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A new Tongue-orchid (Orchidaceae) in southwest Spain: *Serapias occidentalis*

by

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Abstract

Serapias occidentalis is described from several populations (Campo Lugar, Obando and Aljucén) scattered over the Guadiana river basin in Extremadura, Spain. Morphological characters defining the new species are analysed, and differences with related *Serapias* taxa from the Iberian Peninsula and other European countries are established. In addition, distribution, ecology and reproduction are discussed.

Keywords: Orchidaceae, *Serapias*, taxonomy, Spain, Extremadura.

Resumen

Se describe *Serapias occidentalis* a partir de diferentes poblaciones (Campo Lugar, Obando y Aljucén) situadas a lo largo de la cuenca del río Guadiana en Extremadura, España. Se analizan los caracteres morfológicos que definen la nueva especie y sus diferencias con otras *Serapias* de la Península Ibérica y de Europa. Además, se discuten diversos aspectos de su distribución, hábitat y reproducción.

Palabras clave: Orchidaceae, *Serapias*, taxonomía, España, Extremadura.

Introduction

The genus *Serapias* L. (Tongue-orchids) comprises 26 species (Delforge, 2002), with a predominantly Mediterranean distribution. Its range extends from the Azores and the Canaries in the west to the Caucasus in the east, and north as far as Brittany (France) (Gölz & Reinhard, 1980; Pérez Chiscano & al., 1991; Delforge, 1995b, 2002).

Venhuis & al. (in prep) performed multivariate statistical analyses on all *Serapias* species occurring in the Iberian Peninsula and France and distinguished two main groups: a *S. parviflora* group and a *S. vomeracea* group. These two groups were separated predominantly on the basis of the epichile width, which varied between 3-8(9) mm and (7)8-28 mm, respectively. *Serapias vomeracea* (Burm. fil.) Briq. has been reported for nearly the entire European Mediterranean zone (Richter, 1890; Koch, 1907; Schlechter, 1923; Hermann, 1956; Meusel & al., 1965; Nelson, 1968; Landwehr, 1977; Gölz & Reinhard, 1980; Moore, 1980; Meikle, 1985; Pérez Chiscano & al., 1991; Delforge, 1995b, 2002). Most recent studies, however, report several other *Serapias* species covering large parts of this distribution area and suggest that at least parts of the populations previously considered as *S. vomeracea* would, in fact, be representatives of those species. The taxa concerned are *S. strictiflora* Welwitsch ex Veiga and *S. elsae* P. Delforge (*S. parviflora* group) and *S. bergonii* E.G. Camus, *S. orientalis* (Greuter) H. Baumann & Künkele, *S. levantina* H. Baumann & Künkele and *S. feldwegiana* H. Baumann & Künkele (*S. vomeracea* group).

According to Kreutz (2004), *S. vomeracea* consists of three subspecies: *S. vomeracea* subsp. *vomeracea* (Figs. 3c, d), *S. vomeracea* subsp. *longipetala* (Ten.) H. Baumann & Künkele (Fig. 4a) and *S. vomeracea* subsp. *istriaca* (Perko) Kreutz (Fig. 4b). *S. vomeracea* subsp. *longipetala* occurs in Italy and Greece (Baumann & Künkele, 1991) and *S. vomeracea* subsp. *istriaca* is endemic for Istria (Delforge, 2004). The distribution of *S. vomeracea* subsp. *vomeracea* probably extends from the northeastern part of Spain (Benito Ayuso & Tabuenca Marraco, 2001), Basque country

(Lizaur & Lazare, 2004), the lower Pyrenees, southern France (Gölz & Reinhard, 1980) and southern Switzerland (Gölz & Reinhard, 1980; Moser & al., 1999) to northern Italy (Gölz & Reinhard, 1980; Baumann & Künkele, 1991; Kropf, 2002).

In the last 150 years, *S. vomeracea* and its synonyms –*S. pseudocordigera* (Sebastiani) Moricand and *S. longipetala* (Tenore) Pollini– have often been reported from the Iberian Peninsula. Intensive studies during the past 20 years have improved insight into the *Serapias* group. On the basis of these studies, we supposed that earlier presentations of *S. vomeracea* (or equivalent names) from predominantly southwestern coastal regions of the Iberian Peninsula by Pérez Lara (1886), Coutinho (1913), Martínez Gámez (1921), Camus & Camus (1928), Vicioso (1948), Bodegom (1972), Landwehr (1977), Rivera & Cabezudo (1985), Valdés & al. (1987), Buján & al. (1990) and Sáez & al. (2005) probably represent *S. strictiflora* (Fig. 4c) or *S. elsae*. Recent studies indeed confirm that *S. vomeracea* does not occur in northwestern Spain (Cortizo & Sahuquillo, 1999), Portugal (Tyteca, 1997; Delforge, 2002; Venhuis & al., 2004, Sáez & al., 2005), the province of Málaga (Lowe, 1998) and other southern and central parts of Spain up to Madrid (Benito Ayuso & Tabuenca Marraco, 2001). However, reports of *S. vomeracea* by Willkomm (1861), Gandoger (1890), Montserrat (1962), Van der Sluys & González Artabe (1980), Romero & Rico (1989), Cebolla & Rivas (1994), Delforge (1995a) and Sáez & al. (2005) of the northeastern part of Spain presumably involve *S. vomeracea* subsp. *vomeracea* (Table 4; Figure 8). This is supported by the map of distribution of *S. vomeracea* presented by Benito Ayuso & Tabuenca Marraco (2001), which is based on observations to the north of Madrid and from more northeastern localities.

