saô Pedro do Sul, Manhouce, a SW de Salgueiro, à ribeira da abundância, 3-VI-1968, *A. Cunha Direito s.n.* (LISU). Tondela, Caramulinho, Serra do Caramulo, 28-V-1996, *P. Matos & A.L. Crespí 1345* (LISU). Vouzela, Campía, Cambarinho, 30-V-1972, *J.A. Franco 5262* (LISU). **Beira Baixa**: Estrada para Castelo Branco, a 8 km de Rodao, 9-V-1980, *J.A. Guerra 1469* (MA 285492). Penamacor, Monte da Falsa, 17-IV-1952, *J.A. Franco s.n.* (LISU). **Beira Litoral**: Alcobaça, Serra dos Candieiros, encosta voltada, a W a 1250 m da estrada velha em frente de Ataíja de Coina, 26-V-1959, *J. Vasconcellos & J. Amaral Franco s.n.* (LISU 59138). Arouca, Albergaria das Cabras, Vidoeiro, 4-VI-1968, *A. Cunha Direito s.n.* (LISU). Coimbra, Dianteiro, 1-V-1946, *Manuel da Silva 764* (MA 89008). Figueira da Foz, Quiaios, Serra da Boa Viagem, 29-IV-1988, *J.A. Franco, M. Lousâ & J.C. Costa s.n.* (LISU). Circa Coimbra, IV-1876, *Henriques s.n.* (K). Matta do Rangel prope Conimbricam, IV-1883, *A. Moller s.n.* (K). Porto de Mós, Alvados, alto de Alvados, 20-V-1979, *I. Moreira s.n.* (LISU). Vale da Quebrada, conc. da Batalha, 9-V-1963, *C. Trindade s.n.* (LISU). Vale de Cambra, Arôes, Costa da Castanheira, 3-VII-1968, *A. Cunha Direito s.n.* (LISU). Vila Nova D'Ourem, Fátima, a 1,5 km da aldeia, 17-V-1967, *L.M. Lopes Fonseca s.n.* (LISU). **Douro Litoral**: Porto, V-1915, *J.M. de Barros s.n.* (MA 21882). Póvoa de Varzim, III-1920, *Joaquim Sampaio s.n.* (MA 21881). **Estremadura**: Serra de Arrábida, entre Setúbal y Arrábida, 1-IV-1985, *M. Luceño & P. Vargas s.n.* (MA 433793). Setúbal, prox. de Cascalheira-Casal do Marco, 7-V-1975, *M.F. Correia 4337* (LISU). Sintra, arredores no pinhal do Escouto, proximo das Merces, 30-IV-1944, *Bento Rainha 216* (SANT 02898). **Minho**: Serra de Arga, en cumbre, próximo a las antenas de radio y TV, 25-V-1998, *I. Pulgar* (SANT 39980). Viana do Castelo, Montedor, 20-IV-1977, *J. Malato-Beliz & J.A Guerra 13323* (MA 285496). **Ribatejo**: Abrantes, Herdado do Pereiro, 1953, *A. Barreira Ponte s.n.* (LISU). Alcanena, Monsanto, 30-IV-1980, *M. Lousa & al. s.n.* (LISU). Azambuja, Virtudes, V-1941, *J.M. Carvalho & F.M. Flores s.n.* (LISU). Conc. Almeirim, Freg. da Raposa, Hord de Besteiros, 9-V-1954, *J. Manuel Boieiro s.n.* (LISU). Prox. Castelo do Bode, 1-V-1955, *J. Malato-Beliz & al. s.n.* (MA 285490). Rio Maior, Azinheira, Penegral, 9-V-1983, *T. Vasconcelos & G. Melo s.n.* (LISU). Santa Margarida da Coutada, Carvalhoso-Châ, 12-V-1954, *L.F.A. Velho Beirrâo s.n.* (LISU). Tomar, Castelo do Bode, naserre entre a central electrica e o cruzamento do estrada para To-

mar, 6-V-1954, *Beliz & Raimundo s.n.* (MA 285491). Santarém, Torre do Bispo-Carvalhal, IV-1941, *J.M. Carvalho & F.M. Flores s.n.* (LISU).

Localities selected from the bibliography

SPAIN. **Cádiz**: Alcalá de los Gazules, 30STF64 [cf. Díez & Pastor, 1985]. Sierras de Algeciras, 30STE79, [cf. Gil & al., 1985]. Entre Algeciras y San Roque, 30STF70 [cf. Pérez Lara, 1886]. **Lugo**: cerca de Vivero, 29TPJ13 [cf. Merino, 1909]. **Pontevedra**: P.N. Islas Atlánticas (Islas Ons y Onza), 29SNG09 [cf. Castroviejo, 1969]

MOROCCO. **Region of Tánger-Tétouan**: Entre Ksar el Kebir et Larache dans le sous-bois de chênes lièges situé avant Aouamara (Larache 442,2 × 493,4), 11 Mars 1983 (JM) [cf. Moret, 1988]. Entre Larache et Azilah, El-Krota à 20 km de Larache dans le bas de la pente à l'Est de la route, (Larache 442 × 521,6), 3 Avril 1984 (JM) [cf. Moret, 1988]. **Region of Taza-Al Hoceima-Taounate**: Jbel Outka, bord de ruisselet près de Bâb Mareklo, 12 Mai 1949 (RAB 26803) [cf. Moret, 1988]. Beni Zeroual, versant Ouest du Dj. Outka, 5 Avril 1928 (RAB 26805) [cf. Moret, 1988]. **Region of Rabat-Salé-Zemmour-Zaër**: Mamora Lot C, 11 Mars 1958 (RAB 4389) [cf. Moret, 1988]. Rive droite de l'oued Nefifikh, entre la route S 222 et l'autoroute, (Casablanca, 320,6 × 347,4), 13 Mars 1984 (JM) [cf. Moret, 1988]. **Region of Marrakech-Tensift-Al Haouz**: Marrakech [cf. Maire, 1958].

2. Ornithogalum concinnum Salisb., Prodr. Stirp. Chap. Allerton: 240. 1796

O. unifolium var. *concinnum* (Salisb.) Ker Gawl. in Bot. Mag. 24: 953. 1806. *Cathissa concinna* (Salisb.) Salisb., Gen. Pl.: 34. 1866. *Ind. loc.:* "Juxta Gibraltar sponte nasci fertur, unde habuit Fothergill anno 1780" [probably erroneus, since this species does not grow in that area]. TYPE: ESP, Zamora: Torregamones, sobre un asomo granítico al pie de un grupo aislado de encinas., UTM: 29TQF3397, 760 m, 18-V-2003, *M. Martínez-Azorín*, ABH 47140 (neotype, designated by Martínez-Azorín & al., 2006).

O. roccense Link in J. Bot. (Schrader) 2: 320. 1799. *Cathissa roccensis* (Link) Speta in Stapfia 75: 171. 2001. *Ind. loc.*: "Auf dem Cabo da Rocca" [sic; Portugal]. TYPE: not extant at B [synonym from description].

O. subcucullatum Rouy & Coincy in Bull. Soc. Bot. France 37: 167. 1890. *Ind. loc.*: "ESPAGNE: province d'AVILA: au pied des rochers autour d'Avila et de la Venta del Obispo, pêle-mêle avec les Agraphix (herviré Rouy, leg. de Coincy)". TYPE: LY (not seen) [synonym from description and illustrations in Coincy (1893: tab. 9)].

