OROBANCHE CENTAURINA BERTOL. THE CORRECT NAME FOR *O. KOCHII* F.W. SCHULTZ (*OROBANCHACEAE*)

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ABSTRACT: After the studying the original material of *Orobanche centaurina* Bertol. (*Orobanchaceae*) deposited in BOLO, a forgotten species described from Massa (Central Italy) parasitizing *Centaurea paniculata* L., and compared it with the type of *O. kochii* F.W. Schultz and with the types of others taxa actually considered synonyms of this, we concluded that the name of Bertoloni is the correct one for this species. **Keywords:** Nomenclature; Eurasian flora; *Orobanchaceae*; parasitic plants.

RESUMEN: *Orobanche centaurina* Bertol., nombre correcto para *O. kochii* F.W. Schultz (*Orobanchaceae*). Después de estudiar el material original de *Orobanche centaurina* Bertol. (*Orobanchaceae*) depositado en BOLO, una olvidada especie descrita de Massa (Italia central) parásita de *Centaurea paniculata* L., y compararlo con el tipo de *O. kochii* F.W. Schultz y con los tipos de otros táxones actualmente considerados sinónimos de éste, estimamos que el nombre de Bertoloni es el correcto y prioritario para esta especie. **Palabras clave:** nomenclatura; flora euroasiática; *Orobanchaceae*; plantas parásitas.

INTRODUCTION

The renewed interest in the study of *Orobanche* and related genera, notoriously tricky plants, supported by the actual methodologies and equipments (*in vivo* colour photographs readily exchanged online and molecular tests for morphological hypotheses) have enabled a deeper reassessment of supposedly homogeneous species and the vindication of some previously unrecognised taxa. This happened with the broomrape taxa parasitizing *Centaurea* generically called *Orobanche major* L. or, after the formal rejection of this name as nomen ambiguum (TURLAND & RUMSEY, 1997), *O. elatior* Sutton (e.g. GRENIER, 1853; BECK, 1890; COSTE, 1904; BONNIER & DOUIN, 1926; BECK, 1930; NOVOPOKROVSKII & TZVELEV, 1958; CHATER & WEBB, 1972; TZVELEV, 1981; GILLI, 1982; TERYOKHIN & al., 1993; KREUTZ, 1995; UHLICH & al., 1995; ZHANG & TZVELEV, 1998; PUSCH, 2009; etc).

MATERIAL AND METHODS

A great number of herbarium specimens of the taxa under consideration were examined (ZÁZVORKA, 2010; PIWOWARCZYK & KRAJEWSKI, 2015; SÁNCHEZ PEDRAJA & al., 2016+) they are deposited in the following herbaria (B, BEOU, BOLO, BP, BRA, BRNM, BRNU, CB, CHRZ, CLF, CHOM, G, GM, GLM, KRA, KRAM, KTC, KTU, L, LBL, LE, LI, LINN, LOD, M, MPU, MW, P, PE, POZ, PR, PRC, ROZ, SAV, SLA, SLO, WA, WRSL, ZMT and in private herbarium). Based on these herbarium specimens, observations of living plants and numerous images available on the Internet (see SÁNCHEZ PEDRAJA & al., 2016+), we have studied the taxonomy of the species parasites of *Centaurea* (s.l.) indiscriminately called *Orobanche major* L.