In Extremadura, *S. vomeracea* was first reported by Rivas Mateos (1931) as *S. pseudocordigera*. Subsequently, Rivas Goday (1964) used the name *S. longipetala* for plants of the same region. More recently, Pérez Chiscano & al. (1991) mentioned *S. vomeracea* subsp. *vomeracea* for Extremadura. However, a meticulous morphological study by us of this taxon from that region revealed significant differences from data on populations collected in southern France and western Italy, northern Italy by Gölz & Reinhard (1980) and Baumann & Künkele (1991) and Madrid by Benito Ayuso (*pers. comm.*, 2005) for *S. vomeracea* subsp. *vomeracea*. We also compared our measurements with data reported by Baumann & Künkele (1991) and data provided by Pellegrino (*pers. comm.*, 2005) of *S. vomeracea* subsp. *longipetala* from northern, central and southern Italy and Greece. Flowers from specimens of this subspecies are more slender than *S. vomeracea* subsp. *vomeracea* and definitely different from the plants from Extremadura.

Pérez Chiscano (1977) describes Extremaduran populations that probably evolved by hybridisation between *S. vomeracea* and *S. lingua* (= *S.* × *intermedia* Forest.), but in 1991 Pérez Chiscano & al. mentioned no hybrids with any *Serapias* species. Devesa Alcaraz (1995) notes that Extremaduran *S. vomeracea* and *S. cordigera* often form transitions towards *S. lingua*. Recently, Benito Ayuso & Tabuenca Marraco (2001) suggested that individuals on photographs of *S. vomeracea* subsp. *vomeracea*, taken of populations in Extremadura by Pérez Chiscano & al. (1991) differ to some extent from *S. vomeracea* from the northeastern part of Spain. Confusion is further augmented by the fact that Tyteca (1997), Kreutz (*pers. comm.*, 2004), Benito Ayuso (*pers. comm.*, 2004) and Venhuis & al. (2004) postulated that the individuals shown in these photos display morphological similarities with *S. cordigera* L, which occurs throughout Iberian Peninsula (Willkomm, 1861; Nieschalk & Nieschalk, 1973; Landwehr, 1977; Pérez Chiscano & al. 1991, Sáez & al., 2005).

On the basis of the morphological data presented in this paper, the putative *S. vomeracea* from Extremadura probably originated from hybridisation between *S. vomeracea* subsp. *vomeracea* and *S. cordigera*. Consequently, these plants should be considered a new taxon, which we propose to name *S. occidentalis*.

Methods

In the spring of 2004 we compared all the *Serapias* species that occur at the western part of the Mediterranean zone (mainland of Spain, Portugal, France, and western Italy) we sought stable and uniform characteristics that could distinguish between populations of different regions. To get a representative view, we studied three populations per species (Table 1) and measured 25 randomly selected specimens of each population, for a total of 75 specimens per species. Vouchers are kept at the AMD herbarium (Table 1). For each population, we measured fifteen quantitative (Table 2) and eight qualitative characters; the hair density, distribution, curvation, shape and position of the epichile, the shape and lamellae position, hood position, the petal shape and the bract versus hood ratio. The three populations for each species were all chosen with a maximum possible distance (min. 50 km) between, to avoid spatial and ge-

Table 1. Sampled populations of the studied *Serapias* species belonging to the *S. vomeracea* group, including vouchers.

Species	Location	Region	Country	Voucher
S. cordigera	Cotifo	Algarve	Portugal	
S. cordigera	Badajoz	Extremadura	Spain	
S. cordigera	Frejus	Var	France	AMD122572-122573
S. perez-chiscanoi	Badajoz	Extremadura	Spain	
S. perez-chiscanoi	Aljucén	Extremadura	Spain	
S. perez-chiscanoi	Trujillanos	Extremadura	Spain	
S. occidentalis	Campo Lugar	Extremadura	Spain	AMD122200-122202
S. occidentalis	Obando	Extremadura	Spain	AMD123300-123302
S. occidentalis	Aljucén	Extremadura	Spain	
S. vomeracea subsp. *vomeracea*	Arquettes-en-Val	Aude	France	
S. vomeracea subsp. *vomeracea*	Pierrefeu-du-Var	Var	France	
S. vomeracea subsp. *vomeracea*	Taggia	Liguria	Italy	AMD122570

netic autocorrelation as much as possible. The flowers of *S.* × *kelleri* that were used in the flower analyses, were collected by O. Gerbaud in April 1997 from the Var, southern France. Endogenic habitat characters were measured in the form of the soil characteristics acidity (pH) and electric conductivity (EC). Grain size analyses were classified with a triangular texture system for non-aeolian sediments after de Bakker & Schelling (1966). Discriminant analyses were carried out in SPSS 11.5 to determine whether morphological characters could differentiate the taxa.

