LES, D.H., D.J. CRAWFORD, E. LANDOLT, J.D. GABEL & R.T. KIMBALL -2002- Phylogeny and Systematics of Lemnaceae, the Duckweed Family. *Syst. Bot.* 27: 221-240.

NJAMBUYA, J., I. STIERS & L. TREST -2011- Competition between Lemna minuta and Lemna minor at different nutrient concentrations. *Aquatic Bot.* 94: 158-164.

SÁNCHEZ GULLÓN, E. y A. GALÁN DE MERA -2010- Contribución al estudio de las Lemnáceas de Huelva (Andalucía Occidental, España). *Lagascalia* 30: 29-37.

SANZ-ELORZA, M., E. DANA y E. SOBRINO -2001- Listado de plantas alóctonas invasoras reales y potenciales en España. *Lazaroa* 22: 121-131.

VÁZQUEZ MORA, J.R. -2009- Aportaciones a la flora de la provincial de Valencia. *Flora Montiber.* 43: 84-86.

VERLOOVE, F. -2013- New xenophytes from Gran Canaria (Canary Islands, Spain), with emphasis on naturalized and (potentially) invasive species. *Collect. Bot. (Barcelona)* 32: 59-82.

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181. A NEW LOCALITY FOR THE ENDANGERED SPECIES *CERATOCAPNOS HETEROCARPA* DURIEU (PAPAVERACEAE) TO SPAIN AND ITS SYNTAXONOMICAL CHARACTERIZATION

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Una nueva localidad para la especie amenazada Ceratocapnos heterocarpa Durieu (Papaveraceae) para España y su caracterización sintaxonómica

Key words. Chorology, new record, *Ceratocapnos heterocarpa*, Spain, phytosociology.

Palabras clave. Corología, nueva cita, *Cetarocapnos heterocarpa*, España, fitosociología.

Ceratocapnos heterocarpa Durieu is a climbing terophyte which grows in calcareous rocky soils on steep north- and northeast- facing slopes, with low levels of solar radiation, frequently under a dense canopy (Salinas, 2009; Valdés, 1987). It is considered a thermophilous and nitrophilous or sub-nitrophilous species. Its distribution is scattered throughout the south of the Iberian Peninsula and the north of Africa (Morocco and Algeria) (Lidén, 1986). Also, this species has been recorded in Fuerteventura (Canary Islands) by Scholz *et al.* (2006). The first record in Europe was made by Font Quer (1928) in the province of

Seville (Spain). Subsequently, it was recorde in Almeria, Granada (Suau *et al*., 1988; Collac & Fernández Casas, 1994; Pérez García *et a* 2005), Badajoz (Gómez Hernández & Orteg Olivencia, 1988; Ladero *et al*., 1995; Vázque *et al*., 2004), Huelva (Sánchez Gullón & Orteg Expósito, 1997; Santa-Bárbara & Valdés, 199 and Cadiz (Sánchez García & Clares Sánche 2001; Albarreal Núñez & Romero Zarco, 2004 On the other hand, in Portugal it was recorde in the Algarve (Lidén, 1986; Albarreal Núñe & Romero Zarco, 2004) and Baixo Alente (Porto *et al*., 2010).

C. heterocarpa was initially classified as vulnerable (VU B1+2c) in the Red List of Spanish Vascular Flora (RLSVF) (Domínguez Lozano, 2000). Later, in a second edition of the RLSVF (Moreno Saiz, 2008) it was reevaluated as endangered (EN B1ab(ii,iii)). Nevertheless, at a regional level, it is considered as vulnerable (VU A2a;B2ab(i,ii,iii,iv)) in the Red List of the Andalusian Vascular Flora (Cabezudo *et al*., 2005). In the Extremadura region, it is catalogued as sensitive to disturbed habitat (Vázquez *et al*., 2004). This species is characteristic of *Parietario mauritanicae-Ceratocapnetum heterocarpae* Martínez Parras 1982 association.

C. heterocarpa was found in Spring 2013 when a field work on the study of the local flora was undertaken in the municipal area of Cordoba (south of Spain). Two phytosociological inventories were carried out in the locality of Cordoba, and two more in an already known locality of the province of Huelva. A voucher sample of *C. heterocarpa* is located in the herbarium of the Faculty of Sciences of the University of Cordoba (COFC).

