# Primula recubariensis, a new species of Primula sect. Auricula Duby endemic to the SE Prealps, Italy

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Source: Willdenowia, 28(1/2) : 27-46

Published By: Botanic Garden and Botanical Museum Berlin (BGBM)

URL: https://doi.org/10.3372/wi.28.2802

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# *Primula recubariensis*, a new species of *Primula* sect. *Auricula* Duby endemic to the SE Prealps, Italy

**Abstract**

Prosser, F. & Scortegagna, S.: *Primula recubariensis*, a new species of *Primula* sect. *Auricula* Duby endemic to the SE Prealps, Italy. – Willdenowia 28: 27-45. 1998. – ISSN 0511-9618.

*Primula recubariensis* is described as a species new to science, illustrated and its distribution is mapped. *P. recubariensis* is similar to *P. hirsuta*, but differs by lilac-violet (not purple) corollas, few remains of withered leaves, a much stronger aromatic scent and features of the indumentum, viz by hairs with distinctly smaller glandules and, particularly, by a high percentage (at least 25%, usually more than 90 %) of four-celled besides three-celled hairs, the latter in contrast to *P. hirsuta* with a conspicuously slender subterminal cell (2-4 times longer than wide). *P. recubariensis* grows in shady dolomitic cliffs at 1400-2030 m, on the SE side of the Carega Massif (SE Prealps, in the border zone of the districts of Trento, Verona and Vicenza), particularly on two mountain chains above Recoaro named Il Fumante and Tre Croci. *P. recubariensis* hybridises with *P. auricula* subsp. *ciliata* and this hybrid is described as *P.* ×*vallarsae*, a nothospecies new to science, and illustrated.

## Introduction

> "... esiste un bel distretto con prospettiva di preziosi compensi: dai 7 comuni a Lavaron [...] e giù al pian della Fugazza, e traversando a ponente sopra Camposilvano, poi su in prospettiva di Recoaro ..." (letter by Francesco Facchini to Francesco Ambrosi dated 2 May 1852, quoted after Festi 1998).

Some years ago, the second author found during a survey of the flora of the Carega Massif, also known as Piccole Dolomiti and located in the border zone of the districts of Trento, Verona and Vicenza, a lilac-violet flowering primrose on the dolomitic outcrops of the Fumante chain. By means of standard floras (e.g., Pignatti 1982) this plant was identified as *Primula hirsuta* All. and subsequently reported under this name (Curti & Scortegagna 1992, 1997, Buffa & al. 1995). This report seemed questionable to the first author, since *P. hirsuta* usually grows on siliceous rocks and the Carega Massif is situated about 70 km beyond the southeastern limit of *P. hirsuta*, southeastwards of which *P. hirsuta* is replaced by *P. daonensis* (Leyb.) Leyb., an acidophilous species, quite different from the *Primula* observed on the Carega Massif. We analysed this primrose and discovered soon that it represents an undescribed species, being clearly different from *P. hirsuta*.

The discovery of a new *Primula* in this region is surprising. Since the publication of Dalla Torre & Sarnthein's flora (Dalla Torre & Sarnthein 1900-13) several botanists have visited the

Carega Massif and neighbouring areas and have recorded primroses. *P. auricula* L. (sub *P. ciliata* Moretti), e.g., was found by Anton Kerner, Emil Levier, Gregorio Rigo, Enrico Gelmi and Agostino Goiran, *P. spectabilis* Tratt. by Pietro Porta, Levier and Friedrich Leybold. Some of them had described new taxa of *Primula* and one would imagine so that they would have noticed an undescribed primrose. However, apparently most of these botanist did not visit the localities where *P. recubariensis* occurs. Besides, confusion of non-flowering plants of *P. recubariensis* with *P. auricula* is very easy; Jean François Seguier and Agostino Goiran, e.g., recorded the latter species from Monte Zevola (see Goiran 1897-1904), where actually *P. recubariensis* is widespread.

## Material and methods

Apart from living plants and herbarium specimens of *Primula recubariensis*, we examined specimens of all allied species, viz *P. hirsuta* All., *P. albenensis* Banfi & Ferlinghetti, *P. apennina* Widmer, *P. carniolica* Jacq., *P. daonensis* (Leyb.) Leyb., *P. latifolia* Lapeyr., *P. pedemontana* Thomas ex Gaudin, *P. villosa* Wulfen and *P.* ×*pubescens* Jacq. This material was put at our disposal by the following herbaria (abbreviations after Holmgren & al. 1990 and Holmgren & Holmgren 1993, 1994): FI, G, HBBS, LUG, M, MRSN, NEU, PAD, ROV, WU, Z.