Broomrapes parasites on Centaurea *in Europe and Africa, taxonomic story*

In Spain, for instance, PUJADAS (1999) has reinstated *O. icterica* Pau, Not. Bot. Fl. España 3: 5. 1889 first at subspecific rank (*O. major* subsp. *icterica* [Pau] A. Pujadas in Flora Montib. 11: 16. 1999) and soon after at the species level for the parasite of *Centaurea*, mainly *C. aspera*, traditionally referred to as *O. major*. His proposal gained wide acceptance, and most Spanish botanists nowadays recognize as a different species the *Centaurea*-parasite widespread in Spain, whose earliest name, as shown in CARLÓN & al. (2011), is the North-African *Centaurea*-parasite *O. leptantha* Pomel in Bull. Soc. Climatol. Alger 11: 110. 1874 [rosaceous form] (= *O. curvata* Pomel in Bull. Soc. Climatol. Alger 11: 111. 1874 [yellow form] (DOMINA & al., 2013; P 04363860!; P 03428431!) another of those long buried taxa under the synonymy of *O. major* / *O. elatior*. (PUJADAS, 2013) contests this conclusion, but using the type specimen of *O. leptantha* as his only quantitative reference (we have seen other African materials readily contradicting the numbers in his table 1) and misrepresenting qualitative traits supposedly conflicting with Po-

mel's protologue and materials (for instance, the bracts of the Iberian plants characteristically exceed the corolla, and they can hardly be described as *ovate to triangular*).

But the Western Mediterranean region is far from being the only area in which the sequential all-purpose use of *O. major* and *O. elatior* proved to cover an artificial hodgepodge. The work by ZÁZVORKA (2010) showed beyond any doubt that two utterly different species (the true *O. elatior* Sutton in Trans. Linn. Soc. London 4: 178, t. 17. 1798 and *O. kochii* F.W. Schultz, Flora [Regensb.] 30(5): 66. 1847) had been hidden under a single name as a result of systematic host-driven misidentifications. Despite their similarity and even overlap in host specificity (*Centaurea scabiosa*, the main if not the only host of the former, is frequently attacked by the latter), to their morphological and molecular disparity they add a neat biogeographical divergence: *O. elatior* is a temperate-subatlantic species restricted to western, central and northern Europe (ZÁZVORKA, 2010; PIWOWARCZYK & KRAJEWSKI, 2015; SÁNCHEZ PEDRAJA & al., 2016+), whereas *O. kochii* is an Eurasian species which occurs in warmer summer regions, stretching from Mediterranean Europe (France and Italy) to perhaps China and India (ZÁZVORKA, 2010; PIWOWARCZYK & KRAJEWSKI, 2015; SÁNCHEZ PEDRAJA & al., 2016+).

In the present note we will keep pulling this thread in order to establish the correct nomenclature and summarize the geographic and host range of European *Centaurea* parasites.

In France we could personally observe that *O. kochii* does not only occur in the Alpine area with less Atlantic influence, but is widespread in sunny, dry, sandy spots across the strictly Mediterranean region, where as already stated by REICHENBACH f. (1862, sub *O. Ritro*, "Sur le *Centaurea aspera*, l'*Echinops Ritro*: sables de Mazarque [Marseille-Mazargues]. *Roux* et *Blaise*! [P 04419058!, P 0440607!] … Marseille in vineis. *Sonder*!); COSTE (1904, f. 2820 [*O. kochii* (see ZÁZVORKA, 2010, "straighter corolla back in the middle")], sub *O. major* L., p.p., "Sur les *Centaurea* et *Echinops*, dans l'Est, le Centre et le Midi [SLA 048415!]") and BONNIER & DOUIN (1926, sub *O. major* L., p.p., "L'espèce est parasite sur les *Centauréa Scabiósa*, *Centauréa aspera*, *Centauréa collína* ... Provence et Alpes-Maritimes, Languedoc") it parasitizes both *Echinops* and several species of *Centaurea*, namely *C. aspera* L.

Four taxa suspected to be conspecific with *O. kochii* are: *O. centaureae-scabiosae* F.W. Schultz., *O. centaurina* Bertol., *O. elatior* var. *forojuliensis* Coss. and *O. ritro* Gren.