Spain. Cordoba: *Arroyo de Rabanales*, 30SUH4702, 07.IV.2013, *Javier López-Tirado* (COFC 61195); idem 15.IV.2013 (COFC 61196).

This record extends the whole distribution of *C. heterocarpa* in the Iberian Peninsula (fig. 1), being the first record for the province

Figure 1. Current distribution of *C. heterocarpa* (10 x 10 km grid) in the Iberian Peninsula. Light gray grids show the known populations whereas the black one shows the new record. *Distribución actual de C. heterocarpa (en cuadrículas de 10 x 10 km) en la Península Ibérica. En color gris se muestran las poblaciones anteriormente conocidas mientras que en color negro se muestra la nueva población*.

of Cordoba. It was found in a small stream, near the riverbank, in rocky soils shaped by calcareous substrate of metamorphic limestone according to the lithological map of Andalusia (1:400.000 scale), in northeast and east faces under a canopy of wild olives (*Olea europaea* subsp. *europaea* var. *sylvestris*), being the most frequent species in the area. Table 1 shows the phytosociological inventories carried out in the present work. Moreover, a synthetic inventory of our inventories and of the original inventories of Martínez Parras (1982) have been added.

Parietario mauritanicae-Ceratocapnetum heterocarpae Martínez Parras 1982 was described for the first time for the Baetic and Murcian-Almeriensian biogeographical provinces, which is akin to *Torilidi nodosae-Parietarietum mauritanicae* Rivas-Martínez 1977, the latter having its optimum range of distribution in the Lusitan-Extremadurean subprovince. Moreover, two subassociations were described: *ceratocapnetosum heterocarpae* (typical) and *succowietosum balearicae* (*Succowia balearica* (L.) Medicus being the

Inventory number	**1**	**2**	**3**	**4**	**5**	**6**
Elevation (m a.s.l.)	222	220	23	23	-	-
Area (m^2)	1	1	1	1	-	-
Aspect (º)	60	90	330	340	-	-
Slope (%)	45	35	60	60	-	-
Cover (%)	100	100	100	95	-	-
Species number	17	22	15	15	44	35
Characteristic species from association and alliance level						
Ceratocapnos heterocarpa Durieu	4	3	3	3	4	V
Parietaria mauritanica Durieu	-	-	+	-	1	V
Theligonum cynocrambe L.	1	3	-	-	2	-
Characteristic species from order and class level						
Rhagadiolus edulis Gaertn.	+	+	-	-	2	-
Geranium purpureum Vill.	+	+	-	+	3	-
Geranium rotundifolium L.	+	-	-	-	1	IV
Companion species						
Arisarum simorrhinum Durieu	+	1	-	-	2	-
Ceterach officinarum Willd.	+	+	-	+	3	-
Cistus albidus L.	(+)	(+)	-	-	2	-
Euphorbia peplus L.	r	-	-	-	1	V
Euphorbia pterococca Brot.	-	-	+	+	2	-
Galium verrucosum Hudson	-	+	-	+	2	I
Melica minuta L.	(+)	1	-	-	2	-
Mercurialis ambigua L.	-	-	+	+	2	V
Olea europaea var. *sylvestris* (Mill.) Lehr	5	1	-	-	2	-
Phlomis purpurea L.	1	-	(+)	-	2	-
Scandix pecten-veneris L.	-	+	-	-	1	II
Selaginella denticulata (L.) Spring	+	1	-	-	2	II
Smyrnium olusatrum L.	-	-	2	-	1	II
Sonchus oleraceus L.	-	1	-	+	2	-
Trifolium campestre Schreb.	-	-	+	1	2	-
Umbilicus rupestris (Salisb.) Dandy	-	-	+	1	2	-
Urginea maritima (L.) Baker	-	-	-	+	1	I