Related species

Characters shared with *S. cordigera* and *S. vomeracea* subsp. *vomeracea* suggest that *S. occidentalis* originated from hybridisation between those two species. Hybrids between *S. vomeracea* subsp. *vomeracea* and *S. cordigera* were already described by Camus (1926) under the name *S.* × *kelleri* (Fig. 4d). These hybrids occur sporadically and only where *S. vomeracea* subsp. *vomeracea* and *S. cordigera* grow abundantly together at a site. *S.* × *kelleri* has been found near Pisa (Italy), the Var (France) and Kythera (Greece) (Nelson, 1968).

Pérez Chiscano & al. (1991) and Delforge (1995b, 2002) propose that *S. perez-chiscanoi* Acedo is closely related to *S. vomeracea* subsp. *vomeracea*. Discriminant analyses (Fig. 1) on morphological data of *S. vomeracea* subsp. *vomeracea*, *S. cordigera*, *S. perez-chiscanoi* and *S. occidentalis* reveal four nicely clustered groups. The first two functions, each with an eigenvalue above one, explained 90.8% of the total morphological variance (Table 3). Function 1 distinguishes the species by length of the hypochile (correlation = 0.543), the width

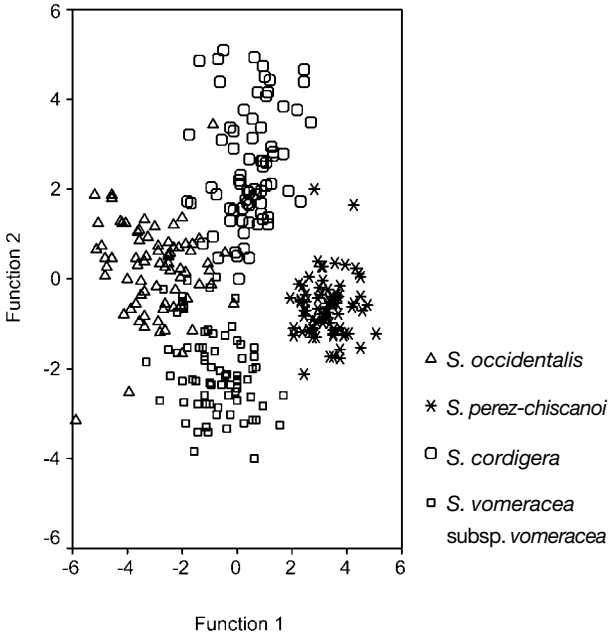

Fig. 1. Simple scatterplot of discriminant scores for the first two functions based on sixteen quantitative morphological characters.

(0.211) and the length of the bracts (0.144) and petal length (0.183) (Table 2). Function 2 distinguishes the species by the width of the epichile (0.674), the width of the hypochile (0.525) and the length of the sepals (0.214) (Table 2). Our analysis reveals that the lamellae (stigmatic surface) in all four species present very constant features. The lamellae of *S. occidentalis* have a stable and uniform appearance and differ from *S. vomeracea* subsp. *vomeracea*, *S. perez-chiscanoi* and from *S. cordigera* as well. The lamellae in *S. vomeracea* subsp. *vomeracea* and *S. perez-chiscanoi* are parallel but widely positioned, in *S. cordigera* they are divergent and in

S. occidentalis the base is parallel with divergent tips. The lamellae indeed show a slight resemblance to the deeply grooved swellings of species that probably evolved from hybrid origin with *S. lingua* L. (*S. strictiflora*, *S. elsae*, *S. gregaria* Godfery and *S. olbia* Verguin), but no characters of *S. lingua* are present in *S. occidentalis*. The combined characteristics of the lamellae of *S. vomeracea* subsp. *vomeracea* and *S. cordigera* also show similarities with those of presumed hybrids of *S. lingua*.

Following identification keys from Nelson (1968), Baumann & Künkele (1991) and Delforge (1995b, 2002), we ended up at *S. orientalis*. This species, however, has an east Mediterranean distribution extending from Greece to Turkey (Nelson, 1968; Baumann & Künkele, 1991; Delforge, 1995b, 2002) so *S. occidentalis* cannot be considered the same taxon.

Characters shared with S. cordigera

The dark red (red-purple) colour of the flowers is a constant character in both taxa. The hairs on the labellum are pinkish to reddish, growing predominantly in a central strip on both epichile and hypochile, most densely at the middle of the transition between those two parts. In both taxa the length of the sepals and petals is almost identical. The position of the epichile is the same as in *S. cordigera*: both are normally reflexed in a position parallel to the stem, occasionally pointing slightly forwards or backwards. The hood is (sub-) horizontally positioned, contrary to *S. vomeracea*, in which it has an erect position. When the labellum is in a flat position, the lateral lobes generally slightly cover the epichile (Fig. 2). *S. perez-chiscanoi* (Fig. 7c, d) seems closely related to *S. cordigera* (Figs. 3a, b) instead of to *S. vomeracea* (Tyteca, 1997; Venhuis & al., 2004; Sáez & al., 2005) and *S. occidentalis*.