Illustrations: Ker Gawler, Bot. Mag. 24: 953. 1806 [ut *O. unifolium* β *concinnum*]; Coincy, Eclog. Pl. Hisp. 1: 22, tab. 9. 1893 [ut *O. subcucullatum*]; Fig. 6.

Geophyte, (10)13-32(42) cm high; bulb 1.6-2.5(3) × (1)1.3-2.5(2.8) cm, ovoid-subspherical, with contractile roots, usually without or with few (2-3) offsets; outer tunics pale brown. Leaves synanthous, 2-3(5), in a basal rosette, (9)15-30(45) × (0.4)0.6-1.5(2) cm, linear or linear-lanceolate, slightly canaliculate, somewhat glaucous green, glabrous, suberect, usually withering at tips. Floral stem (8)10-20(26) × 0.3-0.4 cm, equal to shorter than leaves, erect, glaucous-green, smooth and glabrous. Inflorescence racemose-spiciform, dense, (2)3-12(16) × (0.3)0.4-0.6(0.7) cm, (excluding the flowers but not their pedicels), with (4)7-20(33) flowers; bracts (8)9-16(19) × (4)5-8 mm, much longer than the accompanying pedicel, ovate-lanceolate to triangular, membranous, whitish-hyaline with setose acuminate greenish to brownish apex, sometimes toothed at the basal part; floral pedicels erect or slightly patent, lower ones 2-8 mm, middles ones 1-4(5) mm, and upper ones 1-2(3) mm; fruiting pedicels 4-8 mm, erect and appressed to stem. Flowers 25-30 mm in diameter, slightly fragrant; tepals white, lanceolate to linear-lanceolate, erect or erect-patent, with dense papillate-glandulose apex; outers 13-16(18) × (3.5)4-5(6) mm; inners (12)13-16(18) × 4.5-5(6) mm, being somewhat wider (0.5-1 mm) than the outers. Stamens 6, ½ to ⅔ of the tepal length; filaments white, linear-lanceolate, progressively tapering in a point in the upper third, (6)8-9(10) × 1-1.3 mm, inners somewhat wider; anthers dorsifixed, pale yellow to whitish, 2 × 1 mm. Ovary 4-5(6) × 2 mm, pale green, narrowly ovoid-fusiform to lanceolate, attenuated at the apex, trigonous with three obtuse ridges, bearing nectariferous septals; style whitish, filiform, 4-5 mm; stigma capitate, trigonous, with decurrent glandulose ridges. Capsule (9)11-14(16) × (5)6-9(10) mm, ovate-elliptic, acute, slightly apiculate, trigonous, pale brown, with trivalvar dehiscence through the upper half. Seeds (6)15-40(43) per capsule (n = 23), 1.8-4.9 mg, 2.8-3.9 × 1.7-2.3 mm, dull black, flattened, angulose, with winged edges, testa ruminate or puzzle-like (Type 3), with cells flat with smooth to slightly rugulose surface, delimited by deep sinuate furrows.

Number of chromosomes: $2n = 36$ (Neves, 1952, 1973). $2n = 36$ + (O-6B) (Neves, 1952, 1973; Darlington & Wylie, 1955). $2n = 36$ + (3-5B) (Gallego Martín & Sánchez Anta, 1986).

Biology: This species flowers from March to July, exceptionally to November (Quiroga, Lugo). It usually does not bear offsets or they are in low number, though usually the bulb splits up into two or three equal parts, each of them producing a contiguous mature plant. The reproduction of this species is mainly by seeds. Dehiscence of capsules occurs immediately after ripening, and more rapidly than in *O. broteroi.*

Habitat: Open forest and scrubs, mainly on siliceous soil and in continental areas. It grows between 200 and 2000 m altitude.

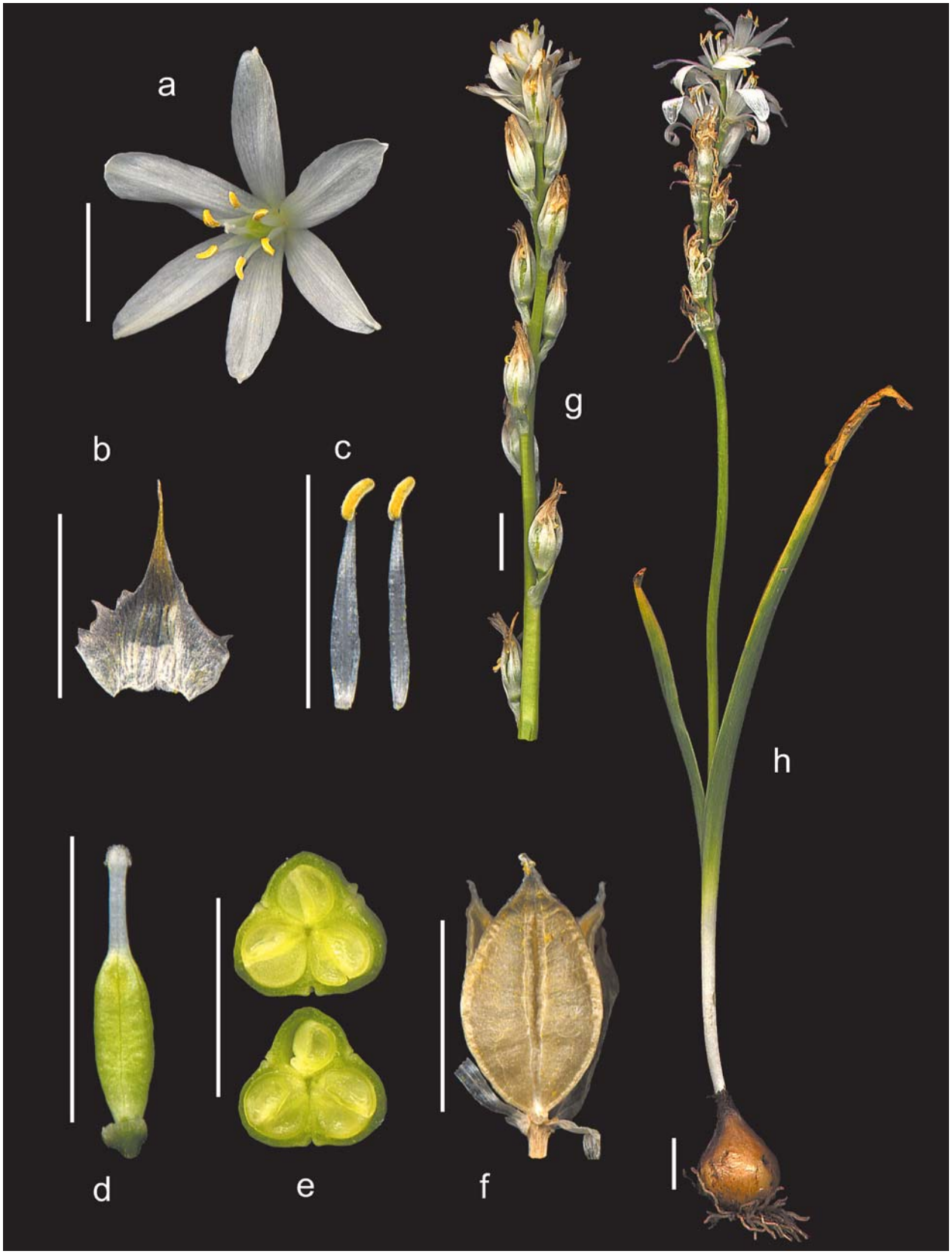

Fig. 6. *Ornithogalum concinnum* [a-g) Ávila, Hoyocasero, Spain: *Martínez-Azorín & al. s.n.* (ABH 47141); h) Zamora, Torregamones, Spain: *Martínez-Azorín s.n.* (ABH 47140) (corresponding to the neotype designated by Martínez-Azorín & al., 2006)]: **a,** flower; **b,** bract; **c,** inner stamen (left) and outer (right); **d,** gynoecium; **e,** sections of the immature capsule; **f,** capsule after dehiscence; **g,** inflorescence; **h,** general view. Scale = 1 cm.

