

# A new species of *Astragalus* L. sect. *Sesamei* DC. (Leguminosae) from the southeast of Spain: *Astragalus castroviejo*

by

Salvador Talavera Lozano<sup>1</sup>, Pedro Sánchez-Gómez<sup>2</sup>, David López García<sup>2</sup>,  
Juan Francisco Jiménez Martínez<sup>2</sup> & Juan Francisco Mota Poveda<sup>3</sup>

<sup>1</sup>Departamento de Biología Vegetal y Ecología, Universidad de Sevilla, Apdo. 1095, E-41080 Sevilla, Spain. stalavera@us.es

<sup>2</sup>Departamento de Biología Vegetal, Área de Botánica, Facultad de Biología, Campus Universitario de Espinardo,  
E-30100 Murcia, Spain. psgomez@um.es

<sup>3</sup>Departamento de Biología Vegetal y Ecología, Universidad de Almería, La Cañada, E-04120 Almería, Spain. jmota@ual.es

## Abstract

Talavera Lozano, S., Sánchez-Gómez, P., López García, D., Jiménez Martínez, J.F. & Mota Poveda, J.F. 2010. A new species of *Astragalus* sect. *Sesamei* DC. (Leguminosae) from the southeast of Spain: *Astragalus castroviejo*. *Anales Jard. Bot. Madrid* 67(1): 41-47.

We describe a new species of *Astragalus* section *Sesamei* from the semiarid zone of SE Spain: *Astragalus castroviejo*. Morphologically the new species resembles *A. sesameus* L. and *A. stella* L. and we provide a key to distinguish the three species. *A. castroviejo* is a diploid species with  $2n = 16$ , the same chromosome number as *A. sesameus* and *A. stella*. We provide an image of the karyotype, together with an illustration of the new species and a map of its distribution. Since the existing populations are restricted in area, we also provide an estimate of the conservation status of this species according to the criteria of the IUCN.

**Keywords:** *Astragalus castroviejo*, Leguminosae, sect. *Sesamei*, karyology, morphology, conservation.

## Introduction

*Astragalus* is the most diverse genus of all Angiosperms, with more than 2,500 species. The genus is mainly distributed through arid and temperate regions of the Northern Hemisphere and South America. It is especially abundant in SW and SC Asia, where 1500 species are found, western North America (around 500 species) and in South America, especially in the Andean region (150 species) (Sanderson & Wojciechowski, 2000). Europe is host to 120 species

## Resumen

Talavera Lozano, S., Sánchez-Gómez, P., López García, D., Jiménez Martínez, J.F. & Mota Poveda, J.F. 2010. Una especie nueva de *Astragalus* sect. *Sesamei* DC. (Leguminosae) del sureste de España: *Astragalus castroviejo*. *Anales Jard. Bot. Madrid* 67(1): 41-47 (en inglés).

En este trabajo se describe una especie nueva de la zona semiárida del SE de España perteneciente a la sección *Sesamei* del género *Astragalus*: *Astragalus castroviejo*. En lo morfológico, esta especie se parece a *A. sesameus* L. y *A. stella* L., por lo que se aporta una clave para la identificación de estas tres especies. *A. castroviejo* es una especie diploide con  $2n = 16$ , el mismo número cromosómico de *A. sesameus* y *A. stella*. Se da la descripción del cariotipo y se aporta la iconografía de la especie y un mapa de distribución. Como los núcleos poblacionales son pequeños se hace también una valoración, siguiendo los criterios de la IUCN, del estado de conservación de la especie.

**Palabras clave:** *Astragalus castroviejo*, Leguminosae, sect. *Sesamei*, cariología, morfología, conservación.

(Podlech, 2008), although N Africa is also a centre of considerable diversity. Molecular studies (Sanderson & Wojciechowski, 2000; Wojciechowski & al., 1999) have indicated that the species from North and South America, the so-called “Neo-*Astragalus*”, show little genetic diversity and are closely related to the annual species *A. echinatus* Murray, the only species of the sect. *Pentaglottis* Bunge endemic to the Mediterranean Region. Most species are perennial herbs or spiny bushes, but c. 70 species are strictly annual, all of them living in the Irano-Turanian and Mediter-

anean Regions. All annual species of *Astragalus* belong to the subgenus *Trimeniaeus* Bunge and can be divided into 13 sections, six of which are monospecific (Podlech, 1994), with sect. *Sesamei* DC. being the most diverse with 22 recognised species (Gazer, 1993).