In order to test the validity of the taxonomically important characters of the indumentum for distinguishing *Primula recubariensis*, it would be difficult to use the results found in the literature, since most authors do not report exactly the methods of their measurement. For this reason, we measured the hairs of the leaf margin of over 150 collections of *P. hirsuta* (with special attention to those from basic substratum) and of c. 130 collections of other allied species. We analysed 1-2 plants per collection and more plants only in case of a strong variability of the hair length. The samples were prepared with some drops of water and the hair length was measured along c. 10 mm of the distal part of the leaf margin (but not at the tip) with a microscope at ×100 and ×400. Only 3-5 normally developed and representative hairs were chosen. The average length was calculated as the arithmetic mean between the average maximal and minimal length of the hairs. The absolute maximal length corresponds to the longest hair measured in the samples of a taxon. By measuring glandule width, we considered only laterally uncollapsed glandules and the width refers to the glandular cell without irregular secretion masses. Counting the number of cells per hair, we did not include the basal cell at epidermis level (this cell was counted by Widmer 1891). The hair width was measured a little above the basis.

The measurements of the pollen were taken on about 20 grains from a dried flower.

The DNA mass per nucleus was measured by Sergio Sgorbati (Milan) using the method of flow cytometry.

***Primula recubariensis*** Prosser & Scortegagna, **sp. nova** – Fig. 1-2, 3A.
Holotypus: Italia, provincia di Trento, comune di Vallarsa, Piccole Dolomiti, sottogruppo del Fumante, lungo il sentiero tra la Sella del Rotolon e Forcella Lovaraste, rupe dolomitica, 1650 m, 18.5.1997, *Scortegagna* (ROV).

Descriptio (dimensiones e speciminibus siccis; ubi numeri tres signo "-" conjucti deferuntur, primus numerus minimo, secundus medio arithmetico, tertius maximo magnitudinis respondit):
Herba perennis, rosulata, efarinosa, fragrantissima praesertim sicca, odore *Primulae albenensi* similis. Rhizoma, usque ad 50 mm longum et 3-5 mm crassum, polystelicum, fulvum sive stramineum, superne residuis paucis foliorum prioris anni in fibrarum cinerearum fasciculos dissolutorum. Cellulae fasces vasculares circundantes parietibus tenuibus (paries simplex, non duplex, circiter 3 µm et non 8 µm sicut in *P. hirsuta*). Massae sclereidum omnes extrafasciales, paucae. Partes virides indumento denso tectae; pili flexuosi tenuesque, circiter 0.1-0.25-0.6 mm

Fig. 1. *Primula recubariensis* – two plants from Il Fumante on the path between Forc. Rotolon and Forc. Lovaraste, c. 1700 m. – Photographs by Giorgio Perazza, 4.6.1998.

Fig. 2. *Primula recubariensis.* – Drawing after the holotype. Scale bar unit = 1 cm.

longi, compositi e 3 vel 4 cellulis uniserialibus; cellulae terminales glandulosae, hyalinae, 27-30-35 µm latae et minores quam in *P. hirsuta*. Folium forma vix varians; laminae obovatae, in petiolos alatos dimidium laminae fere aequantes attenuatae, inferiores 7-10-13 mm latae et 8-18-27 mm longae, superiores usque ad 28 mm latae et usque ad 63 mm longae; folia subintegra seu sinuato-dentata: dentes 3 usque ad 17 subterminales vel laminae trientem apicalem et medium marginantes. Pili marginales apicis laminarum e cellulis 3 (0 usque ad 75 %) vel 4 (-5) (25-100 %, plerumque 90-95 %) compositi; cellulae subterminales pilorum 3 cellularium latitudine sua 2-4plo longiores ideoque graciles. Scapi foliis semper breviores, floriferi 6-10-15 mm tantum longi, fructiferi 20-27-40 mm, raro subnulli; flores 2-5, raro singuli; pedunculi glanduloso-pilosi, floriferi 2-5-9 mm, fructiferi 4-6.8-12 mm longi; bracteae 3-5, breves, plus minusve scariosae, 1-3 mm longae (rarius una earum foliacea et usque ad 6 mm longa). Calyx tubo

hemisphaerico et dentibus a tubo corollae plus minusve divergentibus, acutis, et latitudine sua sesquilongioribus vel rotundatis et plus minusve imbricatis et latitudine sua aequilongis; calyx per anthesin 2.0-1.8-5.3 mm longus dentibus 1.4-2.1-2.7 mm longis et 1.5-1.8-2.1 mm latis, calyx fructifer auctus, 4.7-5.6-6.7 mm longus, dentibus 2.3-3.0-4.0 mm longis et 1.5-2.2-3.0 mm latis. Corolla efarinosa, tubo 6-10 mm longo, extus brevissime glanduloso-piloso, limbo 15-20 mm lato, lavandulaceo, fauce pallidiore, brevissime glanduloso-piloso. Flores dimorphi: brevistyli filamentis 0.5 mm longis, tubo paulum supra medium insertis et stylis 1.2 mm longis; longistyli filamentis subnullis, tubo 1-2 mm supra basin insertis et stylis 4.5 mm longis. Antherae amborum 1.2 longae. Grana pollinis regularia, globoso-tetragona, 14 µm fere diametro. Capsula subglobosa, tubum calycis aequans vel vix superans, 2.5-3.0 mm fere longa. Semina pentaedrica usque ad dekaedrica angulis plus minusve acutis, 0.7-0.8-1.1 mm longa, reticulato-foveolata epidermide papillosa cuticulaque leviter striata. Habitu *Primulae hirsutae* similis, sed compage pilorum, colore limborum corollarum, foliis celeriter dissolventibus, odore insigni et habitatione diversa discrepans.