Besides: Inventory 1.- *Asparagus albus* L. 1, *Fumaria reuteri* Boiss. +, *Rhamnus lycioides* L. subsp. *oleoides* (L.) Maire 2, *Tamus communis* L. 1; inventory 2.- *Anogramma leptophylla* (L.) Link +, *Arum italicum* Mill. (+), *Brachypodium sylvaticum* (Huds.) Beauv. 1, *Campanula erinus* L. +, *Erodium cicutarium* (L.) L'Hér +, *Micromeria graeca* (L.) Rchb. subsp. graeca (+), *Pistacia lentiscus* L. (+), *Sedum mucizonia* (Ortega) Raym.-Hamet +, *Trifolium stellatum* L. +; inventory 3.- *Arrhenatherum album* (Vahl) Clayton +, *Ceratonia siliqua* L. (+), *Dactylis glomerata* L. +, *Delphinium pentagynum* Lam. 2, *Lavandula viridis* L'Hér (+), *Phagnalon saxatile* (L.) Cass. +, *Rumex induratus* Boiss. and Reut. 1, *Urospermum picroides* (L.) Schmidt r; inventory 4.- *Avena barbata* Link 1, *Cynosurus echinatus* L. +, *Euphorbia exigua* L. subsp. *exigua* +, *Polypodium cambricum* L. (+), *Trachynia distachya* (L.) Link 2; inventory 5.- All the species showed above in this paragraph have a value of 1, because they are present in one of the four inventories; inventory 6.- *Allium subhirsutum* L. II, *Anemone palmata* L. I, *Anthriscus caucalis* Bieb. III, *Arisarum vulgare* Targ-Tozz. IV, *Asterolinon linum-stellatum* (L.) Duby II, *Briza maxima* L. I, *Calendula arvensis* III, *Convolvulus siculus* L. subsp. *elongatus* Willd. ex Batt. I, *Fumaria officinalis* L. III, *Galium aparine* L. III, *Geranium molle* L. IV, *Geranium robertianum* L. II, *Oxalis pes-caprae* L. II, *Ranunculus bullatus* L. II, *Ranunculus spicatus* Desf. subsp. *blepharicarpos* (Boiss.) Grau I, *Rhagadiolus stellatus* (L.) Gaertn. III, *Sherardia arvensis* L. III, *Silene vulgaris* (Moench) Garcke I, *Stellaria media* (L.) Vill. V, *Sucowia balearica* (L.) Medicus III, *Torilis nodosa* (L.) Gaertn. III, *Urtica membranacea* Poir. III, *Veronica cymbalaria* Bodard IV, *Vicia lutea* L. II, *Vinca difformis* Pourret III.

Table 1. Phytosociological inventories carried out at the following sites: Column 1 and 2, Cordoba. *Cordoba: Arroyo de Rabanales*; column 3 and 4, Huelva. *Sanlúcar de Guadiana: Rivera Grande*. Column 5 shows a synthetic inventory of the four previous ones, whereas column 6 shows a synthetic inventory of the nine original inventories of *Parietario mauritanicae-Ceratocapnetum heterocarpae* Martínez Parras 1982. *Inventarios fitosociológicos llevados a cabo en: Columnas 1 y 2, Córdoba. Córdoba: Arroyo de Rabanales; columnas 3 y 4, Huelva. Sanlúcar de Guadiana: Rivera Grande. La columna 5 muestra un inventario sintético de los cuatro inventarios previos, mientras que la columna 6 muestra un inventario sintético de los nueve inventarios originales de Parietario mauritanicae-Ceratocapnetum heterocarpae Martínez Parras 1982*

differential species). More recently, *Parietario mauritanicae-Theligonetum cynocrambes* Tamajón, Pinilla & Muñoz 2000 was described. This association is quite similar to *Parietario mauritanicae-Ceratocapnetum heterocarpae* Martínez Parras 1982, having its optimum in the Baetic province (Tamajón *et al.*, 1999). The absence of *C. heterocarpa* in *Torilidi nodosae-Parietarietum mauritanicae* Rivas-Martínez 1977 and *Parietario mauritanicae-Theligonetum cynocrambes* Tamajón, Pinilla & Muñoz 2000 is a good indicator to distinguish these vegetal communities.