Distribution: Endemic to the northwestern Iberian Peninsula (Fig. 7). It covers a quite continuous continental areas of the northewestern quadrant, except for a couple of locations in the coastal areas of Portugal, near Cabo da Roca (Estremadura) and the surroundings of Alcácer do Sal (Baixo Alentejo), both apart over 200 km from the main distribution nucleus. Intermediate populations between both areas would be expected, though all studied collections from there belong undoubtedly to *O. broteroi*.

Observations: Living individuals of *O. concinnum* usually produce two or more leaves per stem, usually longer and many-flowered inflorescences, and the ovary with a fusiform outline. As said before, herbarium materials of *O. concinnum* lacking leaves have been misidentified as *O. broteroi*. However, the much bigger seeds and capsules warrant a correct identification. This species is abundant in the sites where it grows. It does not seem to face serious threats. UICN (2001) category: LR lc.

Selected material

SPAIN. **Ávila**: Barco de Ávila, 24-V-1976, 30TTK86, *A. González, G. López & al. s.n.* (MA 432857). Castille, montagnes d'Avila, V-1907, *Pau s.n.* (MA 21876). Fuentesclaras, loc. dict., 28-V-1935, *L. Ceballos s.n.* (MA 21870). Hoyocasero, Cueva del Maragato, 15-VI-1985, 30TUK2877, *M. Luceño & P. Vargas s.n.* (MA 515545). Hoyocasero, Sierra de Gredos, pista antes de cruzar el puente, 19-V-2003, 30TUK3274, *M. Martínez-Azorín s.n.* (ABH 47141). Hoyos del Espino, 24-V-1992, 30TUK147676, *Felipe Martínez García s.n.* (MACB 84195). In monte Pico Zapatero, Montes Avilae, 13-VI-1893, *A.E. Lomax s.n.* (MA 21875). La Cañada, 4-VI-1980, 30TUK7395, *F. Muñoz & E. Valdés-Bermejo s.n.* (MA 43256). Navarredonda de Gredos, 5-VI-1992, 30TUK213684, *Felipe Martínez García s.n.* (MACB 77044). Puerto de Menga, Valle de Amblés, 20-V-1976, *Fuertes & Ladero s.n.* (GDA 8959). Puerto de Villatoro, 18-V-1976, *E. Fuentes Larole s.n.* (MACB 61667). Sierra de Gredos, del Tormes al Refugio (Mitan superior), V-18.., *E. Huguet del Villar s.n.* (MA 175544). Sierra de Paramera, El Portacho, prox. al Risco Redondo, 8-VII-1978, Sierra de Gredos, *E. Fuertes s.n.* (MACB 7601). Santiago del Collado, Sierra de Gredos, Pto. de la Peña Negra, 21-V-1997, 30TUK0577, *Crespo, Camuñas, Cristóbal, Juan & Serra s.n.* (ABH 40165). Sierra de la Paramera, Sotalvo, proximidades del castillo de Manqueospese, 24-IV-1988, 30TUK4588, *A. Izuzquiza, R. Elvira, I. Granzow, R. Montalvo, B. Ruiz & M. Sánchez s.n.* (MA 439919). Sierra del Zapatero, barranco del Majadal, 9-VII-1978, *Fuerte & Ladero s.n.* (MA 213602). Subida a la Serrota desde el Pto. de Menga, 26-VI-1985, *R. Morales, G. Nieto, M. Luceño, J. Pechal & P. Vargas s.n.* (MA 407278). **Badajoz:** Alburquerque, 23-IV-1981, *B. Casaseca, M. Ladero & F. Navarro s.n.* (MA 258873, MACB 61710, SALA 24630, SALA 61183). Alburquerque, carretera de Alburquerque a Valencia de Alcántara, 15-IV-1988, PD74, *I. Espárrago & M.C. Viera s.n.* (MA 507368). **Cáceres**: 12 km al norte de Trujillo, 18-III-1985, 30STJ58, *J. Fernández Casas & A. Susanna s.n.* (GDA 24661, MA 345953, MACB 24481, OVI 17066, SALA 42885, VAL 56054). Cañaveral, 26-III-1985, 29SQE0910, *M. Ladero & Fernández-Arias s.n.* (SALA 72977). Casar de Cáceres, 25-III-1975, *Bote, M. Ladero, J.L. Pérez Chiscano & S. Rivas Goday s.n.* (GDA 6091, SALA 34290, VAL 128487). Cuacos de Yuste, 13-IV-1987, 30TTK6843, *A. Amor s.n.* (SALA 76463). El Piornal, 12-VI-1979, *Carrasco & Velayos s.n.* (MACB 7996). Garganta de la Olla, arroyo Majaelbrera, 2-VI-1993, 30TTK6144, *G. Aragón & J.L. Castillo s.n.* (MA 528680). Cáceres, 27-III-1975, *J.L. Pérez Chiscano s.n.* (MA 456510). Trujillo, 17-III-1990, *J.L. Pérez Chiscano s.n.* (MA 483074). Las Hurdes, 21-V-1947, *A. Caballero s.n.* (MA 21873). Las Hurdes, Casares de las Hurdes, riberas del río Hurdano, 4-V-1994, 29TQE2579, *E. Rico, F. Amich & al. s.n.* (MA 719381). Las Hurdes, Riomalo, 10-IV-1977, *F. Navarro s.n.* (OVI 05299). Las Mestas, 17-IV-1993, 29TQE47, *G. Mateo s.n.* (VAL 81627). Région forestiere superieure de la Sierra de Majareina, andessus de Gerte pres Plasencia, 18-VI-1863, *E. Bourgeau s.n.* (K, MA 21877). Salida de Cáceres a Valencia de Alcántara, 24-III-1979, 29SQD1469, *G. López 967* (GDA 23379, MA 437135, MACB 35298, SALA 45666, VAL 68740). Sierra de Montánchez, 3-III-1988, 29SQD44, *J.A. Devesa & R. Tormo s.n.* (MA 507402). Trujillo, 19-III-1990, 30STJ5272, *J.L. Pérez Chiscano s.n.* (SALA 85269). Valencia de Alcántara, cercanías de la ermita de Barbón, 27-IV-1994, 29SPD5361, *E. Rico, F. Amich & al. s.n.* (MA 716837). Villasbuenas de Gata, 14-IV-1977, 29TPE9154, *A. Valdés Franzi s.n.* (SALA 74241). Zorita, 10-IV-1974, *Carrasco & Castroviejo s.n.* (MACB 33147). **León**: La Baña, Campo Romo, junto a la estación de montaña Trevinca, 9-VII-1983, 29TPG8687, *G. Nieto Feliner s.n.* (MA 280061). Ponferrada, montes Aquilianos, carretera de Villar de los Barrios al Morredero, 19-VI-1981, 29TQH0402, *Alamillo, Castroviejo, Fdez.-Quirós & Nieto s.n.* (MA 280037). **Lugo**: Quiroga, Paradaseca, en el valle del río Soldón, 26-XI-1981, *J. Amigo & J. Guitián s.n.* (GDA 23229, MA 463738, SALA 80722). **Ourense**: Cabeza de Manzaneda, VI-1898, *M. Gandoger s.n.* (MA 21880). Camino de Campo Romo a Peña Trevinca, 29-VII-1983, 29TPG88, *B. Casaseca & E. Rico s.n.* (SALA 9449). Carballeda, subida a Peña Trevinca, Fonte da Cova, 29-VI-1994, 29TPG8687, *M.A. Carrasco, F. Castilla, M.A. Martín & M. Velayos s.n.* (MACB 52147, MA 542993). La mezquita, 2-V-1987, *X. Giráldez & E. Rico* (SALA 47077). Lovios, río Villameá, 28-VI-1984, 29TNG7740, *S. Castroviejo s.n.* (MA 437140). Nogueira de Ramuín (Luintra), C. Vilaquinte, 3-VII-1993, 29TPG19, *J. Amigo & M.I. Romero s.n.* (MA 551015, OVI 21443). Peña Trevinca, 14-VII-1984, *Casaseca & M. Ladero s.n.* (SALA 92393). Serra do Invernadeiro, alto da Regueira, 20-VII-1973, *S. Castroviejo s.n.* (MA 197925). Serra do Invernadeiro, Villarino de Conso, entre Rocín y Vega de Meda, 21-VI-1973, *S. Castroviejo s.n.* (MA 197924). Sierra de Manzaneda, 14-VI-1958, *F. Bellot & B. Casaseca s.n.* (MA 183185). Sierra del Invernadero, 22-VI-1982, *G. Blanca, A. Romero & F. Valle s.n.* (GDA 14917). **Salamanca**: Aldea del Obispo, 22-IV-1976, *E. Rico s.n.*