Characters shared with S. vomeracea *subsp.* vomeracea

The two species have inflorescences with a similar density of sublaxiflorous flowers: both *S. occidentalis* and *S. vomeracea* subsp. *vomeracea* have on average 1.4 flowers per cm whereas the inflorescence of *S. cordigera* is dense, with on average 2.1 flowers per cm. The shape of the petals is identical. The shape and curves of the epichile can be almost identical, although the epichile of *S. occidentalis* can be much wider, up to 19 mm, in contrast with a maximum of only 14 mm in *S. vomeracea* subsp. *vomeracea* (Fig. 5a). *S. vomeracea* is well-known for its bracts, which are taller than the hood (Moricand, 1820; Pollini, 1824; Willkomm, 1861; Boissier, 1881; Arcangeli, 1882; Briquet, 1910; Camus, 1928; Nelson, 1968; Polunin, 1980; Moore, 1980; Pignatti, 1982; Davis, 1984; Meikle, 1985; Feinbrun-Dothan, 1986; Delforge, 1995b, 2002, Sáez & al., 2005), a character that generally does not apply to *S. occidentalis*.

Differences between S. occidentalis and the other two species

The inflorescence of *S. occidentalis* is rather pauciflorous, having an average of only 4 flowers (Fig. 5d), compared to *S. vomeracea* subsp. *vomeracea* and *S. cordigera*, which both contain an average of 6 flowers per inflorescence. Some dimensions of *S. occidentalis* are larger than in both other species, which is not an unusual phenomenon in orchid specimens of hybrid origin. The average length of both the hypochile (Fig. 5c) and ovary is greater than in the other two species.

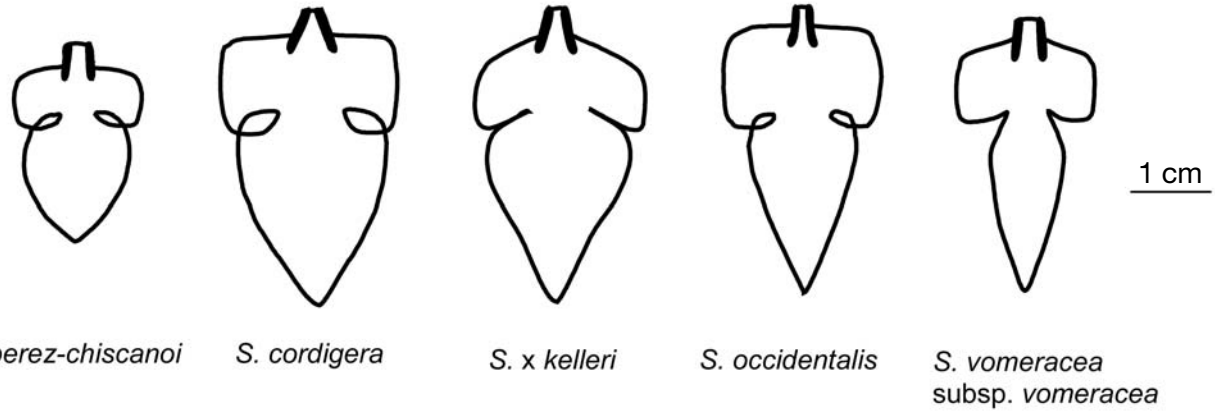

Fig. 2. Labellum and lamellae shapes of *Serapias perez-chiscanoi*, *S. cordigera*, *S.* x *kelleri*, *S. occidentalis* and *S. vomeracea* subsp. *vomeracea* based on averaged measurements.

Fig. 3. a, *Serapias cordigera.* Badajoz, Extremadura, Spain. 16-IV-2004 (Photo: C. Venhuis); **b,** *S. cordigera* (semi-hypochromatic). Badajoz, Extremadura, Spain. 16-IV-2004 (Photo: C. Venhuis); **c,** *S. vomeracea* subsp. *vomeracea*. Biot, Alpes-Maritimes, France. 11-V-2004 (Photo: C. Venhuis); **d,** *S. vomeracea* subsp. *vomeracea*. Miraflores de la Sierra, Madrid, Spain. 4-VI-2000 (Photo: J. Benito Ayuso).

Fig. 4. a, *Serapias vomeracea* subsp. *longipetala.* Mazzarino, Sicilia, Italy. 21-IV-2004 (Photo: C.A.J. Kreutz); **b,** *S. vomeracea* subsp. *istriaca.* Premantura, Istria, Croatia. 13-V-2005 (Photo: C. Venhuis); **c,** *S. strictiflora* (semi-hypochromatic). La Línea de la Concepción, Andalucia, Spain. 11-IV-2004 (Photo: C. Venhuis); **d,** *S.* × *kelleri*. Palayson, Var, France. 11-V-2003 (Photo: O. Gerbaud).