Regarding floristic composition, most of the sampled species in the inventories were pterophytes, always encompassed by shrubs from *Asparago albi-Rhamnion oleoidis* Goday ex Rivas-Martínez 1975 alliance. The number of species in the four phytosociological inventories was substantially higher than in the nine ones carried out by Martínez Parras (1982); 44 and 35 species respectively. Ten of the species were the same in both studies (see table 1). In addition, related species with similar environmental requirements have been shared: *Arisarum simorrhinum, Geranium purpureum* and *Rhagadiolus edulis* in our work and *Arisarum vulgare, Geranium robertianum* and *Rhagadiolus stellatus* in the inventories of Martínez Parras (1982). Although the majority of species have sciophilous and nitrophilous preferences, non-nitrophilous species were also found such as *Briza maxima* and *Trifolium stellatum* in both Martínez Parras (1982) and our inventories. The studied localities in the present work (provinces of Cordoba and Huelva) fitted with *Parietario mauritanicae-Ceratocapnetum heterocarpae* Martínez Parras 1982 according to ecological variables such as climatic and geological conditions, being found in northwest-, northeast- and eastern facing slopes, on humus-rich soils and covered by a dense canopy; it also occurs in high slopes at the bottom of valleys. All the inventories were carried out in the Sierra Morena range, consisting of Precambrian and Paleozoic materials in the main, its nature being basically acid (Núñez Granados *et al*., 2003), although specifically these inventories were carried out in basophilic outcrops.

Floristic composition showed more similarities than differences, especially between inventories carried out in the province of Cordoba and subass. *ceratocapnetosum heterocarpae* from the Hispalensean sector of the Baetic biogeographical province by Martínez Parras (1982). Despite the fact that sampling was carried out in different biogeographical provinces, four species (excluding *C. heterocarpa*) matched in both areas: *Geranium rotundifolium*, *Euphorbia peplus*, *Scandix pecten-veneris* and *Galium verrucosum*. Most of the species remarked upon above are very common in nitrophilous sites belonging to *Geranio purpurei-Cardaminetea hirsutae* and *Stellarietea mediae* classes.

It is interesting to note the presence of *Theligonum cynocrambe* in the inventories from the province of Cordoba, a thermophilous species that grows preferably in sciophilous and calcareous soils (Silvestre, 1987). This species is proposed as a differential species for subass. *ceratocapnetosum heterocarpae*, despite the fact that it was not recorded in the inventories carried out in the *Sierra de Esparteros* (Seville) by Martínez Parras (1982), *T. cynocrambe* is actually well distributed in that area (Peinado *et al*., 1986; Silvestre, 1987). Moreover, *T. cynocrambe* is absent in the coastal areas of Granada and Almeria provinces (Blanca *et al.*, 2009), locations in which subass. *succowietosum balearicae* was described by Martínez Parras (1982) (*Vélez de Benaudalla* and *Turre* respectively).

Regarding inventories from the province of Huelva, slightly fewer species were sampled in comparison with the inventories from the province of Cordoba. Five species were identical in both sites: *Geranium purpureum, Ceterach officinarum, Galium verrucosum,*

Phlomis purpurea and *Sonchus oleraceus*. The majority of the species were characteristic of *Stellarietea mediae* –a class that is normally characterized by annual and nitrophilous species-, although *Tuberarietea* class -with pioneer ephemeral and non-nitrophilous annual short herbs- and *Lygeo-Stipetea* class -perennial xerophytes- (Rivas-Martínez *et al*., 2002) were also well represented. In those inventories, *T. cynocrambe* was absent; it is a rare species in the province of Huelva and it has not been recorded yet in *Andévalo, Sierra de Huelva* and the *Espacio Natural de Doñana* (Valdés *et al*., 2007; Valdés *et al*., 2008) but it is present in the *Condado de Huelva* (Benedí & Silvestre, 1997; Sánchez Gullón & Rubio García, 1999). On the other hand, *Parietaria mauritanica* was sampled in inventory number 3. The absence of *Succowia balearica* in the Lusitan-Extremadurean subprovince, led us to include the inventories from the province of Huelva in *Parietario mauritanicae-Ceratocapnetum heterocarpae* subass. *ceratocapnetosum heterocarpae* as well.

