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Intraspecific variation and taxonomic aspects of some plants from the Apuan Alps (Tuscany, Italy)

Abstract

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In the Apuan Alps (NW Tuscany) several plant species occur as populations that are morphologically, genetically and ecologically distinct. Such natural groups, in formal taxonomy, are best treated at subspecific rank. Taxonomic considerations and nomenclatural adjustments are here presented for a number of taxa in the genera *Carum* (*Umbelliferae*), *Buphthalmum* (*Compositae*), *Rhinanthus* (*Scrophulariaceae*), *Astrantia* (*Umbelliferae*), and *Asperula* (*Rubiaceae*).

Introduction

A biosystematic analysis of the Apuan flora, has been carried out for several years at the Department of Botany of the University of Pisa (for exhaustive bibliographical references, cf. Bechi & al. 1991, Garbari & Bechi 1992). It intends to bring into evidence the possible presence, within this area, of morphologically, genetically, and ecologically distinct populations, to evaluate the appropriate hierarchical level at which they should be recognized taxonomically, and to propose the consequent nomenclatural changes. It is well known that the Apuan region is a territory of intense diversification in plants, and also of survival of remarkable relict taxa (Garbari 1988a), as evidenced by the presence of numerous endemics. Descriptions of new taxa and new floristic records are both frequent in this area (Raffaelli & Fiesoli 1993). The present contribution intends to update the taxonomic and nomenclatural treatment of some taxa by giving formal recognition to the results of a biosystematic analysis of the corresponding natural groups. New intraspecific combinations will be proposed in line with the theoretical criteria of Arrigoni (1988) and Hamilton & Reichard (1992). More concretely, we think that it is justified to use subspecific rank, in amphimictic groups, in order to reflect the existence of distinct morphological and ecogeographical unities within species or population complexes, considered as unities of organismic diversity in Wagner's sense (1984; cf. Garbari 1988b for details).

Carum appuanum (Viv.) Grande in Bull. Orto Bot. Napoli 4: 166. 1914 ≡ *Selinum appuanum* Viv., Elench. Pl.: 32. 1802 ≡ *S. rigidulum* Viv. in Ann. Bot. (Genoa) 1(2): 164. 1804, *nom. illeg.* ≡ *Carum rigidulum* Koch in DC., Prodr. 4: 115. 1830, *nom. illeg.* = *Meum rigidulum* Bertol., Fl. Ital. 3: 314. 1837, *nom. illeg.* ≡ *Bunium rigidulum*