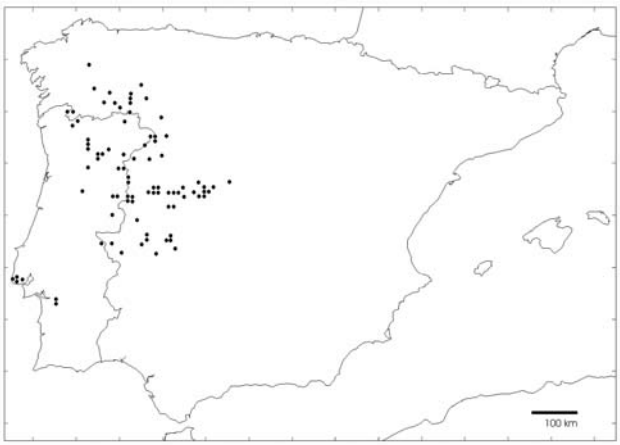

Fig. 7. Distribution of *Ornithogalum concinnum*.

(MA 204099, SALA 10245). Aldeacipreste, 6-V-1976, *Bote, Ladero & Rivas Goday s.n.* (GDA 7168, MA 258874). Base de la Peña de Francia, 15-VI-1974, *S. Castroviejo s.n.* (MA 432578). El Payo, 2-VII-1982, *A. Valdés Franzi s.n.* (SALA 74240). Gomeciego, 6-V-1976, *F. Amich s.n.* (MA 258871, SALA 15700). La Alberca, carretera de Las Batuecas, 24-VI-1946, *A. Caballero s.n.* (MA 21871, MA 21872). La Alberca, Peña de Francia, sierra de la Alberca, Valle de las Batuecas, 11-IV-2004, 29TQE4183, *M. Martínez-Azorín, A. Martínez & E. Azorín s.n.* (ABH 50127). La Hoya, Sierra de Béjar, 15-VII-1983, *F. Amich & F. Herrero s.n.* (SALA 35450). Las Batuecas, 6-IV-1973, *F.J. Fernández Díez s.n.* (SALA 5759). Masueco, ribera del río Uces, 17-III-1978, *F. Amich s.n.* (SALA 15682). Montemayor del Río, 17-V-1983, *E. Rico & A. Guillén s.n.* (MA 317818, SALA 37310). Navacarros, Arroyo del Oso, 28-VI-1984, *F. Herrero s.n.* (SALA 35451). Navasfrías, 17-V-1980, *E. Rico s.n.* (GDA 11999, MA 258877, MACB 7406, OVI 03520, SALA 25876, SALA 63742, VAL 135661, VAL 93983). Navasfrías, Puerto de las Mezas, 19-VI-1985, 29TPE8359, *X. Giráldez & E. Rico s.n.* (SALA 99522). Portillo de Batuecas, 20-III-1973, *J. Aldasoro s.n.* (MA 654525). Puente del Congosto, 11-V-1969, *B. Casaseca s.n.* (MACB 02807, MA 191745, SALA 3408). Saldeana, 7-IV-1982, *M. Ladero, Navarro & C. Valle s.n.* (MA 258876, SALA 63904, VAL 135660). Villarino de los Aires, 6-V-1976, *J. Sánchez s.n.* (MA 258872, SALA 17707). Zona de Ledesma, Embalse de la Almendra, V-1982, *J. Luis Fernández Alonso s.n.* (MA 519782). **Zamora**: Cuzcurrita, 6-V-1979, *J.A. Sánchez Rodríguez s.n* (SALA 33383). Fermoselle, 6-III-1980, *J.A. Sánchez Rodríguez s.n.* (SALA 33385). Peña Trevinca, 16-VII-1982, 29TPG88, *J. Andrés & F. Llamas s.n.* (MACB 41228). Parque natural de Sanabria, Ribadelago, 18-V-1987 (MA 509812). Sanabria, San Martín de Castañeda, subida a la laguna de los peces, 13-VI-2001, 29TPG8768, *L. Delgado & X. Giráldez s.n.* (SALA 103042). Sesnández, El Cotico, 15-VI-1996, 29TQG4333, *P. Bariego Hernández s.n.* (MA 651710). Tábara, Alto de los Cosos, 8-VI-1996, 29TQG4639, *P. Bariego Hernández s.n.* (MA 651700). Torregamones, 18-V-2003, 29TQF3397, *M. Martínez-Azorín s.n.* (ABH 47140). Vega del Castillo, Peña Negra, 5-VI-1990, *R. García Río s.n.* (SALA 54510). Villaseco del Pan, Peñas del Carro, 30-IV-1988, *R. García Río s.n.* (SALA 54509). **Galicia**: *P. Merino s.n.* (MA 21878).