In conclusion, the phytosociological inventories carried out matched with the *Parietario mauritanicae-Ceratocapnetum heterocarpae* Martínez Parras 1982 association, a fact that was supported by Ladero *et al*., (1995) in the province of Badajoz. Also, *T. cynocrambe* is proposed as a good indicator of subass. *ceratocapnetosum heterocarpae*.

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REFERENCES

ALBARREAL NÚÑEZ, J. & C. ROMERO ZARCO -2004- Novedades corológicas para Andalucía occidental (Sevilla-Cádiz). *Acta Bot. Malacitana* 29: 300-304.

BENEDÍ, C. & S. SILVESTRE -1997- *Theligonum* L. In: CASTROVIEJO, S. (coord.), *Flora Ibérica* vol. VIII: 11-13. C.S.I.C., Madrid.

BLANCA, G., B. CABEZUDO, M. CUETO, C. FERNÁNDEZ LÓPEZ & C. MORALES TORRES (eds.) -2009- *Flora Vascular de Andalucía Oriental*. Consejería de Medio Ambiente, Junta de Andalucía, Sevilla.

CABEZUDO, B., S. TALAVERA, G. BLANCA, C. SALAZAR, M. CUETO, B. VALDÉS, J.E. HERNÁNDEZ BERMEJO, C.M. HERRERA, C. RODRÍGUEZ HIRALDO & D. NAVAS -2005- Lista Roja de la Flora Vascular de Andalucía. Consejería de Medio Ambiente, Junta de Andalucía, Sevilla.

COLLADO, A. & J. FERNÁNDEZ CASAS -1994- Asientos para un Atlas Corológico de la Flora Occidental. Mapa 588. *Fontqueria* 39: 368-369.

DOMÍNGUEZ LOZANO, F. (ed.) -2000- *Lista Roja de la Flora Vascular Española*. *Conservación Vegetal* 6 (extra): 11–38.

FONT QUER, P. (1929). De flora occidentale adnotaciones, I-IV. *Cavanillesia* 1(1-3): 16-40.

GÓMEZ HERNÁNDEZ, P. & A. ORTEGA OLIVENCIA -1988- Tres plantas interesantes para la flora pacense. *Boletim da Sociedade Broteriana, Série* 2, 61: 279-280.

LADERO, M., A. AMOR, J.L. PÉREZ CHISCANO & M.T. SANTOS -1995- Algunas plantas interesantes de la flora extremeña. *Stud. bot.* 14: 203-206.

LIDÉN, M. -1986- *Ceratocapnos* Durieu. In: CASTROVIEJO, S. (cood.), *Flora Ibérica* vol. I: 439-441. C.S.I.C., Madrid.

MARTÍNEZ PARRAS, J.M. -1982- *Parietario mauritanicae-Ceratocapnetum heterocarpae*, ass. nov. *Anales Jard. Bot. Madrid* 39(1): 187-190.

MORENO SAIZ, J.C. (coord.) -2008- *Lista Roja 2008 de la flora vascular española*. Dirección General de Medio Natural y Política Forestal, Ministerio de Medio Ambiente y Medio Rural y Marino, Sociedad Española de Biología de la Conservación de Plantas, Madrid.

NÚÑEZ GRANADOS, M.A., R. TAMAJÓN GÓMEZ & J.M. RECIO ESPEJO -2003- Distribución ecológica en función del pH de varias especies leñosas mediterráneas en Sierra Morena (España). *Lazaroa* 24: 49-60.

PEINADO, M., J.M. MARTÍNEZ-PARRAS & C.

BARTOLOMÉ -1986- Notas sobre vegetación nitrófila II: Algunas novedades fitosociológicas en Andalucía. *Stud. bot.* 5: 53-69.

PÉREZ GARCÍA, F.J., A. LAHORA, J.A. GARRIDO, F. MARTÍNEZ HERNÁNDEZ, J.M. MEDINA CAZORLA, A.J. MENDOZA & J.F. MOTA -2005- Contribuciones a la Flora Vascular de Andalucía (España) (101-110). 106. Contribución al conocimiento de la Flora de Andalucía: Citas novedosas para las provincias de Granada y Almería. *Acta Bot. Malacitana* 30: 223-227.