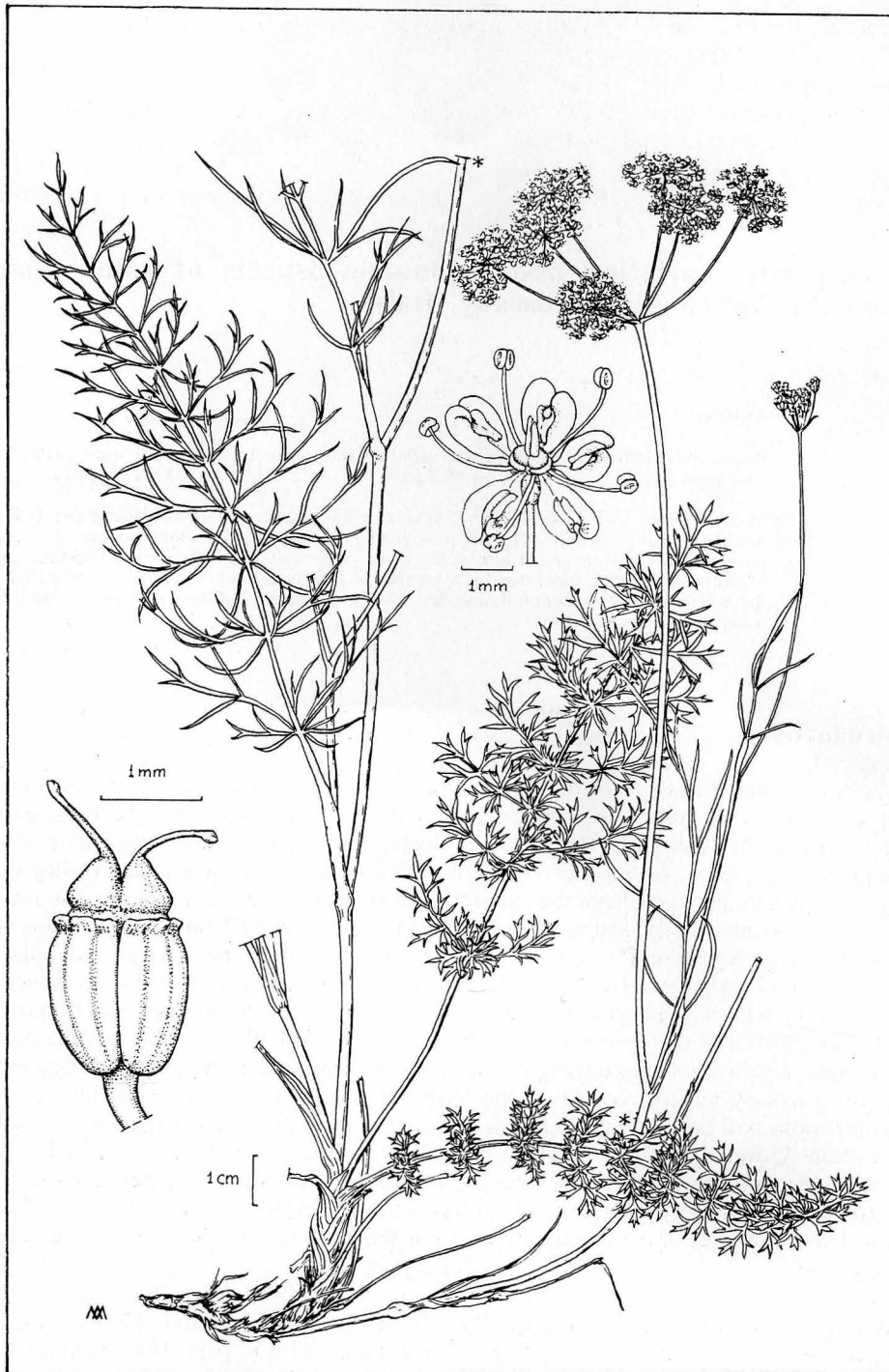


Fig. 1. *Carum appuanum* subsp. *appuanum*: Apuan Alps, Pian della Fioba, 4 Jun 1990, N. Bechi, (PI).

Caruel, Prodr. Fl. Tosc.: 272. 1862, *nom. illeg.* = *Apium rigidulum* Caruel in Parlatore, Fl. Ital. 8: 434. 1889, *nom. illeg.*

subsp. ***appuanum***

subsp. ***bulgaricum*** (Hartvig) Bechi & Garbari, *comb. nov.* = *Carum rigidulum* subsp. *bulgaricum* Hartvig in Strid, Mount. Fl. Greece 1: 698. 1986.

subsp. ***palmatum*** (Hartvig) Bechi & Garbari, *comb. nov.* = *Carum rigidulum* subsp. *palmatum* Hartvig in Strid, Mount. Fl. Greece 1: 698. 1986. = *Carum macedonicum* Quézel & Contandr. in Candollea 23: 17. 1968.

Taxonomy and nomenclature

Viviani (1804) changed the binomial *Selinum appuanum* Viv. (1802) to *S. rigidulum*, preferring an epithet referring to the general habit of the plant to one indicating its provenance. *S. rigidulum* is an illegitimate name because it was nomenclaturally superfluous at the time of its publication (Art. 52.1-2, Greuter & al. 1994). It has the same type as *S. appuanum* (Art. 7.5, l.c.). In consequence, Grande's (1914) combination is legitimate, contrary to all those that are based on *S. rigidulum*. One might wonder whether the latter epithet should not better be retained by invoking conservation or rejection procedures now provided for by the rules of nomenclature (Greuter & al. 1994). Its widespread use in old and recent literature (e.g., Hartvig 1986) seems to support such action, which would avoid the need for the above new combinations. However, the basic Italian Floras (Fiori 1926, Pignatti 1982) adopt *Carum apuanum* (with a "corrected" spelling), so that the chances of success of such a proposal, at present, would be tenuous at best.

Between the disjunct populations of this species in the Apuan Alps and in the Balkan Peninsula, differentiation seems to be taking place. In the Apuan Alps, a marked variability can be observed at the level of secretory structures (Corsi & al. 1988, Corsi & Pagni 1991) as well as a wide ecological range, both of which fit the concept of an expanding taxon. The differentiation of the Apuan and Balkan populations may result from a schizogenetic process. We concur with Hartvig's (1986) formal taxonomic treatment which, however, requires the nomenclatural changes introduced above. *Carum appuanum* subsp. *appuanum* is restricted to the Apuan Alps of Italy (Fig.1); subsp. *bulgaricum* occurs in S. Bulgaria (Pirin, Rodhopi), the Former Yugoslav Republic of Makedonja, and northern Greece; and subsp. *palmatum* is found in northern Greece and perhaps Bulgaria.

Typification

In the introduction to his *Elenchus* Viviani (1802), apologizing for the exiguity of the descriptions of his new species, promised to publish a more detailed treatment in a forthcoming work (*Florae italicae fragmenta*) for which he already had had drawings made and plates cut. Under *Selinum appuanum*, at the end of a brief description, he referred to "Fl. Ital. fragm. Tab. I" (in fact, Viviani 1808: tab. 15, fig. 2); this drawing and engraving are the sole elements to which Viviani refers under the binomial *S. appuanum*. Our search of several herbaria (GE, GDOR, BOLO, FI, REG, CGE, M, O) yielded no authentic Viviani specimens except for a find, at GDOR, of an Apuan specimen of *Carum appuanum* lacking the date of collecting, sent and identified by Viviani as *Selinum chabraei*, and which cannot therefore be confidently accepted as part of the original material. Since the original drawing and engraving do not appear to have survived, we here formally designate the published plate cited above as the type (technically, a neotype) of *S. appuanum*.