PORTUGAL. **Alto Alentejo**: Castelo de Vide, Vale de Calecibras, 11-IV-1952, *Malato Beliz 229* (MA 285457). Serra de San Mamede, Castelo de Vide, estrada da Estaçao de C.F., em frente a casa dos cantoneiros, 5-V-1957, *Malato Beliz & al. 4349* (MA 188627, MA 285454). In Transtagana sabulosis inter segetes, V-1848, unico loco observatum (Herbarium Hookerianum-K). **Baixo Alentejo**: Alcácer do Sal, mata nacional de Valverde, III-1953, *J. Quita Quita s.n.* (LISU). Entre Grandola e Alcacer do Sal, 28-IV-1956, *Malato Beliz & al. 3317* (MA 285455). **Beira Alta**: Arredores de Vale Mourisco, Barrocal, 20-IV-1952, *A. Fernandes, F. Sousa & J. Matos s.n.* (MA 285456). Entre Tabuaço e Moimenta, Toiro Alto, 29-III-1945, *B. Barbosa, F. Garcia & J. Vasconcellos s.n.* (LISU 7878). Figueira de Castelo Rodrigo, Mata de Lobos, 13-IV-1944, *F. García & J. Pedrógão s.n.* (LISU 6309). Figueira de Castelo Rodrigo, Vale de Afonsinho, 8-IV-1944, *F. Mendoça & J. Vasconcellos s.n.* (LISU 6256). Near Vilar de Formoso, 24-IV-1967, *R.K. Brumitt & W.R. Ernst s.n.* (K). Sabugal, Sortelha, numa colina junto d'estrada, Sabugal-Sortelha, 26-IV-1987, *M. Lousâ, M.L. Rosa & J.P. Luz s.n.* (LISU). Tabuaço, Chavâes, ribeira de Fradinho, 7-VI-1941, *J. Gomes Pedro s.n.* (LISU 1535). Vila Nova de Paiva, Touro, 27-VI-1969, *J.J. Silva Melo s.n.* (LISU). Trancoso, freg. de Souto Maior, Qta. de Chapada, 14-IV-1954, *N. Meneses Costa s.n.* (LISU). **Beira Baixa**: Idanha-a-Nova (Sobral), 6-IV-1955, *J.A.G. Avelar s.n.* (LISU). **Beira Litoral**: Coimbra, cerca de Ervedal da Beira, 15-IV-1985, 29TNE97, *J. Fernández Casas & A. Susanna s.n.* (MA 345949, SALA 42785). **Estremadura**: Sintra, Cabo da Roca, proximidades del faro, 22-V-2004, 29SMC5792, *M. Martínez-Azorín, M.B. Crespo & C. Pena s.n.* (ABH 51026). Cascais, Ritouro, IV-1943, *Matos, J.M. Carvalho, F. Flores & E. Vales 2931/55* (LISU). Cintra Hills, V-1935, *S.C. Atchley s.n.* (K). Estoril, 1939, *J. Ogilvie s.n.* (K). Lisboa area, 1935, *Scarlett s.n.* (K). **Minho**: Arcos de Valdevez, Cabreiro, cabeceira do vale do rio Ramiseal, Seida, 26-V-1982, *J. Amaral Franco & M. Correia s.n.* (LISU 8451). Serra do Geres, entre Carris e Altar dos Cabrais, 11-VI-1958, *Malato Beliz & al. 4518* (MA 285453). Serra do Gerés, Lomba de Pan, 16-VI-1958, *Malato Beliz s.n.* (MA 285452). Serra do Gerez, Alto de Carris, 5-VII-1948, *J. Vasconcellos s.n.* (LISU 115). Serra do Gerez, Borrageira, 3-VII-1948, *J. Vasconcellos & al. s.n.* (LISU 71). Terras de Bouro, Vilar da Veiga, prox. da Malhadoura, 25-V-1982, *J.A. Franco & M. Correia s.n.* (LISU 8388). **Trás-os-Montes**: Alto Douro, Bragança, Seua de Nagueira, in pascuis pr. Santuario, 19-VI-1966, *P. Silva, B. Rainha & Y. Martins 7572* (MA 285458). Bragança, França, entre Fonte Ferrugenta e Fonte Fria (Serra de Montesinho), 4-VII-1980, *J. Amaral Franco & M. Lousâ s.n.* (LISU 7428). Carraceda de Ansiâes, Ribalonga, vale próximo do rio Tua, 16-IV-1942, *J. Gomes Pedro s.n.* (LISU 3271). Casais do Douro, Qta. do Teixeira, 17-IV-1942, sub-bosque, *J. Gomes Pedro s.n.* (LISU 3331). Castanheiro-do-Norte: S. Braz, no cimo do monte, *A. Rozeira s.n.* (MA 188626). Ligares, Fragán do Candedo, 30-IV-1942, *G. Barbosa, M. Myre & J. Gomes Pedro s.n.* (LISU 3577). Miranda do Douro, vertente a margen esquerda do Fresno próximo da confluencia com o Douro, 4-V-1944, *B. Barbosa & F. Garcia s.n.* (LISU 6506). Mondim de Basto, Ermelo, planalto da Fervença, 23-VI-1971, *A. da Costa P. & Cruz s.n.* (LISU). Urrós, Pena Ruiva, 23-IV-1941, *P. Lopes & J. Gomes Pedro s.n.* (LISU 597). Valença do Douro, Serra de Sendoés, 4-V-1942, *G. Barbosa, M. Myre & J. Gomes Pedro s.n.* (LISU 3871). Vila Real, n'esquerda do Corgo, 25-IV-1943, *F. Mendoça & J. Vasconcellos s.n.* (LISU 5262).

3. Ornithogalum reverchonii Lange ex Willk., Ill. Fl. Hisp. 2(18): 117. 1891 [*reverchoni*]

Cathissa reverchonii (Lange ex Willk.) Speta in Stapfia 75: 171. 2001.

Ind. loc.: "Hab. in regno Granatensi occidentali, ubi in fissuris rupium calcarearum regionis montanae crescit (in faucibus Tajo de Ronda dictis prope oppidum Ronda ad altit. circ. 200 m., Reverchon!). Floret Junio, Julio". TYPE: Willk., Ill. Fl. Hisp. 2(18): tab. CLVIII, atque explic. tabulae in p. 118. 1891 (lectotype = iconotype, designated by Martínez-Azorín & al., 2006).

O. jacobi Emb. & Maire in Bull. Soc. Hist. Nat. Afr. Nord 27: 132. 1936, nom. nud.

Illustrations: Willk., Ill. Fl. Hispan. 2(18): tab. CLVIII. 1891. Fig. 8.

Geophyte, (26)40-70(80) cm high; bulb 5-6 × 2.5-4 cm, ovoid, with contractile roots, usually without or with few (2-3) offsets; outer tunics pale brown, membranous. Leaves synanthous, 4-6, in a basal rosette, 50-80(100) × (1)1.5-2.5 cm, long tapering, glaucous, pale green, glabrous, drooping, with withered tips. Floral stem (20)30-50(55) × 0.6-0.7 cm, shorter than leaves, erect, glaucous-green, smooth and glabrous. Inflorescence in a lax raceme, (6)10-20(25) × (1)1.5-2.5(3.5) cm (excluding flowers but not their pedicels),