Orobanche centaureae-scabiosae F.W. Schultz in Bot. Lit. Blätt. 5: 500. 1830, is based on *Orobanche de la Centaurée scabieuse* Vaucher, Monogr. Orobanch.: 61. 1827 and refers to a species described near Ronco Scrivia (Liguria) but according to Art. 36 of the ICN is not validly published because this name is listed as a mere synonym of *O. elatior*. Although the characters of the plant described by Vaucher do not coincide with those of a normally developed *O. centaurina*, we have made some attempts to know it. However, the meticulous efforts to locate the original material in G have been unsuccessful (L. Gautier 2017, pers. comm., 21 April) and our fieldworks dedicated to finding specimens of *Centaurea scabiosa* parasitized by broomrapes in the surroundings of Ronco Scrivia (Cipollina, Banchetta, Porale, Alpe di Porale, Tana d'Orso), carried out on 4 July 2017, has not offered positive results.

Orobanche centaurina Bertol., Fl. Ital. 6: 430. 1846 (fig. 1), lectotype BOLO (DOMINA & MAZZOLA, 2011), is a taxon described from S. Giuseppe near Massa (Tuscany), on *C. paniculata* L. and in a similar thermophilous coastal grasslands in which *O. kochii* occurs in France.

Fig. 1. *O. centaurina* Bertol. The lectotype in BOLO designated by Domina & Mazzola (2011).

Orobanche elatior var. *forojuliensis* Coss., Notes Pl. Crit.: 8. 1849 (fig. 2); ≡ *O. forojuliensis* [(Coss.) Nyman] ex Beck in Engl., Pflanzenr., Orobanchac.: 247. 1930, pro syn., lectotype (here designated) [the sheet contains two specimens, the right-hand specimen is a suitable lectotype for *O. elatior* var. *forojuliensis* Coss.]: 1. "E. Bourgeau, Env. de Fréjus. n.º 302, *Orobanche elatior*, Sutton ex Reut. in Prodr. var. *maritima*, Coss. ined., parasite sur le *Centaurea aspera*!, bords de la route entre Fréjus et S.ª Raphaël [Provence-Alpes-Côte d'Azur]., 4 Juin, 1848" (P 04385331); isolectotypes (P 04384972 - Hb. E. Cosson [only the central specimen, close to its label]) and (P 04384973 - Hb. E. Cosson). All these materials support beyond any reasonable doubt that Cosson's trinomen is a mere synonym of *O. centaurina*.

Orobanche ritro Gren. in Gren. & Godr., Fl. France 2: 635. 1853 (fig. 3). Despite its vindication by PUJADAS (2013), a glance at the type (P 00654040!), and other sheets collected by Grenier in the same locality (near Gap, Provence-Alpes-Côte d'Azur), e. g. the topotype (P 0440 6079), moreover the illustrations of *O. ritro* Gren. in Gren. & Godr., Fl. France 2: 635. 1853 published by REICHENBACH f., Iconogr. Fl. Germ. Helv. 20: t. 170. 1862 and BONNIER, Fl. ill. France 8(78): t. 466 f. 2160b. 1926 (all showing ovate to triangular cauline leaves, corolla with straight dorsal line, divergent spoon-shaped lower lip lobes and flat, straight, subentire upper lip) and numerous photographs, in the nature, of the broomrape parasitizing both *Centaurea* and *Echinops* in the *terra classica* of *O. ritro*

(Provence-Alpes-Côte d'Azur), sent to us by Daniel Pavon, suffice to regard Grenier's binomial as a mere synonym of *O. kochii*, a claim otherwise supported by local botanists in recent times [ROYER & al., 2014; PAVON, 2015; PAVON & al., 2015; "around here (Bouches-du-Rhône) there's only one variable species" (D. Pavon 2017, pers. comm., 2 February)].