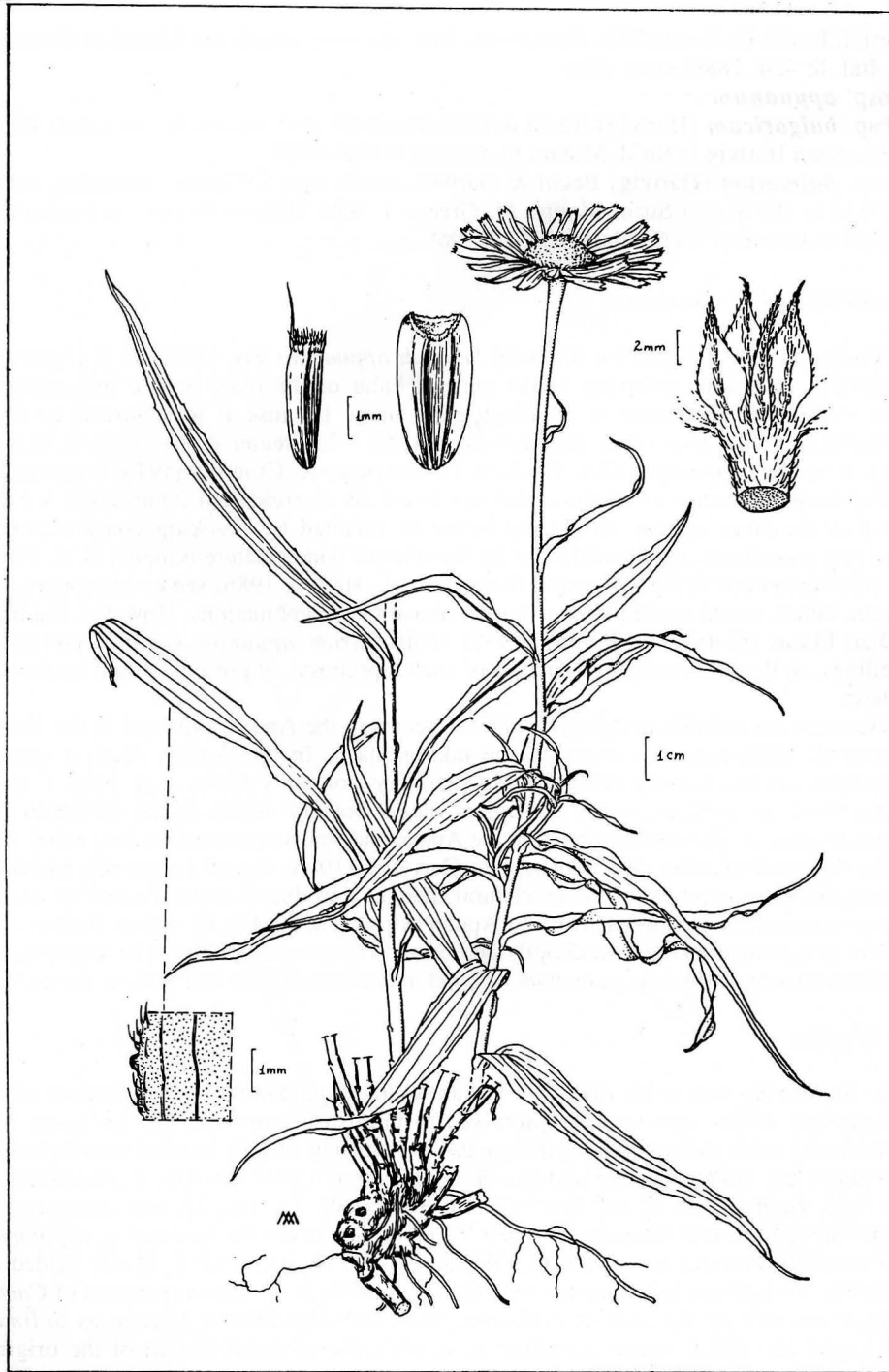


Fig. 2. *Bupthalmum salicifolium* subsp. *flexile*: Apuan Alps, Foce del Procinto, 9 Jul 1989, N. Bechi (PI).

Bupthalmum salicifolium subsp. *flexile* (Bertol.) Garbari in Lavori Soc. Ital. Biogeogr., ser. 2, 1: 197. 1971 ≡ *B. flexile* Bertol., Fl. Ital. 9: 413. 1854 ≡ *B. salicifolium* var. *flexile* (Bertol.) Fiori in Fiori & Paoletti, Fl. Anal. Ital. 3: 295. 1904.
- *B. salicifolium* L. [var.] B, Bertoloni, Amoen. Ital.: 413. 1819.