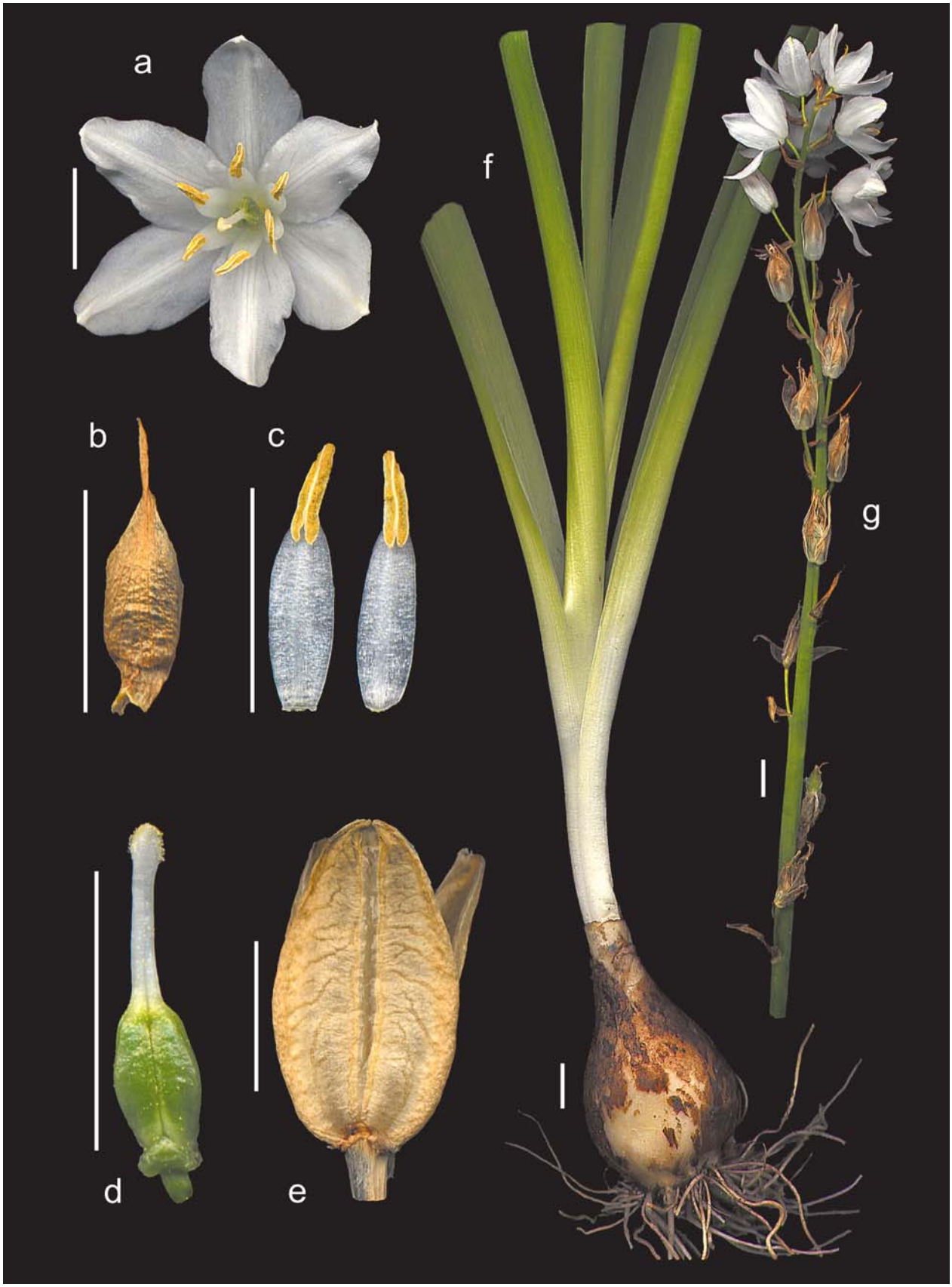

Fig. 8. *Ornithogalum reverchonii* [Spain, Cádiz, Grazalema, Tajo de los Pajaritos, *M. Martínez-Azorín s.n.* (ABH 47138)]: **a,** flower; **b,** bract; **c,** inner stamen (left) and outer (right); **d,** gynoecium; **e,** capsule after dehiscence; **f,** bulb and leaves; **g,** inflorescence. Scale = 1 cm.

with (9)10-15(18) flowers; bracts (18)20-30(32) × (5)6-8(10) mm, usually longer than the accompanying pedicel, oblong-lanceolate, early withering, brownish with long acuminate apex, with about 8 marked nerves; floral pedicels erect-patent, lower ones (7)9-18(25) mm, middle ones (6)8-15(18) mm and upper ones (2)3-8(10) mm; fruiting pedicels 15-20(25) mm, erect and appressed to stem. Flowers (25)35-40 mm in diameter, slightly fragrant, tepals white, rarely with a small and weak dorsal greenish band at the apex, widely elliptic to ovate-elliptic, subacute to obtuse or slightly truncate densely papillate-glandulose apex; outers (17)21-24(26) × (7)8-10(11) mm; inners (18)20-23(25) × (7)8-10 mm. Stamens 6, ⅔ to ¾ of the tepal length; filaments white, broadly oblong-lanceolate, 2-3 mm wide in all their length; outers (8)9-10 × 2-3 mm, inners (8)9-10(11) × 2-3 mm; anthers dorsifixed, sagittate, pale yellow to whitish, 6 × 1.8 mm prior to dehiscence and 4-5 × 1-1.2 mm after dehiscence. Ovary 6-7 × 2.5-3 mm, pale green, oblong-ovoid, rounded at the apex, trigonous, with three obtuse ridges bearing nectariferous septals; style whitish, filiform, (4)5-6 mm; stigma capitate, trigonous, with decurrent glandulose ridges. Capsule 20-25 × 12-13 mm, elliptic-ovoid, rounded at the apex, pale brown, with trivalvar dehiscence through the upper half. Seeds 15-25 per capsule (n = 19), 6-11 mg, 4.5-4.9 × 2.5-2.9 mm, dull blackish, markedly flattened and angulose, with slightly winged edges, testa irregularly granulate (Type 2).

Number of chromosomes: $2n = 32$ (own count). $2n = 32$ (Fernández & al., 1985; Pastor & Diosdado, 1994). $2n = 32 + 4B$ (Fernández Casas & García Guardia, 1977).

Biology: The vegetative period is from January to the end of July. It flowers from the beginning of March to June, exceptionally to July (Sierra de Almijara). Fructification begins in May and finishes at the end of July. The reproduction of this species is mainly by seeds, though some offsets can be produced (cf. Parra & al., 2000).

Habitat: In Cádiz and Málaga provinces, it grows in vertical limestone shady cliffs, facing north or northeast. It usually participates in perennial grasslands, growing in rock crevices or ledges in peaty soils. In Sierra de Almijara (Granada), it is found in open forests with understorey of *Cistus* sp., and in Sierra de las Villas (J) it grows in grasslands on loamy soils. In El Hajeb (Morocco), it was collected in open scrubs and on edges of cultivated grounds on clayey soils. This species is found between 600 and 1300 m altitude.

Distribution: Southern Iberian Peninsula and northwestern Morocco. In Andalucía it grows in Serranía de Ronda (Málaga, Cádiz), Sierra de Almijara (Granada) and Sierra de Cazorla (Jaén). According to Moret (1988), the only known Moroccan locality is El Hajeb (Morocco), where it is very rare (Fig. 9) and has no longer been collected in recent times.

Observations: Plants from El Hajeb (Morocco) were provisionally named *O. jacobi* Emb. & Maire, a name that was never validly published. The Spanish populations are rather small, occupying less than 10 000 m^2, though including many individuals. Thus, according to the UICN (2001) criteria, *O. reverchonii* was labelled as VU by Junta de Andalucía, and more recently as LR dc (cf. Parra & al., 2000).