In the marl-gypsum pastures of SE Spain, populations of taxon evidently belonging to *Astragalus* sect. *Sesamei* that are very similar in morphology to *A. stella*, but with fruits more like those of *A. sesameus*, have been found. All the members of sect. *Sesamei* are characterised by having mostly white basifixed hairs; stipules adnate to the petiole; dense inflorescences, that are axillary, and sessile or long-pedunculate; tubular calyx, with lanceolate teeth usually slightly shorter than the tube, rarely longer; flowers with the standard longer than the wings and keel; androecium diadelphous, 10 stamens, the vexillar stamen free; ovary pilose, with a longitudinal septum, bilocular, with (3)4-8 ovules per locule; style short, fat, curved, glabrous, ending in a semispherical humid stigma with no surrounding hairs; legume sessile, with a keel on the ventral face, and a groove in the dorsal one,  $\pm$  pilose, bilocular, with (2)3 or more seeds per locule; seeds tetragonous, with a sunken hilum,  $\pm$  flat, with smooth or rugulose surface, brownish-gray or greenish. Most species of this section live in SW Asia, although seven species are found in Algeria and six in Morocco (Gazer, 1993). Currently only three species of sect. *Sesamei* occur in Spain: *A. scorpioides* Willd., *A. sesameus* L. and *A. stella* L. (Podlech, 1999).

In this study we focused on a morphology and karyology of these populations that live in the marl-gypsum pastures of SE Spain so as to compare them with *A. sesameus* and *A. stella*, the two species with similar morphology in *Astragalus* sect. *Sesamei* (the *A. stella* group hereafter).

## Materials and methods

The material used for karyological studies came from plants cultivated in the greenhouses at the University of Seville, originally from a population from Murcia in the marl-gypsum pasture of the *A. stella* group.

Chromosomes were observed in root tip meristematic cells that were pre-treated with 0.002 M 8-hydroxyquinolein for three hours at 4 °C and subsequently fixed in Carnoy solution (3 : 1, 96% ethanol: glacial acetic acid) for at least 24 hours. Chromosomes were stained with hydrochloric acid-carminum according to Snow (1963). Images were taken with a Leica DC 300 inserted in an Axiophot Zeiss with Plan-Apochromatic 63/1.4 objective at 2.5 magnification.

For the terminology referring to chromosomes, we have followed Levan & al. (1964) and for size, Stebbins (1938).

Both vegetative and reproductive characters were quantified, based on the material of the *A. stella* group only, at the herbaria of the universities of Seville (SEV) and Murcia (MUB) (see Appendix 1).

## Results and discussion

*Astragalus stella* group species have similar floral characters, with the standard oblanceolate, emarginate or retuse apex, and undifferentiated claw; wings with narrow-elliptic limb, obliquely bilobate, auriculate at the base, and a narrow claw nearly as long as the limb; keel smaller than both standard and wings, with non-auriculate, galeated limb and a broad claw, as long as or even longer than limb. All the flowers of these species encountered at anthesis had the anthers open at the end of the keel, and closely associated with the stigma, giving the impression that they had not been visited by bees. This leads us to think that the whole group is self-fertilising, as is the case with other annual species of *Astragalus* of the sections *Bucerates* DC. and *Epiglottis* Bunge (Gallardo & al., 1994).