PORTO, M., C. ESTIMA RAMALHO, A. JÚLIA PEREIRA, J.L. VITORINO, C. TAULEIGNE GOMES & A. CARAPETO -2010- Notas do Herbário Florestal do INRB (LISFA): Fasc. XXX. Adições corológicas de *taxa* relevantes para as províncias do Baixo Alentejo e Algarve – Portugal. *Silva Lusitana* 18(1): 103-113.

RIVAS-MARTÍNEZ, S., T.E. DÍAZ, F. FERNÁNDEZ-GONZÁLEZ, J. IZCO, J. LOIDI, M. LOUSÃ & A. PENAS -2002- Vascular plant communities of Spain & Portugal. Addenda to the Syntaxonomical checklist of 2001. *Itinera Geobot.* 15(1-2): 5-922.

SALINAS, M.J. -2009- *Fumariaceae*. In: G. BLANCA, B. CABEZUDO, M. CUETO, C. FERNÁNDEZ LÓPEZ & C. MORALES TORRES (eds.), *Flora Vascular de Andalucía Oriental* vol. II: 65. Consejería de Medio Ambiente, Junta de Andalucía, Sevilla.

SÁNCHEZ GARCÍA, Í. & A. CLARES SÁNCHEZ -2001- Noticiario. Botánica. Nota sobre algunas especies nuevas para la Flora Gaditana. *RSGHN* 2: 119-122."

SÁNCHEZ GULLÓN, E. & J.A. ORTEGA EXPÓSITO -1997- Fragmentha chorologica occidentalia, 6230-6235. *Anales Jard. Bot. Madrid* 55(2): 451.

SÁNCHEZ GULLÓN, E. & J.C. RUBIO GARCÍA -1999- Novedades florísticas para el litoral de Huelva y provincia. I. *Lagascalia* 21: 7-16.

SANTA-BÁRBARA, C. & B. VALDÉS -1997- Novedades florísticas para la provincia de Huelva. I. *Lagascalia* 20(1): 151-160.

SCHOLZ, S., J.A. REYES-BETANCORT & W.W. DE LA TORRE -2006- Notas corológico-taxonómicas de la flora macaronésica (Nº 128-142). Adiciones a la flora vascular de Fuerteventura (Islas Canarias) II. *Bot. Macaronés.* 26: 65-76.

SILVESTRE, S. -1987- *Theligonaceae*. In: B. VALDÉS, S. TALAVERA, & E. FERNÁNDEZ-GALIANO (eds.), *Flora Vascular de Andalucía Occidental* vol. II: 594. Editorial Ketres, Barcelona.

SUAU, R., A.I. GARCÍA, R. RICO, B. CABEZUDO, J.M. NIETO & A. E. SALVO -1988- Alcaloides en la Flora de Andalucía, I. *Acta Bot. Malacitana* 13: 189-200.

TAMAJÓN, R., R. PINILLA & J.M. MUÑOZ -1999- Novedades fitosociológicas de Andalucía occidental (clase *Stellarietea mediae*). *Stud. bot.* 18: 5-20.

VALDÉS, B. -1987- *Fumariaceae*. In: B. VALDÉS, S. TALAVERA & E. FERNÁNDEZ-GALIANO (eds.), *Flora Vascular de Andalucía Occidental* vol. I: 137-149. Editorial Ketres, Barcelona.

VALDÉS, B., V. GIRÓN, E. SÁNCHEZ GULLÓN & I. CARMONA -2007- Catálogo florístico del Espacio Natural de Doñana (SO de España). Plantas vasculares. *Lagascalia* 27: 73-362.

VALDÉS, B., C. SANTA-BÁRBARA, C. VICENT & A. MUÑOZ -2008- Catálogo florístico del Andévalo y Sierra de Huelva (plantas vasculares). *Lagascalia* 28: 117-409.

VÁZQUEZ, F.M., S. RAMOS, A. FERNÁNDEZ & J.M. LÓPEZ (coords.) -2004- *Especies protegidas de Extremadura: Flora.* Colección Medio Ambiente. Consejería de Medio Ambiente. Junta de Extremadura, Badajoz.

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