Studied material

SPAIN. **Cádiz**: Grazalema, Tajo de los Pajaritos, 3-V-2003, 30STF8871, *M. Martínez-Azorín s.n.* (ABH 47138). Grazalema, 28-IV-1984, *A. Aguilella s.n.* (VAL 5578). Grazalema, 2-V-1986, *X. Giráldez s.n.* (MA 395440, SALA 41781). Grazalema, ermita los Ángeles, 21-V-1983, *A. Aparicio s.n.* (MA 469104). Hillside behind Grazalema, 21-IV-1968, *V. Horton 130* (K). Grazalema, Sierra del Pinar, Puerto de las Palomas, 5-IV-1981, *J. Fernández Casas & A. Susanna s.n.* (MA 258896, MA 355415, SALA 22568). Puerto de Grazalema, 30-V-1986, *M. Ruiz Rejón s.n.* (GDA 23473, GDA 23474). Grazalema-Pto. de las Palomas, 29-IV-1983, TF8770, *A. Aparicio & S. Silvestre s.n.* (K, SEV). Serranía de Ronda, Sierra de Conio supra Jimena, inter Grazalema & Sierra de Alibe pr. Monteajate, 29-V-1895, *Porta & Rigo s.n.* (K, P 00549872, P 00549873). Serranía de Ronda, 4-VI-1890, *E. Reverchon s.n.* (K, P 00549874). Villaluenga del Rosario, 24-III-1982, *M. Ladero & al. s.n.*.(SALA 63999). Villaluenga del Rosario, sierra del Caillo, subida Casa del Cao, 22-VI-1984, TF8765, *A. Aparicio & J.G. Rowe s.n.* (SEV). Grazalema, 27-IV-1999, *F. Amich, S. Bernardos, L. Delgado & E. Rico s.n.* (SALA 102960). Grazalema, Sierra

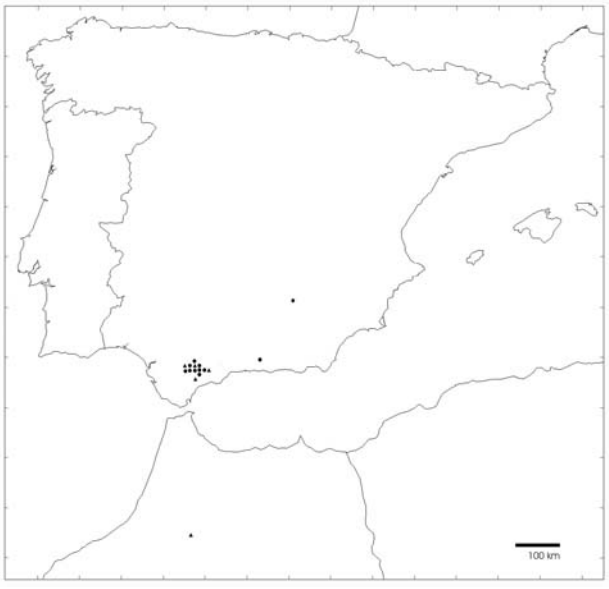

Fig. 9. Distribución of *Ornithogalum reverchonii*. Dots correspond to studied herbarium sheets; triangles indicate bibliographic data.

del Endrinal, subida al Reloj, 11-IV-1980, TF86, *F. García & S. Silvestre s.n.* (SEV 79639). Benaocaz, sierra de la Silla, 10-III-1984, TF7764, *A. Aparicio & J.G. Rowe s.n.* (SEV). El Gastor, sierra del Gastor, 29-V-1983, TF9280, *A. Aparicio & J.G. Rowe s.n.* (SEV). Grazalema, Coros, 13-VI-1986, TF8874, *A. Aparicio & J.G. Rowe s.n.* (SEV). **Granada**: Jayena, beside track leading to Herrero, 19-VII-1981, 36º53'N 3º43'W, *M.F. & S.G. Gardner 1317* (K). **Jaén**: Villacarrillo, Sierra de las Villas, por encima del embalse de Aguascebas, 3-V-1985, 30SWH0411, *C. Soriano s.n.* (MA 458975). **Málaga**: Cartagima, Sierra de Almola, 23-V-1932, *L. Ceballos & C. Vicioso s.n.* (MA 21892). Entre Ronda y Cartajima, Serranía de Ronda, Peña Roda, entrando por el cortijillo, 18-VI-1974, *S. Talavera & B. Valdés 2755/74* (SEV 90412). Serranía de Ronda, entre Ronda y Atajate, km 72, 21-III-1980, *J. Ubera & B. Valdés 280/80* (SEV 54881, SEV 55030). Ronda-Montejaque road, 24-IV-1964, *D.M.C. Briton-Lee s.n.* (SEV 82487). Montejaque, base de Hacho, 4-V-1983, VF0069, *A. Aparicio & S. Silvestre s.n.* (SEV). Montejaque, base de Hacho, sierra Juan Diego, Poyato de Pérez, 4-VI-1983, TF9767, *A. Aparicio & S. Silvestre s.n.* (SEV). Montejaque, Mures, 16-III-1984, *A. Aparicio & S. Silvestre s.n.* (MA 469122). Puerto de Encinas Borrachas, cerca de Ronda, 28-III-1982, *C. Arnaiz, J. Loidi & A.G. Bueno s.n.* (GDA 21234, MA 258897, SALA 67520, VAL 135666). Ronda, *Reverchon* (MA 21893).

MOROCCO. **Region of Meknès-Tafilalet:** In arvis et chamaeropetis argillaceis infra El Hajeb, 13-IV-1936, *Maire s.n.* (ut *O. jacobi* Emb. & Maire; RAB 26762). In arvis argillaceis infra El Hajeb, 14-IV-1936, *R. Maire s.n.* (P 00556196, P 00556197).

Localities selected from the bibliography

SPAIN: **Cádiz**: El Bosque, Sierra Albarracín, cerro del Ponce, 30STF77, [cf. Aparicio & Silvestre, 1987]. El Gastor, Sierra del Gastor, 30STF97, [cf. Aparicio & Silvestre, 1987]. **Málaga**: Gaucín, hacia Ronda, 30STF94, 18-III-1974, *González Bueno & López* s.n. (MAF 94095) [cf. Moreno Saiz & Soriano, 1989]. Sierra de Tolox y Yunquera, 30SUF26 [cf. Moreno Saiz & Soriano, 1989].

Acknowledgements

We thank the curators of the herbaria cited in the text for the loan of vouchers. Ignacio Pérez Núñez took us to populations of *O. broteroi* in Sierra de Aracena (Huelva). Julio Pastor (University of Sevilla) brought us important chorological information on the Andalusian populations of some taxa. Antonio Rivas Rangel and Junta de Andalucía brought us permissions and field help for collecting *O. reverchonii* in P.N. de Sierra de Grazalema (Cádiz-Málaga).

References

Aparicio, A. & Silvestre, S. 1987. *Flora del Parque Natural de la Sierra de Grazalema*. Junta de Andalucía, Agencia de Medio Ambiente, Monografías del Medio Ambiente, Sevilla.

Baker, J.G. 1873. Revision of the genera and species of Scilleae and Chlorogaleae. *Journal of the Linnean Society* 13: 209-292.

Castroviejo, S. 1969. *Catálogo de Ons y Onza*. O.A.P.N. Madrid, inédito.

Coincy, A.H. 1893. *Écloga plantarum hispanicarum*. Masson Éd., Paris.

Coskuncelebi, K., Kandemir, A. & Beyazoglu, O. 2000. Scanning electron microscopic examination of Ornithogalum (Liliaceae) species distributed in Black Sea Region of Turkey. *Biologia, Bratislava* 55(4): 397-401.

Darlintong, C.D. & Wylie, A.P. 1955. *Chromosome atlas of flowering plants*. George Allen & Unwin Ltd. Londres.