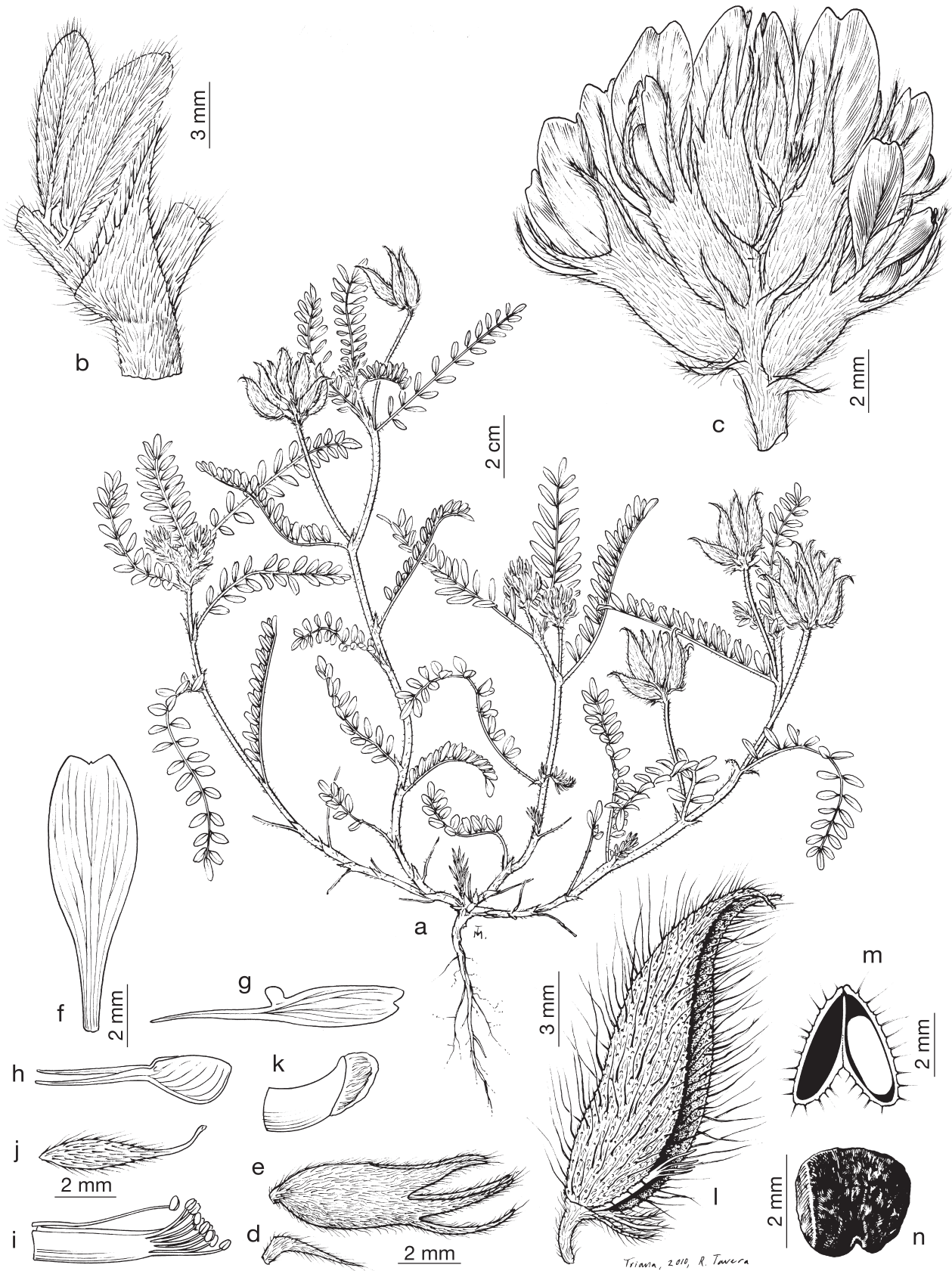
Although petal morphology and disposition of the androecium and gynoecium are similar in the *A. stella* group, nevertheless, a series of characters serve to distinguish three taxa: the pedunculate or subsessile inflorescence, specially the morphology of the calyx, the number of ovules/locule in the ovary, the disposition of the legumes in the infrutescence, the dorsal and dorso-ventral width of the legumes, and also the length of the hairs on the legumes. These three taxa comprise *A. stella* and *A. sesameus*, and a new species to which we give the name *A. castroviejoi*, in honour and memory of the distinguished taxonomist Dr. Santiago Castroviejo Bolibar.

Following the description, we provide a key to identify these three species.

### ***Astragalus castroviejoi* Talavera & Sánchez-Gómez, sp. nov. (Fig. 1)**

*Species similis ac Astragalus stella habitu, foliis et inflorescentia. Huius dissimilis: 1) calice cum inaequalibus dentibus (in A. stella sunt  $\pm$  aequales), 2) ovario cum (3)4 ovulis per loculi [in A. stella (5)6(7)] atque 3) legumine erecto vel erecto-patenti (patent in A. stella), latitudine dorsali 3-4.5 mm (in A. stella 2-2.5 mm), cum pilis -longissimis- 1.7-3 mm (in A. stella 1-1.2 mm).*

*Species in memoriam et honorem Doctoris Santiago Castroviejo Bolibar.*



**Fig. 1.** *Astragalus castroviejoii*, Alcoluche, Lorca, Murcia (SEV 250016): **a**, habit; **b**, stem node at the base of a leaf showing stipules; **c**, inflorescence; **d**, bract; **e**, calyx; **f**, standard; **g**, wing; **h**, keel; **i**, androecium; **j**, gynoecium; **k**, stigma; **l**, legume; **m**, transverse section of legume in median zone; **n**, seed.