Floret mense majo exeunte et mense junio incipiente. Crescit in rupium humidarum dolomiticarum fissuris in austro-occidentali parte montium Piccole Dolomiti dictorum, et praesertim ab monte Il Fumante usque ad jugum Tre Croci.

Etymologia: Epitheton ex oppido Recubario dictum, in Vicetina provincia.

Description

Perennial, rosulate, efarinose, very scented especially when dried (± like *P. albenensis*). Rhizome up to 5 cm long and 3-5 mm thick, pale yellow to greyish brown; leaves decaying within a year into grey fibres. Rhizome polystelic; parenchyma cells, which surround the bundles, thin-walled (about 3 µm; in *P. hirsuta* about 8 µm); groups of sclereids few, all outside the bundles. All green parts covered with flexuose, slender glandular hairs formed by (3)-4-(5) cells, the three-celled hairs with a slender subterminal cell (more than twice as long as wide); hairs on the distal blade margin 0.1-0.6 mm long (average c. 0.25 mm), the small, colourless glandule 27-35 µm wide (average 30 µm), colourless or very pale yellow as the whole hair. Leaves rather homogeneous, with ± obovate blade and ± well separated winged petiole half as long as the blade; vernal leaves 8-27 × 7-13 mm (average 10 × 18 mm), summer leaves up to 63 × 28 mm long; margin subentire or sinuate-dentate with 3-5 to 17 teeth in the distal 2/3 of the blade. Scape always shorter than leaves (rarely without a scape), at flowering 6-15 mm (average 10 mm), at fruiting 20-40 mm (average 27 mm) long, carrying 2-5 flowers (rarely only one flower). Peduncles at flowering 2-9 mm (average 5 mm), at fruiting 4-12 mm (average 6.8 mm) long, in the axil of 3-5 short (1-3 mm) and ± scarious bracts (rarely one foliaceous bract up to 6 mm long). Calyx hemispherical, 2.0-5.3 mm (average 4.3 mm) long, at fruiting 4.6-6.7 mm (average 5.6 mm) long; sepals 1.4-2.7 × 1.5-2.1 mm (average 2.1 × 1.8 mm), at fruiting 2.3-4.0 × 1.5-3.0 mm (average 3.0 × 2.2 mm), ± diverging, with variable shape, either acute, in length 1.5 times the width, or rounded with subequal dimensions (and then with overlapping margins). Corolla with lilac-violet limb, a whitish throat 15-20 mm wide (18-23 mm in vivo) and a 6-10 mm long tube (in vivo 8-13 mm), efarinose, with very short glandular hairs on the outside of the tube and in the throat. Anthers 1.2 mm long. Flowers heteromorphic: in brevistylous flowers anthers with 0.5 mm long filaments, inserted just above the middle of the tube, and style c. 1.2 mm long; in macrostylous flowers anthers subsessile, inserted c. 1-2 mm above the base of the tube, and style c. 4.5 mm long. Pollen grains normally developed, about 14 µm in diameter. Capsule subglobose, slightly vertically depressed, as long as the calyx tube or a little longer, c. 2.5-3 mm long. Seeds 0.7-1.1 mm in diameter (average 0.84 mm), irregularly polyhedral, with ± acute edges and c. 5-10 sides, normally developed; epidermis papillose, cells with finely striated walls, seed-coat reticulate-foveate.

Chromosome number: Unknown, likely to be the same as *P. hirsuta*. DNA per nucleus: 4.43 pg, the same value obtained for *P. hirsuta*.

**Systematic position and delimitation from closely related species**

*Primula recubariensis* belongs to *P.* subg. *Auriculastrum* Schott, characterized by the involute vernation of the leaves and by flowers arranged in umbels, and within this subgenus to the European *P.* sect. *Auricula* Duby. Among its seven subsections as listed by Smith & Fletcher (1948), only *P.* subsect. *Erythrodrosum* (Schott) Pax and *P.* subsect. *Brevibracteatae* Widmer ex Pax always have ± purple or violet flowers and short bracts like *P. recubariensis*. Unfortunately, on the basis of the characters given by Pax & Knuth (1905) and Smith & Fletcher (1948), it is difficult to place *P. recubariensis* in either of them. A morphological comparison between *P. recubariensis* and the species of *P.* subsect. *Erythrodrosum* and *Brevibracteatae* is given in Tab. 1. Among the nine species of the two subsectiones *(P. albenensis* has to be placed in *P.* subsect. *Brevibracteatae)*, the very variable *P. hirsuta* bears the strongest resemblance to *P. recubariensis*. Therefore, we will particularly stress the differences between *P. recubariensis* and *P. hirsuta*.