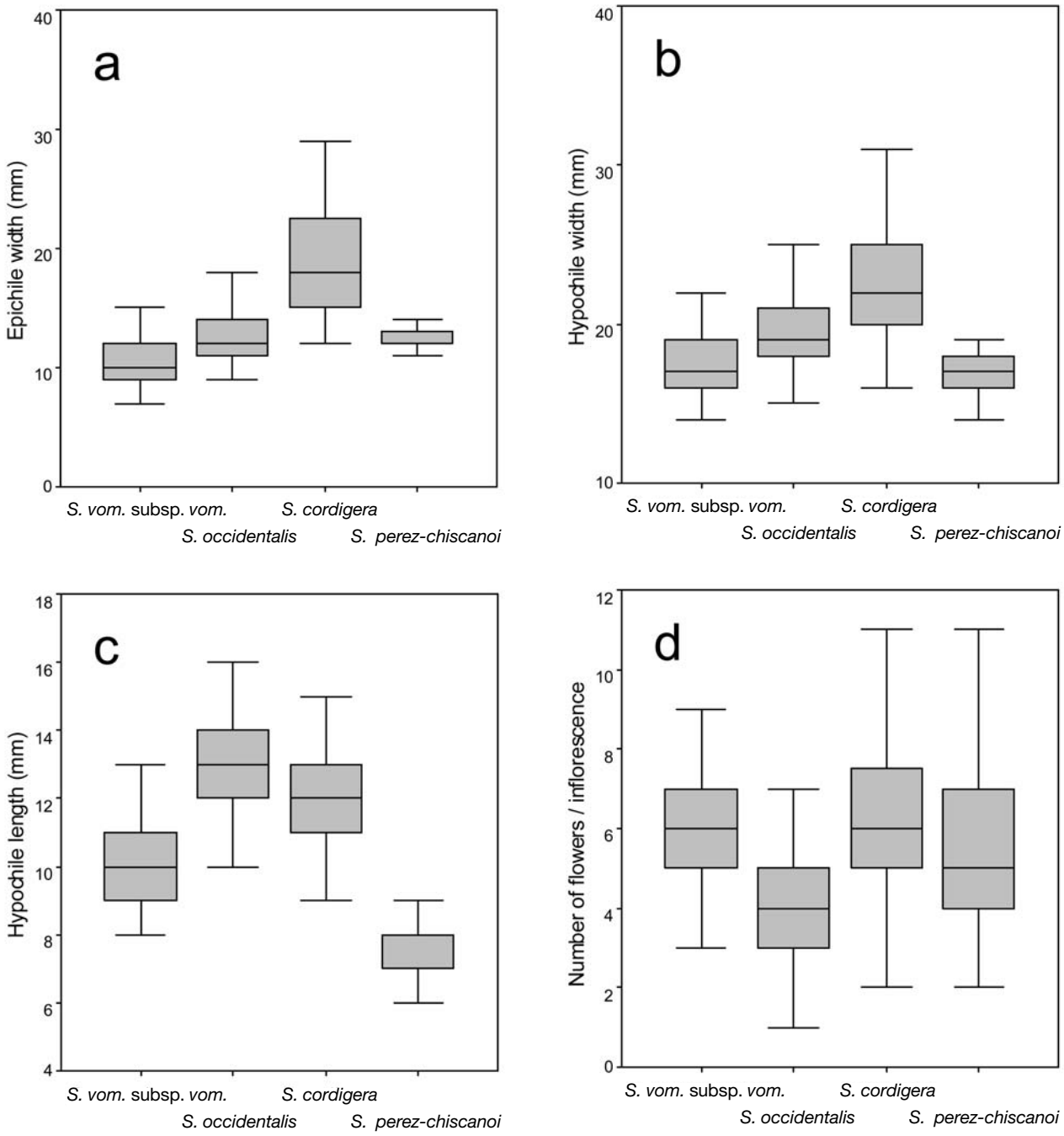

Fig. 5. Boxplots of *Serapias vomeracea* subsp. *vomeracea*, *S. occidentalis*, *S. cordigera* and *S. perez-chiscanoi*; outliers and extremes were removed **a,** Epichile width; **b,** Hypochile width; **c,** Hypochile length; **d,** Number of flowers per inflorescence.

The hypochile width (Fig. 5b) is intermediate between the two proposed parental species.

Differences between S. occidentalis and S. x kelleri

We found several *S.* × *kelleri* specimens near les Mayons (Var, France), which at first sight showed strong similarities with *S. occidentalis*. A closer examination of *S.* × *kelleri*'s flowers disclosed in several morphological differences. In *S.* × *kelleri,* the bracts extended well above the hood (Fig. 4d) (like *S. vomeracea* subsp. *vomeracea*), whereas the bracts of S. occidentalis were generally shorter (like *S. cordigera*). *S.* × *kelleri*'s hypochile shape was like *S. vomeracea* subsp. *vomeracea* and its epichile shape looked like *S. cordigera*. In contrast to *S.* × *kelleri*, *S. occidentalis*' hypochile shape

resembled *S. cordigera* and its epichile shape was similar to *S. vomeracea* subsp. *vomeracea*, though wider. Furthermore, *S. occidentalis*' labellum colour matched *S. cordigera*'s (deep red/purple), while *S.* × *kelleri*'s labellum had a colour intermediate between the two parental species. It thus seems that *S.* × *kelleri* and *S. occidentalis* contain reversed characters.