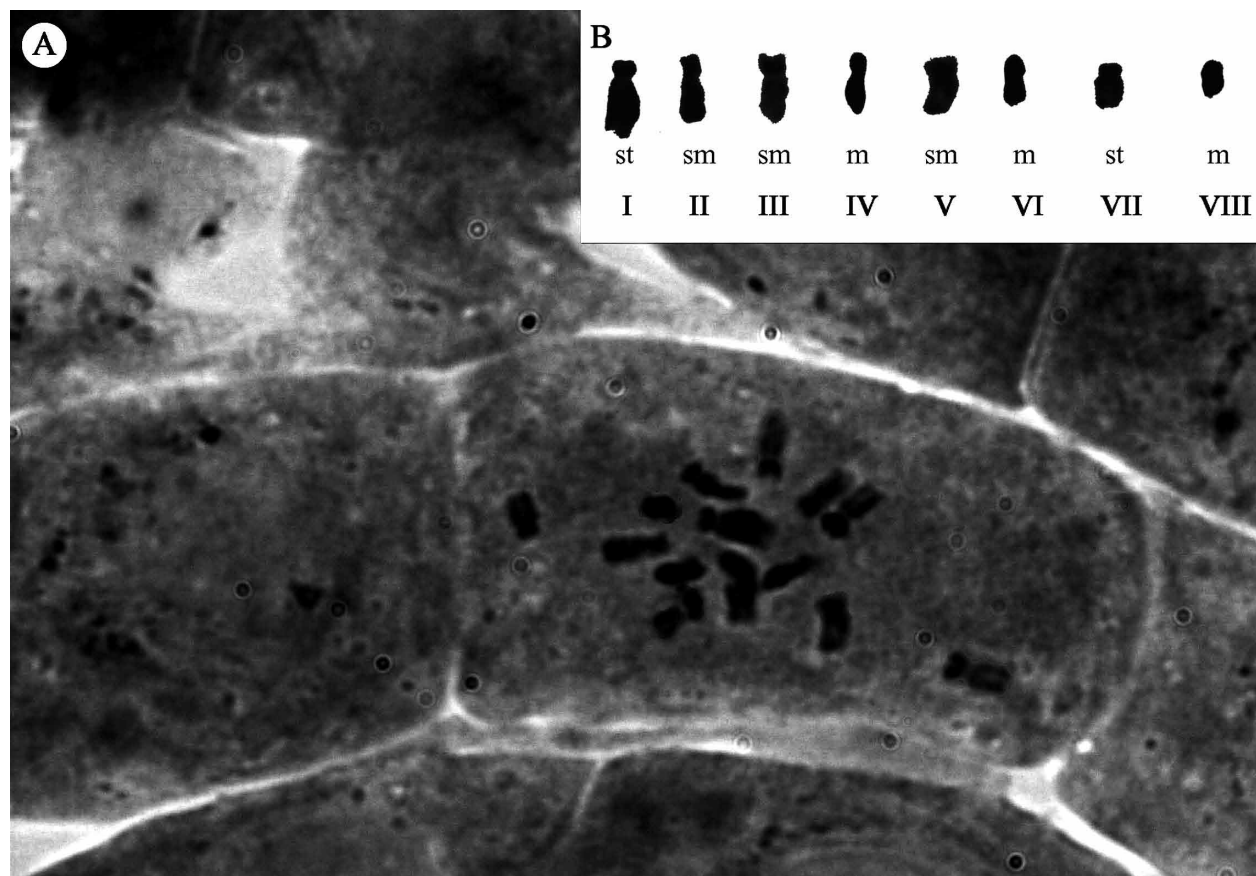


*Type:* Murcia, Lorca, Alcoluche, 30SWH8990, 780 m, matorral de *Ononis tridentata* y *Lygeum spartum* sobre margas yesíferas, 2-V-2009, D. López, P. Sánchez-Gómez, J.F. Jiménez & J.F. Mota s.n. (holotype: SEV 250016; isotypes: MUB 111108, MUB 111109, MUB 111110, SEV 250017, SEV 250018, SEV 250019).

*Paratypes:* Almería, Vélez Blanco, Cañada Caballero, 30SWWH8991, 850 m, matorral de *Ononis tridentata* y *Lygeum spartum* sobre margas yesíferas, 22-V-2009, D. López, P. Sánchez-Gómez, J.F. Jiménez & J.F. Mota s.n. (MUB 111111).

Annual herb 13-30 cm, branched from the base, with ascending or procumbent villous stems, striated, with dense erect or erect-patent hairs up to 1.5 mm, with exception of legume, which also has short appressed, basifixed white hairs, rarely with black hairs on stipules, which sometimes are also present at the base of flowers, at the apex of the sepals, and on the stems. Leaves 50-85(90) mm long, petiolate, imparipinnate, with 7-11 pair of leaflets; stipules 5-7 × 2-2.3 mm, triangular, greenish, shortly adnate at base to

petiole, densely hairy; petiole 10-13 mm; leaflets 6.5-11 × 3.5-5.2 mm, petiolulate, elliptic, truncate or rounded at the apex, villous, more glabrous in the upper side, with petiolule c. 0.5 mm. Inflorescences axillary, pedunculate, ± spiciform, with (3)7-8(13) flowers; peduncle 18-65(78) mm, densely hairy, shorter than its leaves in flowering, as long as its leaves in fruiting. Flowers sessile, bracteate; bract 3.5-5 × 0.3 mm, linear or lanceolate, densely villous. Calyx 7-8.2 mm, tubular, densely villous; teeth 1.7-3.5 × 0.5 mm, the three abaxial longer than the two vexillar teeth. Corolla with bluish standard, white wings and white pink-suffused keel; standard 8.5-10 × 2.4-3.5 mm, oblanceolate, emarginate, with a wide undifferentiated claw; wings 7-8.2 mm, smaller than standard, with limb 4-4.7 × 1.5-1.6 mm elliptic, obliquely bilobed, auriculate (ca. 1 mm) at the base, with a narrow claw 3-3.5 mm; keel 5.6-6.5 mm, smaller than wings, with limb 2-2.5 × 1.4-1.5 mm, galeate, obtuse at the apex, attenuated in a wide claw of 3-4 mm. Androecium with 10 stamens, the vexillar free, the other 9 stamens forming a tube up to the middle of the fila-