Taxonomy and nomenclature

Bupthalmum salicifolium subsp. *flexile* occurs in the Apuan Alps, in the nearby Lucchese and Pistoiese Apennines and, as resulted from a through search of herbaria (FI, PI, SIENA, TO, MI, PAV, BOLO), also in some localities of the western Alps (Cozie Alps and Maritime Alps).

The distinctive characters of the Apuan-Apenninic-W Alpine subspecies as compared to *Bupthalmum salicifolium* subsp. *salicifolium* are flexuous stems, longer, narrowly acuminate leaves and, above all, disk cypselas with a lateral awn 3-5 times as long as the coronula (Fig.2).

In as much as one can judge from specimens coming prevalently from Italy - the distribution area of *Bupthalmum salicifolium* is central to south European - some characters show clinal variation along a gradient leading from the eastern Alps along the whole Alpine arc to the Apuan Alps.

The lanceolate leaf blade becomes progressively narrower, the apex more pointed, the margins more grossly dentate, the hairs rarer; the minutely denticulate pappus coronula with subequal teeth up to 0.5 mm high becomes irregular, with one or two teeth more developed and up to 1 mm high, and finally has a lateral awn 3-5 times as long as the coronula.

Fig. 3 represents some disk cypselas morphotypes: in the eastern Alps the "*salicifolium*" morphotype (g) is widespread; in Lombardy both "*salicifolium*" (g) and "intermediate" morphotypes (f) are present; in Piedmont "*flexile*" (d) and "intermediate" morphotypes (e) co-exist; in Tuscany, where the "*flexile*" morphotype (a) dominates, sporadically some specimens with double-awned (c) or unawned (b) achenes appear. The term "intermediate" also refers to a greater range of variation in size and/or shape of the pappus of the disk cypselas; this variability is usually less pronounced in the forms at the opposite ends of the morphological cline.

The "extreme" populations (eastern Alps and Apuan Alps) seem to correspond to the descriptions of *Bupthalmum salicifolium* and *B. flexile* respectively; those with "intermediate" characters (from the central and western Alps) approach the description of *B. grandiflorum* L., a taxon usually included in *B. salicifolium* (Tutin 1976, Pignatti 1982).

As to the karyotype, according to Del Caldo & Martinoli (1970- 1971) one notes a slight but evident increase of chromosome size from *Bupthalmum salicifolium* through *B. grandiflorum* to *B. flexile* and further to *B. inuloides* Moris, endemic to the northern coast of Sardinia as a vicariant to the corresponding continental taxa (Valsecchi 1977).

With regard to reproductive biology, the Alpine and Apuan- Apenninic populations of *Bupthalmum* recall the situation of a "commisuum" (Danser 1929): a group of inbreeding individuals consisting of geographically heteromorphic biotypes (regional facies) that arose through differential selection. From a taxonomic viewpoint the most adequate treatment seems to be that proposed by Garbari (1971) according to which the extreme morphotypes are accepted as subspecies, *B. salicifolium* subsp. *salicifolium* and subsp. *flexile*. The intermediate populations, not easily attributed to either subspecies, might then be described as a third subspecies, or treated as a variety.