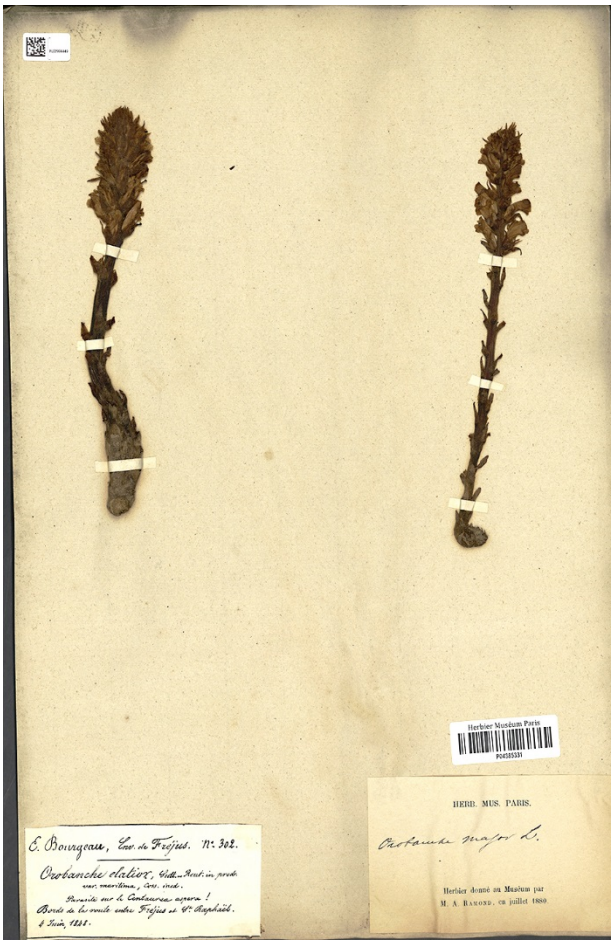

Fig. 2. *O. elatior* var. *forojuliensis* Coss. The lectotype in P, here designated.

RESULTS

The Bertoloni's type refers to the same taxon of *O. kochii*, the two specimens of Bertoloni's sheet (fig. 1) show the typical characters of this species, stems relatively shorter with leaves broad at base and ovate-triangular shape, inflorescences subcylindrical, ± loose, corolla with straight dorsal line, lower lip with lobes divergent and spoon-shaped, upper lip flat, straight, subentire, specimens brownish-rusty when dry (see ZÁZVORKA, 2010: 82 t. 1). We could observe all these features even more unmistakably in a set of photographs of living plants taken in the Carrara marble quarries near the caves of Fantiscritti, about 10 km away from the *locus classicus* of *O. centaurina*, shared online in "Il Forum dei Funghi e Fiori in Italia" of the Associazione Micologica Italiana Naturalistica Telematica – AMINT [(https://www.funghiitaliani.it/), accessed: 21 Dec 2005, 23 Aug 2006] by the user "Apuano" and now removed. "Apuano" mentioned several species existing in the vicinity of the broomrape, the first was *Centaurea arachnoidea* Viv. (= *C. rupestris* L.). We'd be pleased to better acknowledge the authorship of these pictures (fig. 4), but the user "Apuano" no longer belongs to the association and they have not address to contact him.

Fig. 3. *O. ritro* Gren. The lectotype in P, designated by Pujadas (2013).

The path would thus be paved for the name *O. centaurina* Bertol. to be adopted as the correct one for the plant so far called *O. kochii* (ZÁZVORKA, 2010; CARLÓN & al., 2011; PIWOWARCZYK, 2012; PIWOWARCZYK & KRAJEWSKI, 2015).

DISCUSSION

Summing up, three species of *Orobanche* can be found parasitizing *Centaurea* s.l. (incl. *Cyanus*, *Psephellus*, *Rhaponticoides*) in Europe: 1) ***O. elatior*** Sutton, with dense spikes of regularly curved corollas, divergent elliptic lower lip lobes and bracts shorter or slightly longer than the flowers, occurs to the northwest of an axis linking the Alps to the Pyrenees, where it is parasitic mainly if not only on *Centaurea scabiosa*; 2) ***O. leptantha*** Pomel (= *O. curvata* Pomel [described on a yellow variant] = *O. icterica* Pau), similar to *O. elatior* but with rounded, convergent lower lip lobes and longer bracts, often long exceeding the flowers, occurs around the western Mediterranean where it is parasitic on several species of *Centaurea* (mainly *C. aspera* L. but also *C. fragilis* Durieu, *C. hyssopifolia* Vahl, *C. ornata* Willd., *C. pullata* L. and *C. sphaerocephala* L.), as well as *Rhaponticoides alpina* (L.) M.V. Agab. & Greuter and *Cheirolophus intybaceus* (Lam.) Dostál; and 3) the distantly related ***O. centaurina*** Bertol. (= *O. kochii* F.W. Schultz = *O. ritro* Gren. [described on a yellow variant