**Fig. 2.** Karyotype of *Astragalus castroviejoii*, Alcoluche, Lorca, Murcia (from seeds of SEV 250017): **A**, somatic metaphase,  $2n = 16$ ; **B**, karyogram.

ments. Anthers ca. 0.4 mm, ovoid. Ovary bilocular, sessile, hairy, with (3)4 ovules per locule; style 1.5-2 mm glabrous, arched; stigma elliptic, extrorse, humid, glabrous. Legume 10-17(19) × 3.2-5 mm, 3-4.5 mm wide on the dorsal face, erect-patent, widely lanceolate longitudinally, bilobate on the back, almost didymous, with rounded lobes, keeled ventrally, with an almost completely closed septum, and a short hooked prickly beak 1-2 mm, valves coriaceous, with (2)3-4 seeds per locule, covered with two kinds of hairs (heterotrichous indumentum), with dense short appressed hairs ca. 0.5 mm, and more sparsely with long, markedly tuberculate-based hairs 1.7-3 mm; septum 1.4-2 mm. Seeds 1.7-3 × 1.3-2 mm, reniform, flat, rugulose, somewhat cerebriform, dark-green, with reddish spots.

*Phenology.* April-May.

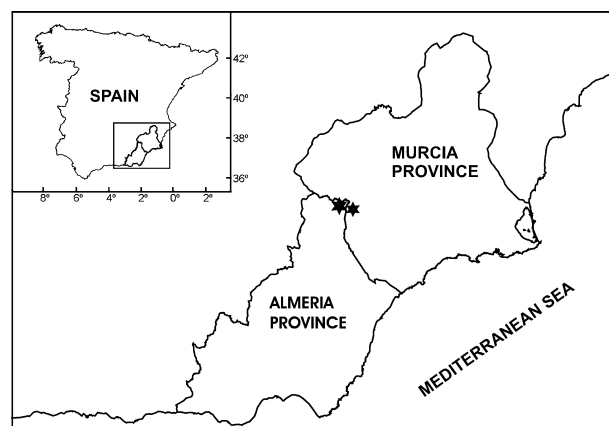
*Karyology.* Chromosome number in *Astragalus castroviejoii* is  $2n = 16$  (Fig. 2A), as in *A. sesameus* and *A. stella* (Pretel Martínez, 1974). Chromosomes are small (1.6-1.79  $\mu\text{m}$ ; pairs VI to VIII of the karyotype) and medium-small (2.15-3.28  $\mu\text{m}$ ; pairs I to V of the karyotype). Three pairs of chromosomes present centromere in median region (m; pairs IV, VI and VIII of the karyotype; Fig. 2B), three in the submedian region (sm; pairs II, III and V of the karyotype) and two in subterminal region (st; pair I and VII of the karyotype). The karyotype asymmetry, sensu Stebbins (1971), is 3B.

*Distribution and habitat.* *Astragalus castroviejoii* is endemic to SE Spain, only known from the area bordering the provinces of Almería (Vélez Blanco) and Murcia (Lorca), in enclaves known as Cañada Caballero and Rambla de La Pinosa (Almería) and Alcoluche (Murcia) (Fig. 3). From a biogeographical point of view, the localities where the species is found belong to the Castilian-Maestracense-Manchegan chorological province, Manchegan sector, Manchegan-Espunense subsector (Sánchez-Gómez & Guerra, 2007), characterised by a steppe-like environment with a certain degree of continentality, and where marl-gypsum substrates predominate. *Astragalus castroviejoii* only grows on lower Cretacic dark-green marls with secondary gypsum. It forms part of annual and pastureland communities on nitrified soils among shrublands dominated by *Ononis tridentata* L. and *Lygeum spartum* L., accompanied by species such as *Cleonia lusitanica* L., *Onobrychis stenorbiza* DC., *Linum strictum* L., *Bombycilaena discolor* (Pers.) Lainz, *Moricandia moricandioides* (Boiss.) Heywood, *Convolvulus siculus* L., *Astragalus alopecuroides* subsp. *grosii* (Pau) Rivas Goday & Rivas Mart., *Plantago albicans* L., *Guiraoa arvensis* Coss. and *Scorpiurus sulcatus*

L., within the meso-Mediterranean bioclimatic belt at altitudes between 780 and 850 m, with semiarid-dry ombrotypes (Sánchez-Gómez & Guerra, 2007).

*Conservation.* Only six small subpopulations are known, and these form a single population which is included in two 1×1 km<sup>2</sup> UTM squares. In 2009, two subpopulations are located in the province of Murcia, with 512 reproductive individuals, while the other four subpopulations are located in the province of Almería, with 1186 reproductive individuals. The known area of distribution is about 15 ha in a total area of around 60 ha.