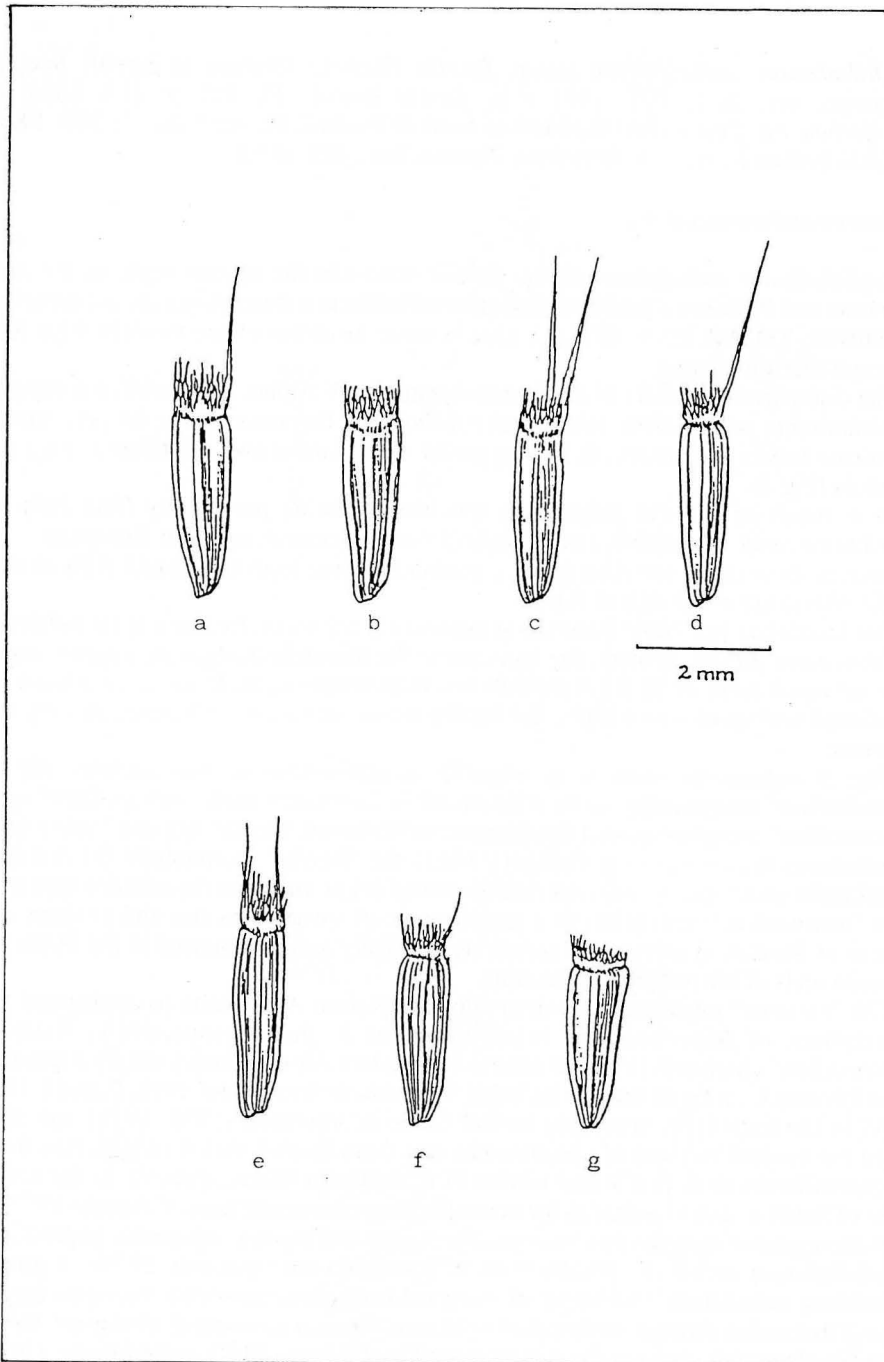


Fig. 3. Some disk cypselas morphotypes in *Bupthalmum salicifolium*: a-c, Tuscany, Apuan Alps; d-e, Piedmont, western Alps; f, Lombardy, central Alps; g, central and eastern Alps.