Hairs

Already Widmer (1891) identified the glandular hairs as an important mean to discriminate the European species of *Primula*. More recently Widder (1971), e.g., used dimensions and shapes of the hair cells to distinguish *P. villosa* Wulf. from related species of *P.* subsect. *Erythrodrosum* and Kreß (1973) analysed critical populations of *P.* subsect. *Erythrodrosum* species by means of hair features. The results of our examination of the glandular hairs in *P. recubariensis* and the allied species are presented in Tab. 2 and Fig. 3 and are summarized in the following.

The indumentum of *P. recubariensis* usually consists of many four-celled hairs and few (5-10 %) three-celled and five-celled hairs; rarely we found plants with 75 % three-celled and 25 % four-celled (and some five-celled) hairs. We never found less than 25 % four-celled hairs. All hairs are conspicuously slender (average length-to-width ratio 7 : 1). The length of the subterminal cell of the three-celled hairs is always more than twice (42 ± 7 µm) its width (17 ± 4 µm). The glandules are colourless or very pale yellow and small (27-35 µm wide, average 30 µm).

In *P. hirsuta*, in contrast, four-celled hairs are either absent or rare (we never traced more than 1 %). Besides, the three-celled hairs are much less slender (average length-to-width ratio 1:3.5), the subterminal cell is about as long (22 ± 7 µm) as wide (20 ± 4 µm) and the glandules are large (average width 42 µm), golden to reddish, rarely colourless.

*P. villosa* Wulfen can always be distinguished from *P. recubariensis* by its large red glandules, its different habit (the scape of *P. villosa* is usually longer than its leaves) and the shape of its glandular hairs.

Tab. 1. Differential characters of species of *Primula* subsect. *Erythrodrosum* and *Brevibracteatae* in comparison with *P. recubariensis*.

| | farina present | glands red or golden | flower colour | substrate | odour |
|---|---|---|---|---|---|
| *P. recubariensis* | no | no | ± violet | basic | strong |
| ***P.* subsect. *Erythrodrosum*** | | | | | |
| *P. pedemontana* | no | yes | ± purple | acid | weak |
| *P. daonensis* | no | yes | ± purple | acid | weak |
| *P. villosa* | no | yes | ± purple | acid | weak |
| *P. hirsuta* | no | yes/no | ± purple | acid (rr basic) | weak (rr strong) |
| *P. apennina* | no | yes | ± purple | acid | weak |
| ***P.* subsect. *Brevibracteatae*** | | | | | |
| *P. marginata* | yes | no | ± violet | basic (rr acid) | weak |
| *P. caniolica* | yes | no | ± violet | basic | weak |
| *P. latifolia* | yes | no/yes | ± violet | acid | strong |
| *P. albenensis* | yes | no | ± violet | basic | strong |