The natural habitat of *Astragalus castroviejoii* is open to many threats, mostly anthropic in origin, mainly related with agriculture and animal husbandry. A good part of the potential habitat of the species is at present occupied by extensive cereal crops, and recent ploughing, for example, has seriously affected one of the subpopulations found in Murcia. Given the absence of any steep slopes in the area where *A. castroviejoii* is found and the proximity to cultivated zones, there is a strong risk that the remaining enclaves will suffer a similar fate. As regards grazing, the Murcian subpopulations in particular are exposed to strong pressure, and *A. castroviejoii* plants have not only been eaten, but are also exposed to the harmful effect of substrate compaction. Given the annual character of the species and the irregular nature of rainfall in the area, extreme inter-annual fluctuations in plant numbers are to be expected, although this remains to be confirmed. According to the data available, and applying IUCN (2001) criteria, *A. castroviejoii* should be considered as a threatened species within the category CR B1ab(i,ii,iii,iv,v) + 2ab(i,ii,iii,iv,v), and it is highly probable that sub-criterion



**Fig. 3.** Map showing location of populations of *Astragalus castroviejoii*.

“c” could be applied once the populations have been monitored for several years. In accordance with the above, we recommend the inclusion of *A. castroviejoi* in Red lists and Catalogues of legally protected species at regional, national and European levels, a measure that should help the short-term stabilisation and recovery of known populations.

#### IDENTIFICATION KEY

1. Inflorescences sessile, rarely pedunculate (and then up to 5 mm length); legume 1.5-2 mm wide on the dorsi-ventral face ..... **A. sesameus**
- Inflorescences pedunculate (2)12-90 mm; legume 2.5-5 mm wide on the dorsi-ventral face ..... 2
2. Calyx 5-7.5 mm; teeth subequal; ovary with (5)6(7) ovules per locule; legume patent when mature, 2-2.5 mm wide on the dorsal face, with hairs up to 1-1.4 mm ..... **A. stella**
- Calyx 7-8.2 mm; teeth unequal, the two vexillar teeth smaller than the other three; ovary with (3)4 ovules per locule; legume erect or erect-patent when mature, 3-4.5 mm wide on the dorsal face, with hairs up to 1.7-3 mm ..... **A. castroviejoi**

#### Acknowledgements

We thank Manuel López for correcting the latin diagnosis. The authors are indebted to P.E. Gibbs for his invaluable comments on the English version of the manuscript. Also thank R. Tavera for the drawing of the type, M.J. Ariza for the cultivation of the plants in the CITIUS instalations of the University of Sevilla, R. Berjano and F.J. Salgueiro for the images of the chromosomes, and M.P. Fernández-Piedra for her assistance in the edition of the manuscript. This study was supported by an Agreement between the University of Murcia, the General Directorate of Universities and Scientific Policy of the Autonomous Community of Murcia, and grant Projects from the Ministerio de Ciencia e Innovación to Salvador Talavera (CGL2006-00817 and CGL2009-08178).

#### References

- Gallardo, R., Domínguez, E. & Muñoz, J.M. 1994. Pollen-ovule ratio, pollen size, and breeding system in *Astragalus* (Fabaceae) subgenus *Epiglotis*: A pollen and seed allocation approach. *American Journal of Botany* 81: 1611-1619.
- Gazer, M. 1993. Revision of *Astragalus* L. sect. *Sesamei* DC. (Leguminosae). *Sentdnra* 1: 69-155.
- IUCN. 2001. *IUCN Red List Categories and Criteria: Version 3.1*. IUCN Species Survival Comission. IUCN, Gland, Switzerland and Cambridge, UK.
- Levan, A., Fredga, K. & Sandberg, A. 1964. Nomenclature for centromeric position on chromosomes. *Hereditas* 52: 201-220.
- Podlech, D. 1994. Revision der altweltlichen anuellen Arten der Gattung *Astragalus* L. (Leguminosae). *Sentdnra* 2: 39-170.
- Podlech, D. 1999. *Astragalus*. In: S. Talavera, C. Aedo, S. Castroviejo, C. Romero Zarco, L. Sáez, F.J. Salgueiro & M. Velayos (eds.), *Flora Iberica* 7: 279-338. C.S.I.C., Madrid.
- Podlech, D. 2008. The genus *Astragalus* L. (Fabaceae) in Europe with exclusion of the former Soviet Union. *Feddes Repertorium* 119: 310-387.
- Pretel Martínez, A. 1974. IOPB chromosome number reports. XLVI. In: A. Löve (ed.), *Taxon* 23: 804-805.
- Sánchez-Gómez, P. & Guerra, J. 2007. *Nueva Flora de Murcia - Plantas Vasculares*. DM Editor. Murcia.
- Sanderson, M.J. & Wojciechowski, M.F. 2000. Improved bootstrap confidence limits in large-scale phylogenies, with an example from Neo-*Astragalus* (Leguminosae). *Systematic Biology* 49: 671-685.
- Snow, R. 1963. Alcoholic hydrochloric acid-carmin as a stain for chromosomes in squash preparations. *Stain Technology* 38: 9-13.
- Stebbins, G.L. 1938. Cytological characteristics associated with the different growth habits in the dicotyledons. *American Journal of Botany* 25: 189-198.
- Stebbins, G.L. 1971. *Chromosomal evolution in Higher Plants*. Edward Arnold (Publishers) Ltd., London.
- Wojciechowski, M.F., Sanderson, M.J. & Hu, J.-M. 1999. Evidence on the morphology of *Astragalus* (Fabaceae) and its major subgroup based on nuclear ribosomal DNA ITS and chloroplast DNA trnL intron data. *Systematic Botany* 24: 409-437.