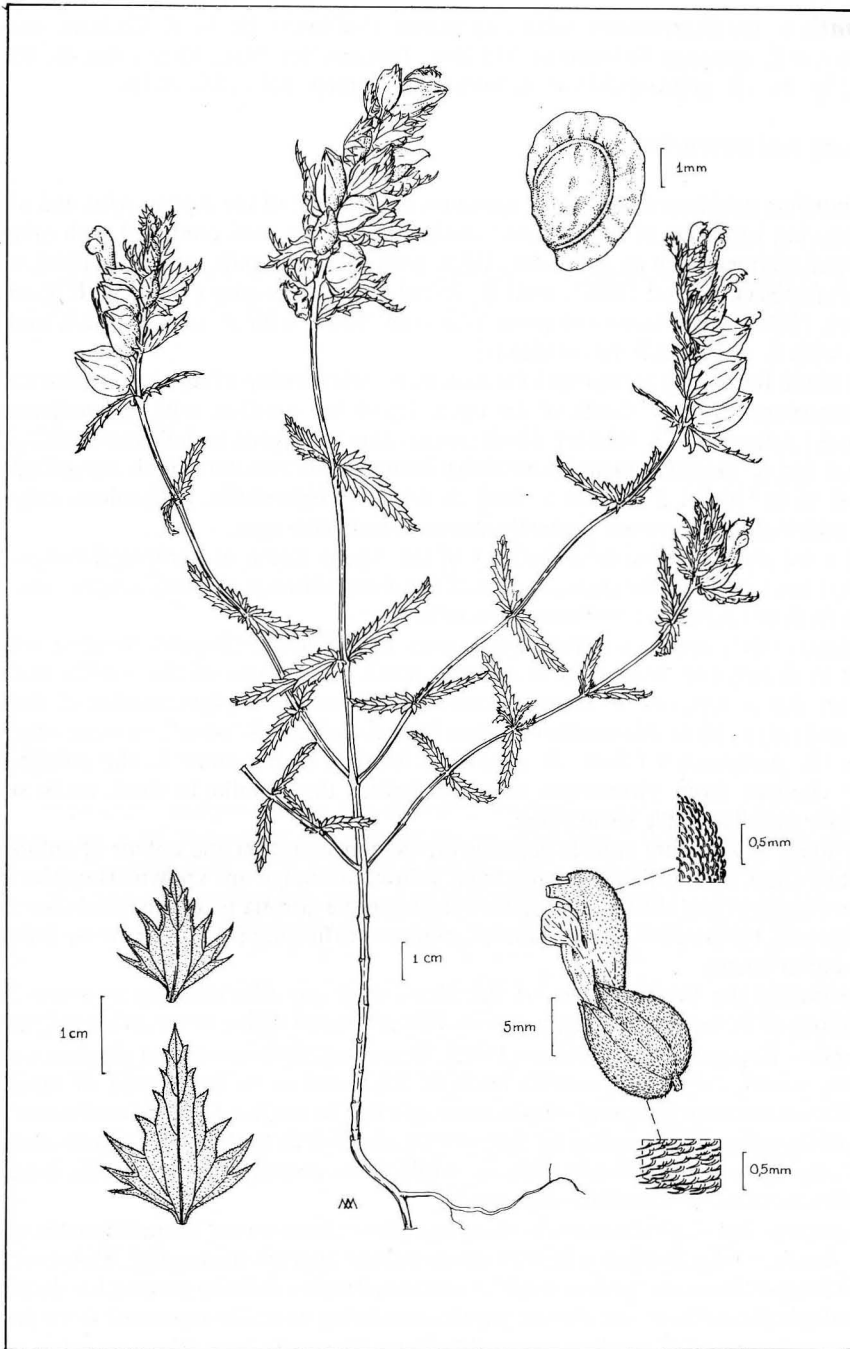


Fig. 4. *Rhinanthus mediterraneus* subsp. *apuanus*: Apuan Alps, Levigliani, 23 Jul 1989, N. Bechi (PI).

Rhinanthus mediterraneus subsp. *apuanus* (Soldano) Bechi & Garbari, *comb. & stat. nov.* ≡ *R. apuanus* Soldano in Atti Soc. Toscana Sci. Nat., Mem., Ser. B, 89: 276. 1982 (Fig. 4). - *R. crista-galli* var. δ , Bertoloni, Amoen. Ital.: 380. 1819.

Taxonomy and nomenclature

Rhinanthus mediterraneus subsp. *apuanus*, an endemic of the Apuan Alps and of some neighbouring localities of the Tuscan-Emilian Apennines, was confused with other taxa by several authors, such as Bertoloni (1819, with *R. crista-galli*, as var. δ ; 1844, with *R. alectorolophus*), Caruel (1863, with *R. crista-galli*), Sommier (1894, with *R. major*), Sterneck (1895, with *Alectorolophus ramosus*; 1901, with *A. arvernensis*), and Fiori (1926, with *R. crista-galli* var. *ovifugus*).

The credit for having recognized the systematic relationship of this taxon, characterized by a concolorous "nose" (teeth of the upper lip of the corolla), with *R. mediterraneus* (Sterneck) Adamović (*R. subsect. Mediterranei* Janchen), goes to Soldano (1982). His *R. apuanus* and *R. mediterraneus* share cleistoleme corolla structure, with curved tube and squared "nose" about 2-3 times as long as wide; an eglandular, puberulous calyx; and bracts with teeth that become gradually shorter towards the apex.

The most showy differential features of the Apuan taxon as compared to typical *R. mediterraneus* concern the pigmentation of the stem (absence of black stripes) and of the corolla (yellow rather than violaceous "nose").

Soldano (1982) considered these differences, in addition to allopatry, to be of sufficient weight to distinguish both taxa at specific level. The colour of the corolla teeth is a character that is reported in most species descriptions, as is pigmentation of the stem, bracts and calyx. Most *Rhinanthus* species have a violaceous "nose", in some others it is yellow (*R. pampaninii* Chab., *R. dinaricus* Murb.); in *R. minor* L. the colour of the "nose" changes from violaceous to white before the corolla is shed, as is seen in successive corollas of the same plant.

The shade of a mature corolla depends on the concentration and colour of anthocyanic pigments; cases of corollas changing from yellow to orange are known (Hamblen 1958). The development and diffusion of anthocyanins in the corolla is an inherited character in some species, but besides genetic control, pigment diffusion also appears to be influenced by the environment.

Concerning the black stripes on the stem, they are also missing in some French populations of *R. mediterraneus*, a species that in France seems to be rather polymorphic (Champion- Bourget, acc. to Soldano 1982). Sterneck (1901) considered pigment variation in stem, bracts, calyx and corolla teeth of *Rhinanthus* to be devoid of taxonomic significance, because it occurs within most species. In the most recent treatments of the genus *Rhinanthus*, in particular by Soó (1970) and Soó & Webb (1972), such characters do not appear in the diagnostic phrases, while those concerning the corolla, bracts and calyx indumentum have notable importance.

R. apuanus and *R. mediterraneus* share just those characters of unquestionable specific value, which is why Soldano's (1982) interpretation appears inadequate. However, since the phenotypic character "yellow nose" is correlated with a definite geographic distribution and ecological condition, the Apuan populations being spatially separated from the other Italian populations of *R. mediterraneus* (Maritime Alps and Cozie Alps), it seems justified to recognize such a variation at subspecific level. Therefore, the above taxonomic and nomenclatural adjustment is proposed here.