common in this group], with dorsally straight flowers showing a flattened adaxial surface and big, divergent, spathulate, concave lower-lip lobes and patent, wide upper-lip lobes, is a "steppic" species occurring to the southeast of the above-mentioned imaginary axis, where it parasitizes chiefly *Echinops* and *Centaurea* (mainly *C. scabiosa* and *C. paniculata* s.l.) and apparently also *Rhaponticoides ruthenica* (Lam.) M.V. Agab. & Greuter (PLANTARIUM, 2007+, Russian republic of Tatarstan) and *Ptilostemon echinocephalus* (Willd.) Greuter (PLANTARIUM, 2007+, Crimean Peninsula).

Fig. 4. *Orobanche centaurina* Bertol. Left photo: near Fantiscritti (10 km north of Massa, *loc. class*.), Italy, probably parasite of *Centaurea rupestris*, *"Apuano"*, 2005 (sub *O. elatior*). Right photo: military maneuvers camp of Aglanet, pr. Orange (Provence-Alpes-Côte d'Azur, *terra class*. of *O. elatior* var. *forojuliensis*), France, 31TFJ4587, 50 m, beside *Centaurea aspera* in very dry and sunny soils, *L. Carlón*, *G. Gómez*, *M. Laínz*, *G. Moreno* MM0106/2003 & *J.-M. Tison*, 28 May 2003 (hb. Sánchez Pedraja 11371). Photos "Apuano" and G. Moreno.

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Fig. 5. *Orobanche centaurina* Bertol. Boria, near Ćmielów (Małopolska Upland, Poland, original area of distribution of *O. kochii*), on *Centaurea scabiosa*, xerothermic grassland, *R. Piwowarczyk*, 1 July 2014 (hb. KTC). Photo R. Piwowarczyk.

Fig. 6. *Orobanche centaurina* Bertol. Boria, near Ćmielów (Małopolska Upland, Poland; original area of distribution of *O. kochii*), on *Centaurea scabiosa*, xerothermic grassland, *R. Piwowarczyk*, 1 July 2014 (hb. KTC). Photo R. Piwowarczyk.

Fig. 7. *Orobanche centaurina* Bertol. Near Quartier du Grès, south of Orange (Provence-Alpes-Côte d'Azur, *terra class*. of *O. elatior* var. *forojuliensis*), France, 31TFJ4584, 55 m, beside *C. aspera* in roadside ditch, *G. Gómez* & *G. Moreno* MM0121/2006 (hb. Sánchez Pedraja 12593). Photo G. Moreno.

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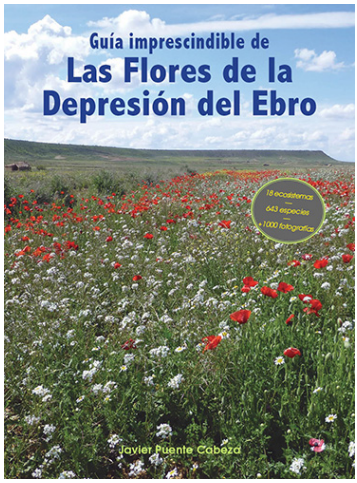

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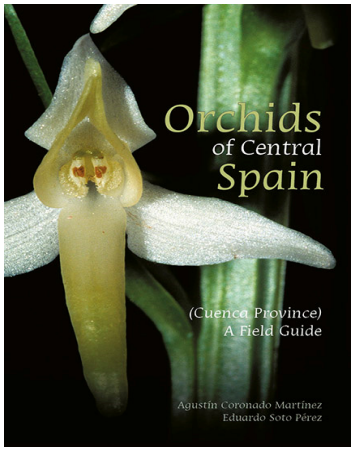