Descriptio

Serapias occidentalis C. Venhuis & P. Venhuis, **sp. nov.**

Holotypus: HISPANIA. **Extremadura**: Cáceres, Campo Lugar, 30STJ54, 320 m, 23-IV-2005, C. Venhuis & P. Venhuis (AMD 122200) *(isotypi,* AMD 122201-122202).

Inter S. cordigeram *et* S. vomeraceam *subsp.* vomeraceam *intermediam –etsi notas discrepantes quoque ferens–, verisimiliter ex hybridatione harum specierum orta: differt ab ambobus hypochilo saepissime longiore atque inflorescentia comparate pauciflora (medio numero florum* 4 *in* S. occidentali, 6 *in* S. cordigera *et in* S. vomeracea *subsp.* vomeracea). *Intermedia certe inter eas quoad mediam latitudinem epichili et hypochili. Orta ut supra dicitur –probabiliter– ab iisdem parentibus quam rara* S. × kelleri; *sed ab hac disclusa notis compluribus –de quibus antea dictum est.*

Species nova occidentalis *appellatur cum proveniat in parte occidentali dispersionis generis.*

Description

Plants with 2 sessile, subglobose or ovoid pseudotubercules. Stem straight and cylindrical, 10-37 cm high, green with red-spotted base. Leaves linear-lanceolate, 4-8, i.e. 3-5 basal-leaves 4-16 cm long and 0.6-1.8 cm wide, green with red-spotted base and 1-3 bract-like cauline leaves. Inflorescence sub-laxiflorous and pauciflorous comprising (1)2-6(9) large flowers. Bracts ovate-lanceolate, grey-lilac with reddish or green veins and a reddish to greenish base, 3.0-5.2(6.0) cm long and 1.2-2.2 cm wide, normally shorter than the hood.

Sepals and petals form a pointed hood, which is normally sub-horizontally positioned. Sepals ovate-lanceolate, 1.8-3.2 cm long, abaxial side grey-lilac coloured with dark-lilac to reddish veins, adaxial side red-purple with purple veins. Petals usually 0.3 cm shorter than sepals, from a deep-purple, orbicular base abruptly acuminate into a slender, tapering, red apical part. Labellum divided by a constriction into hypochile and epichile. Hypochile with a bright red coloured centre and covered with pinkish hairs, 1.1-1.6 cm long and 1.7-2.5 cm wide, while the lateral lobes, hidden inside or slightly emerging from the hood, are deep red to purple. Base with 2 subparallel, closely positioned lamellae, deep purple or almost blackish. Epichile ovate, 1.5-2.8 cm long and 0.8-1.9 cm wide, bright red, with dark red veins and short pinkish to reddish hairs. Ovary cylindrical, sessile, 1.0-2.3 cm long, green. Pollinia yellow-green.

Distribution

The main area of distribution of S. occidentalis probably is the Guadiana river basin in central eastern Extremadura, with scattered populations throughout the autonomic region (Fig. 8). Pérez Chiscano & al. (1991) described 18 localities as *S. vomeracea* subsp. *vomeracea* in Extremadura, some of them very west- and eastwards. This distribution suggests that this taxon can probably also can be found also in adjacent Portu-

Table 2. Pooled within-group correlations between the discriminating quantitative characters and standardized canonical discriminant functions. Characters are ordered by absolute size of correlation within function.

	Function		
	1	2	3
Hypochile length	-,543*	,484	-,102
No of stem leaves	,241*	-,086	,094
Bract width	-,210*	,003	,094
Petal length	-,183*	,178	-,092
Bract length	-,144*	-,003	-,066
Width of rosette leaves	-,116*	-,029	-,076
Epichile width	,101	,674*	-,302
Hypochile width	-,098	,525*	-,272
Length of rosette leaves	,017	,251*	,015
Sepal length	-,160	,214*	-,062
Plant height	-,001	,143*	,009
No of flowers/inflorescence	,133	,012	-,424*
Epichile length	-,190	,301	-,412*
Ovary length	-,036	,067	,190*
No of rosette leaves	,147	,129	,158*

* Largest absolute correlation between each variable and any discriminant function.

Table 3. Eigenvalues, percentage of variance and the correlation for the first three canonical functions that were used in the discriminant analyses.

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	5,221[a]	59,3	59,3	,916
2	2,766[a]	31,4	90,8	,857
3	,810[a]	9,2	100,0	,669

[a] The first 3 canonical discriminant functions were used in the analysis.

Fig. 6. *Serapias occidentalis*. Obando, Extremadura, Spain. 7-IV-2003 (Photo: C. Venhuis).