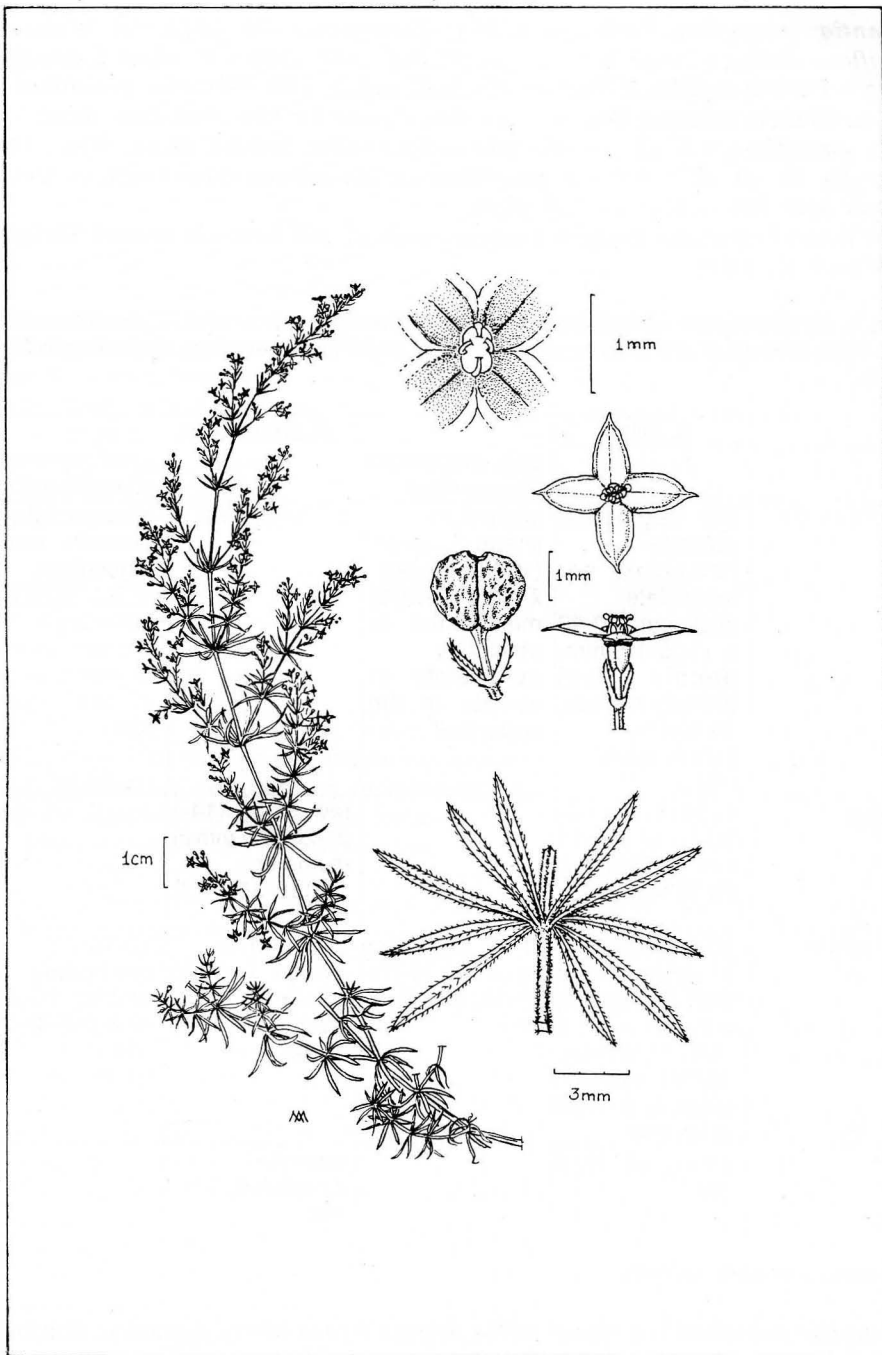


Fig .5. *Asperula purpurea* subsp. *apuana*: Apuan Alps, Monte Altissimo, 24 Jun 1990, N. Bechi (PI).

Astrantia pauciflora Bertol. in J. Bot. (Desvaux) 2: 76. 1813 \equiv *A. minor* var. *pauciflora* (Bertol.) Cesati & al., Comp. Fl. Ital.: 577. 1880 \equiv *A. minor* f. *pauciflora* (Bertol.) Paoletti in Fiori & Paoletti, Fl. Anal. Ital. 2: 150. 1900 \equiv *A. pauciflora* var. *genuina* Grint. in Annuaire Conserv. Jard. Bot. Genève 14: 124. 1910, *nom. inval.*
 subsp. *pauciflora* = *A. diversifolia* Stur in Sitzungber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl. 40: 497. 1860 \equiv *A. pauciflora* var. *diversifolia* (Stur) Grint. in Annuaire Conserv. Jard. Bot. Genève 14: 124. 1910.
 subsp. *tenorei* (Mariotti) Bechi & Garbari, *comb. & stat. nov.* \equiv *A. tenorei* Mariotti in Webbia 43: 11. 1989.

Table 1. Morphological comparison between *Astrantia minor* L. and *A. pauciflora* Bertol. (from living and dried specimens; vouchers in FI and PI). Terminology according to Stearn (1983).