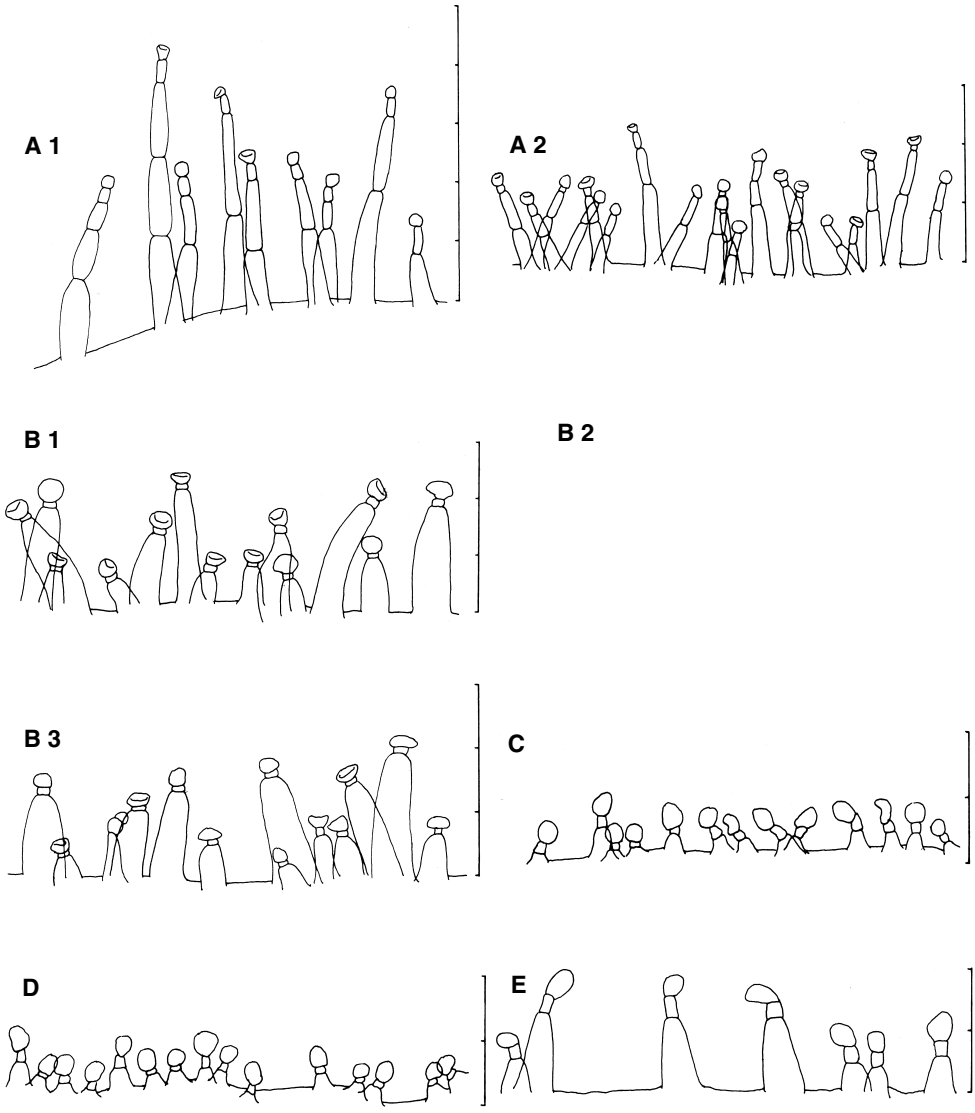


Fig. 3.1. Hairs on the leaf margin of *Primula recubariensis*, *P.* ×*vallarsae* and allied species of *P.* subsect. *Erythrodrosum* and *Brevibracteatae* – A: *P. recubariensis*, A1: Piccole Dolomiti, sottogruppo del Fumante, ai piedi della parete Nord della Guglia Cesareo, 1750 m, 24.9.1997, *Prosser & Scortegagna* (ROV), A2: [Fumante], fessura della roccia, 1600 m, 20.-28.5.1989, *S. Sandri* (PAD); B: *P. hirsuta*, B1: Suisse, Canton du Valais, Les Granges-sur-Salvan, 1000 m, 19.4.1951, *C. Oberson* (ded. & det. H. Brunner) (NEU) [reddish glandules], B2: provincia di Varese, presso la Bocca di Cuvignone in direzione del M. Nudo, 1120 m, 1.10.1997, *Prosser & Scortegagna* (ROV), B3: Grigna settentrionale, Westseite, 12.7.1904, *G. Geilinger* (Z) [colourless glandules]; C: *P. apennina*, Toskanischer Apennin, Mte. Orsaro, P. Davies, cult. BG Munich, leg. *A. Kreß*, 14.5.1965 (M); D: *P. pedemontana*, Prov. Torino, unterhalb Piamprato, about 1300 m, 18.8.1964, *H. Merxmüller & W. Wiedmann* (M); E: *P. daonensis*, Trentino, Lagorai, Forc. Montalon, prateria alpina su silice, 2130 m, 30.7.1997, *F. Prosser* (ROV). – Scale bar unit = 0.1 mm. – Continued on the following page.