Fig. 7. a, *Serapias occidentalis:* Obando, Extremadura, Spain, 19-IV-2004 (Photo: C. Venhuis); **b,** *S. occidentalis:* Campo Lugar, Extremadura, Spain, 6-IV-2004 (Photo: C. Venhuis); **c,** *S. perez-chiscanoi:* Badajoz, Extremadura, Spain, 26-IV-2006 (Photo: C. Venhuis); **d,** *S. perez-chiscanoi:* Trujillanos, Extremadura, Spain, 24-IV-2006 (Photo: C. Venhuis).

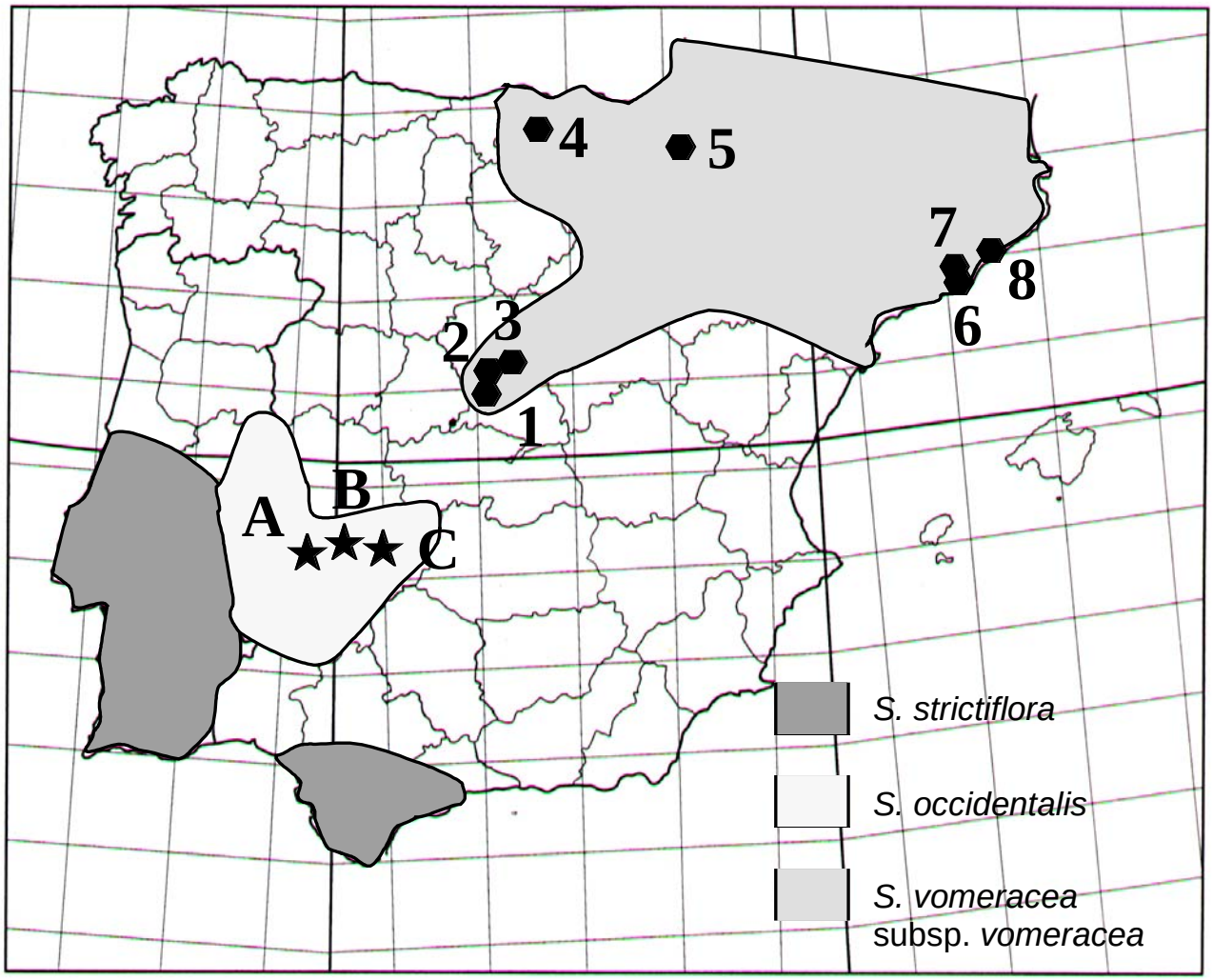

Fig. 8. Probable distributions of *Serapias strictiflora* (Benito Ayuso & Tabuenca Marraco, 2001), *S. occidentalis* and *S. vomeracea* subsp. *vomeracea*. The dots with numbers represent known localities of *S. vomeracea* subsp. *vomeracea* (Table 4) and the stars represent our study populations of *S. occidentalis* (A = Aljucén, B = Campo Lugar, C = Obando). *S. cordigera* probably occurs throughout the entire Iberian Peninsula.