#### Appendix 1

##### Selectec herbarium material studied

##### *Astragalus sesameus* L.

MOROCCO. **Atlas Medio**: Taza, cerca de Aïn-Hamra, 1140 m, 25-V-1981, J. Fernández Casas s.n. (SEV 73936). **Rif**: Chefchaouen, De Chefchaouen a Oued Laou, 345 m, 1-V-1996, M.A. Mateos, F.J. Pina & S. Silvestre s.n. (SEV 155176<sup>6</sup>); Chefchaouen, a 1 km del cruce con la carretera de Tetuán, 300 m, 6-IV-1995, A.J. Caruz, M.A. Mateos & F.J. Pina s.n. (SEV 154572); Chefchaouen, Tarhzout, calizas, 310 m, 1-V-1996, M.A. Mateos, F.J. Pina & S. Silvestre s.n. (SEV 155146).

SPAIN. **Albacete**: Los Bañuelos, Socovos, 23-IV-1988, P. Sánchez-Gómez s.n. (MUB 7749); Los Molinos, Socovos, 20-III-1984, P. Sánchez-Gómez s.n. (MUB 16735); sierra del Cuchillo, 30SXH68, 11-V-2001, P. Sánchez-Gómez, J. B. Vera, A. Hernández & M. A. Carrión s.n. (MUB 102264). **Alicante**: puerto de la Carrasqueta, 1-VI-1978, J.A. Devesa, J. Pastor & B. Valdés s.n. (SEV 133183); Jijona, margas, 1-VI. 1978, J.A. Devesa, J. Pastor & B. Valdés s.n. (SEV 133181). **Almería**: cerca de Gelgar, 30-V.1971, J. Fernández-Casas s.n. (SEV 9309); **Barcelona**: Tibidabo, 1-VI-1928, F. *Secundaire* s.n. (SEV 88490); ídem, V-1910, F. *Sennen*, Pl. Espagne n° 973 (SEV 88487); Barcelona, barbechos, IV-1921, F<sup>re</sup> *Sennen* s.n. (SEV 95764). **Gerona**: Llers, 15-V-1905, F<sup>re</sup> *Sennen* s.n. (SEV 88486). **Jaén**: sierra de Cazorla, 21-V-1952, V.H. *Heywood* s.n. (SEV 38546). **Madrid**: Campos de Amaniel de la Moncloa, 17-V-1968, J. Izco & D. Rodríguez s.n. (SEV 33195); Vaciamadrid, V-1960, J. Borja s.n. (SEV 1659). **Murcia**: entre Caravaca y Lorca, a 23 km de la Colonia de Sta. Teresa, yesos, 800 m, 27-VI-1988, S. Talavera, B. Valdés et al. s.n. (SEV 237658); Charán, Moratalla, 1240 m, 30SWH8534, 29-IV-1988, P. Sánchez-Gómez s.n. (MUB 25801); sierra Espuña, Casa Leiva, 680 m, 30SXG3192, 26-IV-2002, P. Sánchez-Gómez & M.A. Carrión s.n. (MUB 102259); El Chorrillo, 130 m, 30SXG8765, 9-III-2002, A. López s.n. (MUB 102260); Rincón de Tallante, 360 m, 30SXG6266, 23-V-1998, M.A. Carrión s.n. (MUB 102261); Rambla del Cabez Negro, 30SXG6763, 28-III-1999, M.A. Carrión s.n. (MUB 102262); Yecla, Monte Arabí, 600 m, 30SXH48, 12-V-2001, J.B. Vera s.n. (MUB 102263); ídem, casa del guarda, 700 m, 30SXH48, 1-V-2000, J.B. Vera s.n. (MUB 102266); sierra de la Muela, 30SWH93, 23-III-1997, E. Coy & A. Hernández s.n. (MUB



102265); puerto de la Agüica, 30SXH2613, 18-V-2008, *P. Sánchez-Gómez, J.L. Cánovas & D. López s.n.* (MUB 109073); sierra de los Cucos, proximidades de los yesos, 30S XG3762, 11-V-2008, *P. Sánchez-Gómez, J.F. Jiménez, D. López & J.L. Cánovas s.n.* (MUB 109764); cerca de Perín, 30SXG6865, 12-III-2009, *I.M. Martínez & P. Sánchez-Gómez s.n.* (MUB 110614; MUB 110636). **Sevilla:** Coripe, cerca del puente del río Guadalporcum, yesos, 30-V-1984, *A. Aparicio & J. García-Rowe s.n.* (SEV 117880). **Zaragoza:** Bisimbre, 350 m, 1-V-1973, *A. Segura Zubizarreta s.n.* (SEV 55757).