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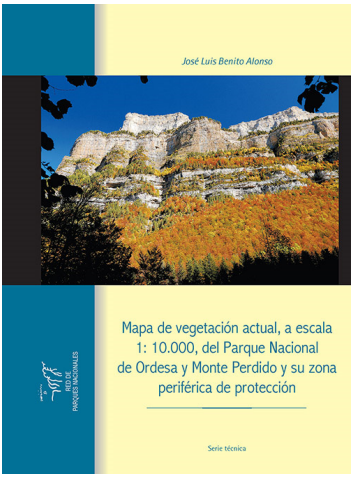

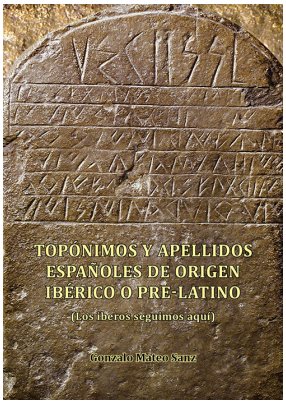

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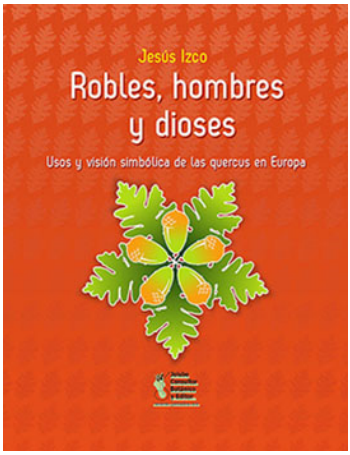

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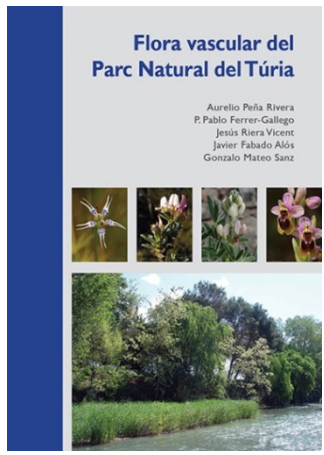

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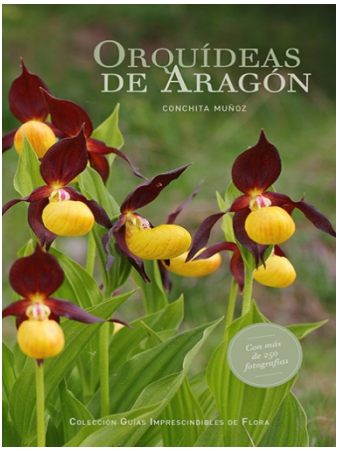

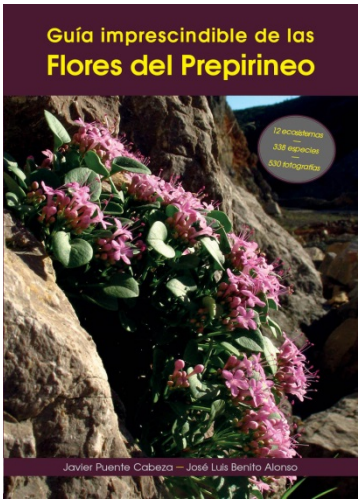

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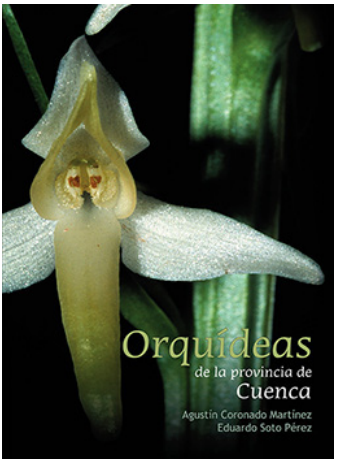
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