gal and in the regions Castilla y León, Castilla la Mancha and maybe even in Andalucía. With the help of Dr. José Luis Pérez Chiscano, we tried to retrace six localities of *S. occidentalis* out of the 18 known from Extremadura. At least five of them have disappeared, probably due to vegetation succession, altered land-use and/or livestock grazing. Nowadays, populations of *S. occidentalis* have become very localized and contain only a few plants per population, contrary to observations made by Pérez Chiscano & al. (1991) and Devesa (1995), who described *S. vomeracea* subsp. *vomeracea* as (relatively) common. By the end of our investigation, we were able to find three populations in Extremadura; the first (type locality), near Campo Lugar, contained one hundred and ten flowering plants; the second, near Obando, presented ninety flowering plants; and the third population, near Aljucén, contained up to sixty flowering plants. We also found a single plant in an extended dehesa near Trujillanos. In the spring of 2005, we found the population near Aljucén destroyed due to ploughing for the cultivation of oats.

Habitat

S. occidentalis prefers siliceous to muddy soils, which are humid during spring. These soils are extremely poor in nutrients (average Electric Conductivity (EC) 17.3 µS/cm) and slightly acidic (pH 4.6 - 5.2). Grain size analyses from the samples from Campo Lugar and Obando reveal a very similar grain size, so they can be classified as sandy loam, while the soil of the third population near Aljucén may be labelled as clay.

Table 4. Localities of *Serapias vomeracea* subsp. *vomeracea* reported in literature on the Iberian Peninsula. Numbers refer to the distribution map in Figure 8.

Number	Town	Region	Author(s)	Year
1	El Escorial	Madrid	Gandoger	1890
2	Guadarrama	Madrid	Willkomm	1861
3	Miraflores de la Sierra	Madrid	Benito Ayuso & Tabuenca Marraco	2001
4	Los Montes de Orduntes	Burgos	Delforge	1995
5	Cizur Mayor	Navarra	van der Sluys & González Artabe	1980
6	Mataró	Catalonia	Montserrat	1962
7	La Roca	Catalonia	Montserrat	1962
8	Blanes	Catalonia	Montserrat	1962

Serapias occidentalis can be found in grasslands (dehesas) in plant communities of several alliances: the *Agrostidion castellanae*-alliance and the *Molinio-Holoschoenion*-alliance as well as, though less frequently, the *Tuberarion guttatae*-alliance (Pérez Chiscano & al., 1991). Although it prefers the same habitat as *S. perez-chiscanoi* (Fig. 7c, d) (Pérez Chiscano & al., 1991), we only found them growing together in an extended dehesa near Obando, where almost all *Serapias*-species of Extremadura are present. The population near Campo Lugar also contained 2 plants of *S. lingua* at the edge of the area; we did not find any other *Serapias* species in the population of Aljucén.

IDENTIFICATION KEY FOR THE GENUS *SERAPIAS* IN THE IBERIAN PENINSULA

1. One blackish-purple swelling at the base of hypochile, whole, deeply grooved or channelled, sometimes divided into 2 joined lumps 2
1. Two parallel or divergent lamellae at the base of hypochile 3
2. Swelling at base of hypochile whole or very slightly grooved and emarginated ..... **S. lingua**
2. Swelling at base of hypochile deeply grooved or channelled ..... **S. strictiflora**
3. Epichile width 3-6 mm; petals wide 2-4 mm .... **S. parviflora**
3. Epichile width 7-28 mm; petals wide 4-9 mm 4
4. Base of hypochile with 2 clearly diverging lamellae .... **S. cordigera**
4. Base of hypochile with 2 +/- parallel lamellae 5
5. Ratio hypochile width / hypochile length = 2.0–2.6; entire epichile greenish ..... **S. perez-chiscanoi**
5. Ratio hypochile width / hypochile length = 1.0–2.0; epichile pink to red 6
6. Hypochile 8-12(13) mm long; lateral lobes do not cover epichile when labellum is flat positioned; bracts generally taller than the hood; epichile pointing generally backwards.. ..... **S. vomeracea** subsp. **vomeracea**
6. Hypochile (10)12-16 mm long; lateral lobes slightly cover epichile when labellum is flat positioned; bracts generally shorter than the hood; epichile generally parallel to stem .... **S. occidentalis**

Reproduction

S. occidentalis flowers from the end of March until the beginning of June, depending on weather and altitude. Like most *Serapias* species, *S. occidentalis* is an obligate outcrosser and is pollinated by small bees that use the hoods for shelter during bad weather, spending the night and by inexperienced bees seeking nectar (Venhuis & al., 2004). Pérez Chiscano & al. (1991) studied a population near Madrigalejo. Of 150 open flowers, 110 (66.7%) had been visited (pollinia removed and pollen on stigma surface); 51 were occupied by male *Euceras longicornus* bees. Of these 51 male bees, 19 (37.2%) had pollinia on their heads, some with 2 as well as 4, 6, 8, 10 and even 12 pollinia due to 4, 6, 8, 10 and even 12 pollinia, due to visits to multiple flowers.

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