### *Astragalus stella* L.

ALGERIA. **Al-Masilah:** Bou-Saada, Moulin Ferrero, 2-IV-1986, *A. Aparicio & J. García-Rowe s.n.* (SEV 246967). **Biskra:** Entre Chegga y el cruce hacia El Haouch, 1-IV-1986, *A. Aparicio & J. García-Rowe s.n.* (SEV 246986). **Bouira:** 5 km S of M'Chedallah, E of Bouira, forêt de Boudjellil, 500 m, 22-IV-1976, *D.A. & S.J. Sutton s.n.* (SEV 237663).

MOROCCO. **Gran Atlas:** Er Rachidia, N de Erfoud, 59 km de Rissani, 1 km N de Ksar Jdid, 19-II-2002, *S.L. Jury, M. Rejdali & T.M. Upson s.n.* (SEV 250790); Ouazazate, pr. Msemrir, 2010 m, 1-VI-1985, *C. Blanché & al. s.n.* (SEV 123784). **Rif:** Chefchaouen, de Chefchaouen a Oued Laou, calizas, 345 m, 1-V-1996, *M.A. Mateos, F.J. Pina & S. Silvestre s.n.* (SEV 155176b); Chefchaouen, Jbel Tassaot, 1500-1600 m, 21-VI-1994, *S. Talavera & al. s.n.* (SEV 149438); Chefchaouen, entre Bou-Ahmed y Targha, 210 m, serpentinias, 3-V-1996, *M.A. Mateos, F.J. Pina & S. Silvestre s.n.* (SEV 155571).

SPAIN. **Albacete:** entre Albacete y Balazote, 8 km de Albacete, 3-VI-1978, *J.A. Devesa, J. Pastor & B. Valdés s.n.* (SEV 133417); Tamayo, Villamalea, 20-V-1990, *M.D. Sánchez-López s.n.* (MUB 36763); Hellín, estación de Agramón, 380 m, 30SXH1952, 17-V-

1980, *F. Alcaraz s.n.* (MUB 4744); Algibe, Socovos, 490 m, 30S XH0245, 28-V-1988, *P. Sánchez-Gómez & F. Alcaraz s.n.* (MUB 25733). **Alicante:** Orihuela, sierra de Orihuela, 100 m, 30SXH 7617, 23-III-1980, *F. Alcaraz s.n.* (MUB 2384). **Almería:** Vera, 100 m, 30SWG9717, 10-IV-1993, *A. Labora s.n.* (MUB 44469); Terremos, Pulpí, 20 m, 30SXG1634, 26-III-1991, *A. Labora s.n.* (MUB 44470); sierra Almagrera, 280 m, 30SXG1027, 9-V-1993, *A. Labora s.n.* (MUB 42335); Turre, loma del Colorado, 260 m, 30SWG 9307, 1-V-1993, *A. Labora s.n.* (MUB 42337). **Barcelona:** Tibidabo, 26-V-1919, *F<sup>re</sup> Sennen s.n.* (SEV 87754). **Ciudad Real:** Villahermosa, 30-V-1980, *T. Luque, J. Ubersa & B. Valdés s.n.* (SEV 133416). **Gerona:** Llers, 15-V-1905, *F<sup>re</sup> Sennen s.n.* (SEV 78159). **Granada:** alrededores de Baza, 8-V-1975, *E.F. Galiano, S. Talavera & B. Valdés s.n.* (SEV 236385); antre Gorafe y Baños de Alicún, 800 m, 10-VI-1971, *J. Fernández Casas s.n.* (SEV 9297). **Huesca:** Castiello de Jaca, Molino de Aratores, 920 m, 29-VI-1971, *P. Montserrat s.n.* (SEV 119467). **Lérida:** a 3 km de Cervera, 31-V-1981, *J.A. Devesa, T. Luque & C. Romero s.n.* (SEV 133413). **Murcia:** Puerto Lumberras, 6-IV-1990, *A. Labora s.n.* (MUB 33042); Calasparra, carretera a Socovos, 3-V-1986, *C. Selma s.n.* (MUB 23224). **Soria:** Ambrona, yesos, 1100 m, 4-VI-1977, *A. Segura Zubizarreta s.n.* (SEV 99385). **Zaragoza:** Calatayud, 15-VI-1910, *C. Vicioso in Sennen Pl. Espagne n° 1127* (SEV 78158).

TUNISIA. **Kébili:** Gabés-Kébili, dunas del Oasis, junto al Hotel Fort des Autruches, 25-V-1997, *C. Blanché, J. Molero & J. Vicent s.n.* (SEV 246985). **Tozeur:** Le Belvedere, cercanías del camping El Palmeral, 31-III-1986, *A. Aparicio & J. García-Rowe s.n.* (SEV 246966).

Associate Editor: C. Aedo

Received: 24-II-2010

Accepted: 30-III-2010