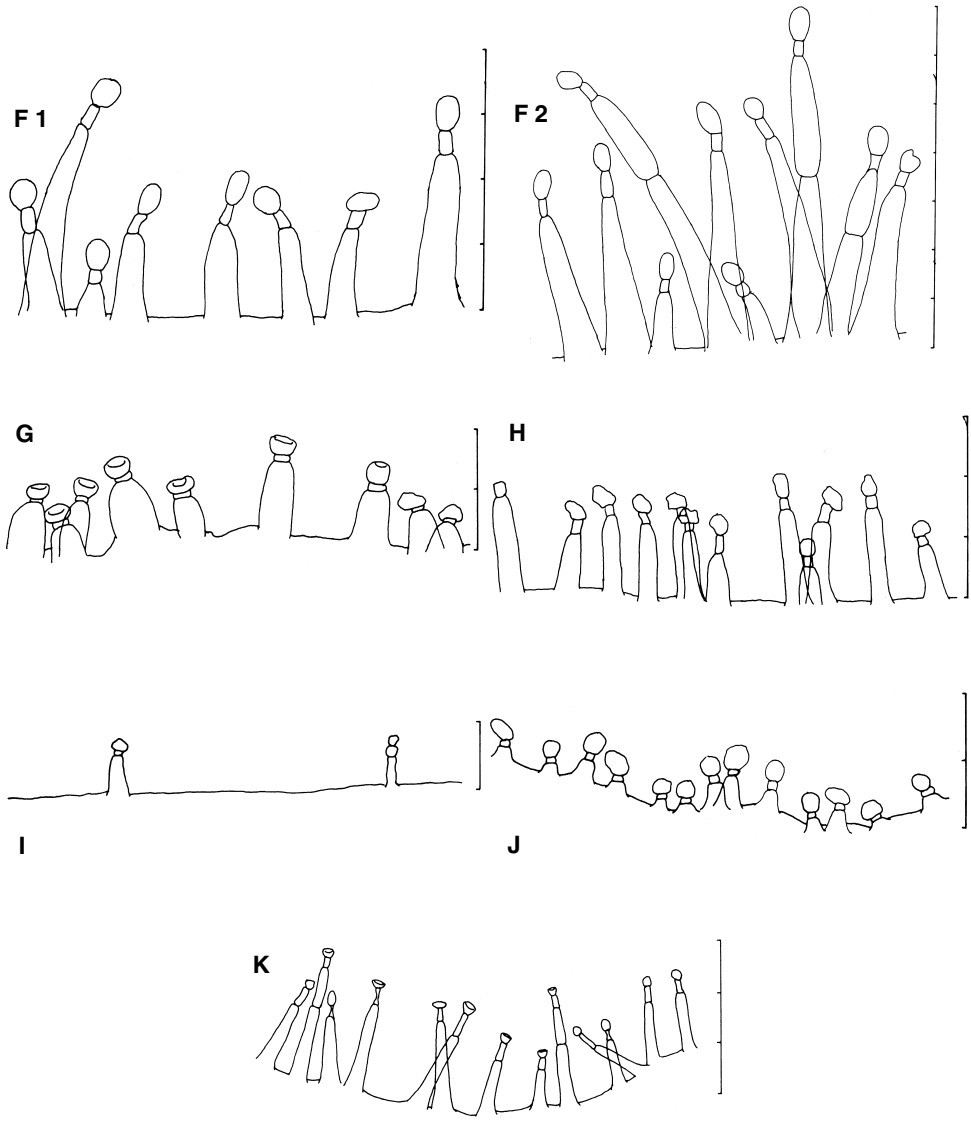


Fig. 3.2. Hairs on the leaf margin of *Primula recubariensis*, *P.* ×*vallarsae* and allied species of *P.* subsect. *Erythrodrosum* and *Brevibracteatae* [continued from the preceding page] – F: *P. villosa*, F1: Stiria, Herberstein, *J. C. Pittoni* (NEU) [reddish glandules], F2: Stiria inferior., in monte Rappold (Stubalpe), 1800-1900 m, *Dominicus*, rev. Widder (WU) [orange glandules]; G: *P. latifolia*, Schweiz, Albulapaß, westl. des Paßhauses bei fast 2300 m, 8.7.1989, *O. Angerer* (M); H: *P. albenensis*, provincia di Bergamo, Val d'Aucogno nel comune di Valtorta, about 900 m, 2.11.1997, *R. Ferlinghetti* (ROV); I: *P. carniolica,* Ager Goritiensis, in umbrosis subalpinis prope pagum Chiapovano, 700-800 m, 5.1912, *C. Marchesetti* (FI); J: *P.* ×p*ubescens*, Tirolia central., ad pedem m.ti Tribulaun in Pflersch, 2000-2200 m, 6.1888, *Huter*, rev. Kreß (M) [colourless glandules]; K: *P.* ×*vallarsae*, holotype. – Scale bar unit = 0.1 mm.

*P. daonensis*, the allied species whose distribution area is geographically nearest to the Carega Massif, is very different from *P. recubariensis* in macromorphological characters (scape length, leaf shape) as well as in character of the glandular hairs (see Tab. 2).

*P. albenensis* is quite similar to *P. recubariensis*. It has the same flower colour, a very similar scent, always colourless glandules and grows in similar habitats. However, *P. albenensis* is larger, always very farinose and has only three-celled hairs. The eglandular hairs mentioned by Banfi & Ferlinghetti (1993) in their description of *P. albenensis* have to be interpreted as glandular hairs which have lost their glandules.

Flower colour

The flower colour of *Primula hirsuta* is lilac to purplish-red, while the colour of *P. recubariensis* is lilac-violet (sometimes pale). In the field, the colour difference between *P. spectabilis* (with pinkish to red-lilac flowers similar to *P. hirsuta*) and *P. recubariensis* is always evident. See, e.g., the pictures of *P. marginata* and *P. hirsuta* in Rasetti (1980).

Leaf persistence

The rhizome of *Primula hirsuta*, as in every other species of *P.* subsect. *Erythrodrosum*, is abundantly covered in the upper part with a marcescent foliage, which persists for many years. The leaves of *P. recubariensis*, in contrast, quickly decay and in one year only bunches of grey fibres remain. This behaviour does neither depend on the basic substrate, since we observed the persistence of withered *P. hirsuta* leaves also in plants on the dolomitic cliffs of Monte Nudo (Varese), nor on climatic conditions, since these differences can also be observed in plants of both species cultivated under the same conditions. Instead, the quicker decay of the withered leaves of *P. recubariensis* compared with *P. hirsuta* may depend on the less xeromorphic leaf tissue of the former.

Odour

The odour seems to be a distinctive feature of some species of *Primula*. Hegnauer (1969-90), e.g., reports a classification of some *Primulaceae*, including many primroses according to the odour of fresh grated roots.