Díez, M.J. & Pastor, J. 1985. Contribución al estudio del polen y las semillas de la tribu Scilleae (Liliaceae) en Andalucía Occidental. *Anales del Jardín Botánico de Madrid* 41(2): 351-360.

Fernández, I., Díez, M.J. & Pastor, J. 1985. Números cromosómicos para la flora española, 373-381. *Lagascalia* 13(2): 299-302.

Fernández Casas, J. & García Guardia, G. 1977. Números cromosómicos para la flora española, 35-38. *Lagascalia* 7(2): 209-210.

Franco, J.A. & Rocha Afonso, M.L. 1994. *Nova Flora de Portugal (Continente e Açores). (Alismataceae-Iridaceae)* 3(1). Escolar Ed. Lisboa.

Gallego Martín, F. & Sánchez Anta, M.A. 1986. Números cromosomáticos de plantas occidentales, 376-384. *Anales del Jardín Botánico de Madrid* 43(1): 143-146. Madrid.

Gil, J.M., Arroyo, J. & Devesa, J.A. 1985. Contribución al conocimiento florístico de las sierras de Algeciras (Cádiz, España). *Acta Botanica Malacitana* 10: 97-122.

Gray, S.F. 1821. *Natural arrangement of British Plants*, 2. Londres.

Holmgren, P.K. & Holmgren, N.H. 1993. Additions to Index Herbariorum (Herbaria), 8 ed. Second series. *Taxon* 42: 489-505.

Holmgren, P.K., Holmgren, N.H. & Barnett, L.C. 1990. *Index Herbariorum Part I. The herbaria of the world. 8th ed. Regnum Vegetabile* 120. New York.

Landström, T. 1989. *The species of Ornithogalum L. subg. Ornithogalum (Hyacinthaceae) in Greece.* (Tesis). Institutionen för systematisk botànik. Lund.

Link, J.H.F. 1799. Nachricht von einer Reise nach Portugal nebst botanischen Bemerkungen. In einem Schreiben an den Herausgeber von dem Hrn. Prof. Link. *Journal für die Botanik* 1(2): 297-326.

Maire, R. 1958. *Flore de l'Afrique du nord*, vol. 5. P. Lechevalier Paris.

Manning, J.C., Goldblatt, P. & Fay, M.F. 2004. A revised generic synopsis of Hyacinthaceae in Sub-Saharan Africa, based on molecular evidence, including new combinations and the new tribe Pseudoprospereae. *Edinburgh Journal of Botany*, 60(3): 533-568.

Martínez-Azorín, M., Crespo, M.B. & Spencer, M. 2006. Typification of names of taxa in Ornithogalum L. subg. Cathissa (Salisb.) Baker (Hyacinthaceae). *Taxon* 55(4): 1014-1018.

Merino, B. 1909. *Flora descriptiva e ilustrada de Galicia*, vol. III. Tipografía Galaica, Santiago.

Moreno Saiz, J.C. & Soriano, C. 1989. Asientos para un Atlas Corológico de la Flora Occidental. Mapa 18. *Fontqueria* 22: 20-21.

Moret, J. 1988. Catalogue des espèces du genre Ornithogalum L. (Liliaceae) au Maroc. *Revue de Cytologie & de Biologie Vegetales – le Botaniste* 11: 289-302.

Moret, J., Couderc, H., Bari, A. & Delarue, Y. 1990. Micromorphology of seeds of Ornithogalum (Hyacinthaceae) in North Africa. *Nordic Journal of Botany* 9(5): 461-468.

Müller-Doblies, U. & Müller-Doblies, D. 1996. Revisionula incompleta Ornithogalorum Austro-Africanorum (Hyacinthaceae). *Feddes Repertorium* 107(5-6): 361-548.

Neves, J.B. 1950. Sobre a cariologia de Ornithogalum unifolium Ker-Gawl. *Boletim da Sociedade Broteriana* ser. 2, 24: 335-347.

Neves, J.B. 1952. Estudos cariológicos no género Ornithogalum L. *Boletim da Sociedade Broteriana* ser. 2, 26: 5-192.

Neves, J.B. 1973. Contribution à la connaissance cytotaxonomique des spermatophyta du Portugal. VIII. Liliaceae. *Boletim da Sociedade Broteriana* ser. 2, 47: 157-212.

Obermeyer, A.A. 1978. Ornithogalum: a revision of the southern African species. *Bothalia* 12(3): 323-376.

Parlatore, F. 1854. *Nuovi generi e nuove specie di piante monocotiledoni*. Florencia.

Parra, R., Valdés, B., Ocaña, M.E. & Díaz Lifante, Z. 2000. *Ornithogalum reverchonii*. In: Blanca, G., Cabezudo, B., Hernández-Bermejo, J.E., Herrera, C.M., Muñoz, J. & Valdés, B.

(eds.), *Libro rojo de la flora silvestre amenazada de Andalucía*, 2 *(Especies vulnerables)*: 256-258. Junta de Andalucía, Sevilla.

Pastor, J. & Diosdado, J.C. 1994. Contribución al estudio cariológico del género Ornithogalum en Andalucía occidental (España). *Acta Botanica Gallica* 141(1): 49-60.

Pérez Lara, J.M. 1886. Florula gaditana. Pars prima. *Anales de la Sociedad Española de Historia Natural* 15: 349-475.

Pfosser, M. & Speta, F. 1999. Phylogenetics of Hyacinthaceae based on plastid DNA sequences. *Annals of the Missouri Botanical Garden* 86: 852-875.

Rafinesque, C.S. 1837. *Flora Telluriana*, 1-3. H. Probasco. Philadelphia.

Rouy, G. 1890. Diagnoses de plantes nouvelles pour la flore européenne. *Bulletin de la Société Botanique de France* 37: 162-168.

Salisbury, R.A. 1866. *The Genera of Plants: a fragment containing part of Liriogamae*. John van Voorst, London.

Speta, F. 2001. Die Echte und die Falsche Meerzwiebel: Charybdis Speta und Stellarioides Medicus (Hyacinthaceae), mit Neubeschreibungen und Neukombinationen im Anhang. *Stapfia* 75: 139-176.

Stearn, W.T. 1983. The Linnaean species of Ornithogalum (Liliaceae). *Annales Musei Goulandris* 6: 139-170.

UICN. 2001. *Categorías y criterios de la lista roja de la UICN: Versión 3.1.* Comisión de Supervivencia de Especies de la UICN. Gland (Suiza) y Cambridge (Reino Unido).

Willkomm, M. 1891. *Illustrationes florae hispanicae insularumque Balearium*, vol. 2 (18). Schweizerbart, Stuttgart.

Wittmann, H. 1985. Beitrag zur Systematik der *Ornithogalum* Arten mit verlängert-traubiger Infloreszenz. *Stapfia* 13: 1-117.

Zahariadi, C. 1965. Sous-genres & sections mésogéens du genre Ornithogalum & la valeur comparative de leurs caractères differentials. *Revue Roumaine de Biologie. Serie Botanique* 10(4): 271-291.

Zahariadi, C. 1980. *Ornithogalum* L. In: Tutin, T.G., Heywood, V.H., Burges, N.A., Moore, D.M., Valentine, D.H., Walters, S.M. & Webb, D.A. (eds.), *Flora europaea* 5: 35-40. Cambridge University Press, Cambridge.

Associate Editor: C. Aedo
Received: 5-II-2007
Accepted: 28-III-2007