	<i>A. minor</i>	<i>A. pauciflora</i>		
		ssp. <i>pauciflora</i> (Apuan Alps)		ssp. <i>tenorei</i> (Central Apennines)
BASAL LEAVES	7-9 segments, obovate-lanceolate or lanceolate-sublinear, 20-40 x (1-)5-10 mm, deeply and densely serrate, sometimes subpinnately cleft	lanceolate-linear or linear, (10-)30-40(-90) x (0.8-)2-3(-6) mm, entire or obscurely denticulate or serrate in the upper half	5-7 segments	oblanceolate-obovate, rarely lanceolate, (2.5-) 20-30 (-60) x (2-) 4-7 (-13) mm, serrate or rarely entire in the upper half
UMBELS	numerous, (2)3-6(12); (7-)11-14 mm in diameter; 25-35 flowered		few, 1-3; (14-)21-26(-35) mm in diameter; (22)30-36 (43) flowered	
BRACTEOLES	10-12, equalling or rarely shorter than the umbel; 6-8(-15) x 1.5-3 mm, white; lateral veinlets scarcely evident or lacking	10-12, exceeding the umbel; (9-)11-12(-16) x (1.9-) 2-3 mm	pinkishwhite except for the green ribs; lateral veinlets evident	10-15, exceeding the umbel; 10-21 x (2.2-)2.5-4(-5) mm
FRUIT	ovoid, up to 3 mm		obovate-cylindrical, 3.5-4 mm	

Taxonomy and nomenclature

Astrantia pauciflora is a species with a disjunct Apuan-central Apenninic distribution. The existence of a marked intraspecific morphological variability and the tendency towards an effective geographical separation of two extreme morphotypes were already evidenced and described by Stur (1860) and Grintzesco (1910). Mariotti (1989) basing himself on biometrical tests, deemed that the observed differences in individual variation of leaf and bract characters combined with patterns of geographical distribution suffice to consider the

Apuan and central Apenninic populations as two distinct species: *Astrantia pauciflora* and *A. tenorei*, respectively.

It must be underlined, however, that the above-mentioned characters show largely overlapping variation ranges within the two sub-areas. Table 1 offers a synthesis of some differential morphological features of the Apuan and central Apenninic populations of *Astrantia pauciflora*, and of *A. minor* L. as well (see also Mariotti 1989: figs. 5 - 6). Further to the inter-individual character variation, some intra-individual variation can also be observed: in the same plant the primary basal leaves always possess relatively wider segments than the following ones. Considering that widespread inter- and intra-individual variability in shape and size of the basal leaves may be found in other *Astrantia* species as well, particularly in *A. minor*, and noting the nature of differential characters, at the specific level, elsewhere in *A. sect. Astrantiella*, it seems preferable to treat at subspecific rank the populations of *A. pauciflora* of the two subareas, which seem to be regional facies more or less distinctly connected by a range of intermediate types rather than clearcut species. As is well known, there is common agreement (Heslop-Harrison 1953, Briggs & Walters 1969, Mayr 1982) in regarding subspecies as expressions of the geographic variation of the species. The foregoing nomenclatural change reflects this position.

Asperula purpurea subsp. *apuanum* (Fiori) Bechi & Garbari, *comb. & stat. nov.* ≡ *Galium purpureum* var. *apuanum* Fiori, Nuova Fl. Anal. Ital. 2: 491. 1927.

Taxonomy and nomenclature

Plant densely hairy on the leaves and stem, hardly hirsute: thus Fiori (1927) characterized his *Galium purpureum* var. *apuanum*. *G. purpureum* L. is a species with a wide distribution and uniform morphology: glabrous, or rough through some little antrorse asperities on the stem and leaves, as observed by Kliphuis (1974) on individuals of different origin grown for several years.

The Apuan populations differ by their well developed indumentum that can vary in density, extent (only at the bottom or also in the inflorescence) and length. Merely rough, scarcely pubescent individuals are rare. The pubescence is maintained in cultivation under standard conditions and is thus genetically based (Fig. 5). The subspecific rank seems adequate for these populations that represent a regional facies of the species.

Ehrendorfer (in Gutermann & al. 1973) has deemed that *Galium purpureum* L., owing to the presence of bracteoles in the inflorescence and to the overall likeness with *Asperula* species with funnel-shaped corolla, is better referred to the latter genus. In his treatments of *A. purpurea* (L.) Ehrend., Ehrendorfer (1976, 1982) did not ascribe any taxonomic significance to the peculiar pubescence of the Apuan populations. We believe that such a morphotype, linked with a definite geographical area and ecological condition, must not be ignored, and therefore we propose the foregoing new combination.

Typification

At FI numerous specimens of *Galium purpureum* bear the addition "ß apuanum" in Adriano Fiori's handwriting, dated 6 Mar 1926.

We here designate as lectotype one of these specimens, labelled as follows: "In rupibus Alpium Apuanarum prope Mosceta, julii 1875, legit J. Arcangeli".

Acknowledgements

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