Among the species of *P.* subsect. *Erythrodrosum* and *Brevibracteatae*, *P. latifolia* and *P. albenensis* have particularly strong scents. According to Widmer (1891), the leaves of *P. latifolia* smell of musk, whereas, according to Smith & Fletcher (1948), they smell like bitumen or *Geranium robertianum* or stink "rancidly of goat". However, this odour is very different from that of *P. albenensis*, which is described by Banfi & Ferlinghetti (1993) as "aromatic". We verified on living plants of *P. albenensis* and *P. recubariensis* that they exhale a very similar, strong and aromatic scent. We also noticed traces of this odour in other species, such as *P. auricula*, *P. vulgaris* and in the rhizomes of *P. hirsuta* from Monte Nudo (Varese). In the latter, this odour was partly hidden by the typical resinous smell of the species. The odour of *P. recubariensis*, like that of *P. albenensis*, is stronger during the desiccation and then it persists some months. In the field it is particularly strong in autumn; then it is possible to identify each sterile rosette, distinguishing them, e.g., from those of *P. auricula*, only by their smell.

Phenology

*Primula recubariensis* flowers from May to June. A comparison with the flowering of *P. hirsuta* is difficult, due to the wide altitudinal range of the latter. Nevertheless, we noticed that the calyxes of *P. recubariensis* remain green to the end of September, whereas those of *P. hirsuta* and *P. daonensis* are usually withered in August.

Further features

The sepals are sometimes broader in *Primula recubariensis* than in *P. hirsuta* and then they slightly overlap. The sepals of *P. hirsuta*, in spite of their large variability, are always ± acute and never overlapping.

Tab. 2 – Hair characters of the species of *Primula* subsect. *Erythrodrosum* and *Brevibracteatae* (without *P. marginata* and including *P. ×pubescens*) in comparison with those of *P. recubariensis* and *P. ×vallarsae*. For taxa marked with an asterisk (*) the values are less reliable due to the low number of measurements.

| | *Primula* | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***recubariensis*** | ***hirsuta*** | | | ***apennina**** | ***pedemontana*** | ***daonensis*** | ***villosa*** | ***latifolia*** | ***albenensis**** | ***carniolica**** | ***×pubescens*** | ***×vallarsae**** |
| Figure | A1, A2 | B1 | B2 | B3 | C | D | E | F1, F2 | G | H | I | J | K |
| Gland colour | colourless | red to colourless | yellow | colourless (red) | red | red | red | red (colourless) | colourless (pale yellow) | colourless | colourless | colourless | colourless |
| average ratio length : width of subterminal cell in three-celled hairs (µm) | 2.4 : 1 | 1.1 : 0 | 0.9 : 1 | c. 1 : 1 | c. 1 : 1 | c. 1 : 1 | 1.3 : 1 | 1.8 : 1 | c. 1 : 1 | c. 2 : 1 | c. 1: 1 | c. 1 : 1 | c. 2.5 : 1 |
| absolute maximal length the hairs (mm) | 0.6 | 0.5 | 0.48 | 0.42 | 0.12 | 0.3 | 0.4 | 1.1 | 0.3 | 0.3 | 0.1 | 0.25 | 0.32 |
| six-celled hairs (%) | rr | – | – | – | – | – | – | – | – | – | – | – | – |
| five-celled hairs (%) | 0-25 | rr | – | – | – | – | – | rr | – | – | – | – | – |
| four-celled hairs (%) | 25-100 | r | – | r | – | rr | r | r | – | – | – | – | 25 |
| three-celled hairs (%) | 0-75 | 99-100 | 100 | 99-100 | 100 | 100 | 99-100 | 99-100 | 100 | 100 | 100 | 100 | 75 |
| width of hairs near the base (µm) | 40 ± 12 | 55 ± 11 | 67 ± 11 | 69 ± 7 | 46 | 45 ± 8 | 55 ± 9 | 59 ± 15 | 68 ± 15 | 40 | 26 | 50 ± 9 | 39 |
| average maximal length (mm) | 0.17 ± 0.03 | 0.11 ± 0.03 | 0.16 ± 0.04 | 0.12 ± 0.02 | 0.08 | 0.07 ± 0.01 | 0.15 ± 0.03 | 0.15 ± 0.03 | 0.13 ± 0.02 | 0.1 | – | 0.1 ± 0.02 | 0.12 |
| average length of hairs (mm) | 0.29 ± 0.02 | 0.17 ± 0.04 | 0.25 ± 0.04 | 0.23 ± 0.07 | 0.10 | 0.10 ± 0.01 | 0.22 ± 0.03 | 0.31 ± 0.10 | 0.14 ± 0.03 | 0.15 | 0.08 | 0.13 ± 0.04 | 0.23 |
| width of glandule (µm) | 31 ± 3 | 42 ±7 | 45 ± 5 | 38 ± 4 | 41 | 40 ± 7 | 44 ± 7 | 44 ± 8 | 46 ± 7 | 32 | 25 | 38 ± 6 | 29 |
| average ratio length : width of hairs | 6.9 (± 1.7):1 | 3.4 (± 1.1):1 | 4.4 (± 1.3):1 | 4.3 (± 0.8):1 | 2.2:1 | 2.6 (± 0.6):1 | 4.5 (± 1.2):1 | 5.1 (± 1.6):1 | 2.4 (± 0.9):1 | 3.7:1 | 3.0 : 1 | 2.9 (± 0.7):1 | 5.9:1 |
| number of examined plant collections | 10 | 148 | 6 | 4 | 2 | 20 | 34 | 29 | 30 | 2 | 2 | 19 | 2 |

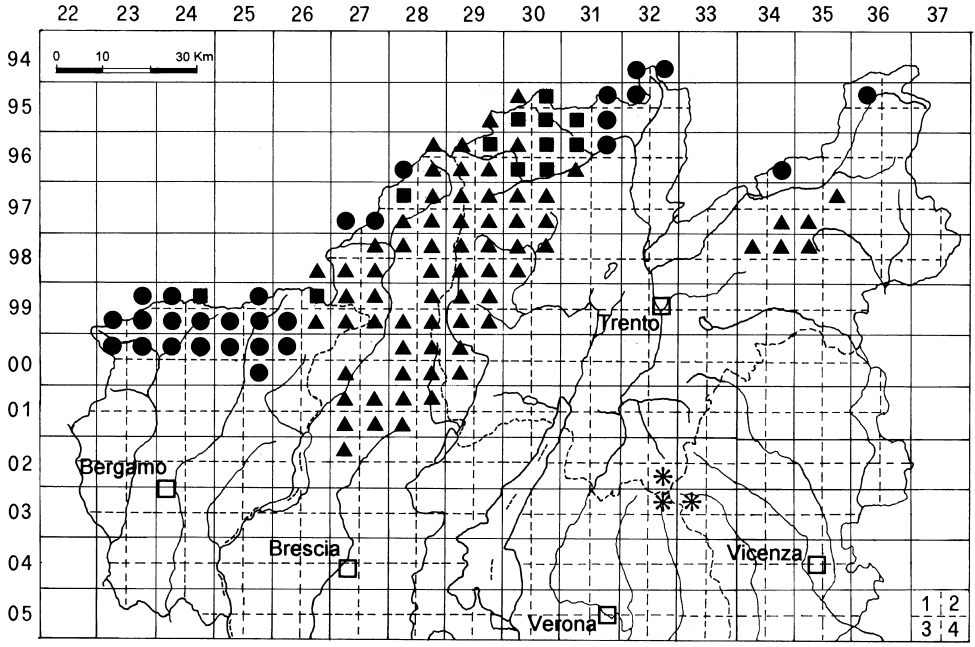


Fig. 4. Distribution of *Primula recubariensis* (❊), *P. hirsuta* (●) and *P. daonensis* (▲, co-occurrence and intermediate populations of *P. hirsuta* and *P. daonensis* = ■) in the districts of Bergamo, Brescia, Trento and Vicenza. – Grids corresponding to Ehrendorfer & Hamann (1965); distribution data of *P. hirsuta* and *P. daonensis* collected in the frame of local floristic mapping projects (see Marconi 1993, district Bergamo; Fenaroli & Martini 1993, district Brescia; Prosser & Festi 1993, district Trento).

Measurements in a few specimens revealed that the thickness of the parenchyma cell wall in the rhizome seems lower in *P. recubariensis* (c. 8 µm) than in *P. hirsuta* and *P. daonensis* (c. 3 µm), the tissues of *P. recubariensis* being thus less xeromorphic. If confirmed, this feature could be explained as an adaptation to the different moisture of their habitats.

## Comparison between *Primula recubariensis* and two *P. hirsuta* populations on basic substrate

The habitats of *Primula recubariensis* and *P. hirsuta* are different: the former species grows on dolomite, the latter on siliceous substratum. Nevertheless, at least two occurrences of *P. hirsuta* on basic rocks are known: one on the mountains E of the Lago Maggiore, between Laveno and Luino, the other E of Lago di Como, in the Grigna Massif (Kreß 1963, Heß & al. 1980). In both localities *P. hirsuta* grows directly on carbonate rocks (dolomite) together with many plants typical of basic substrata. Apart from these two exceptions, *P. hirsuta*, as well as *P. daonensis*, can be considered a strictly silicicolous species. Further records from basic substrata are, in contrast, always from contact areas of siliceous and limestone rocks (as, e.g., in case of *P. daonensis* var. *judicariae* Widmer (1891) from the Alpe Magiassone (Judicarian Alps), situated near the siliceous rocks of the Adamello group).

1) The populations on the mountains E of Lago Maggiore
Dübi-Cortivallo (1952-53) described the flower colour of these populations as red ("di colore roseo cupo fino al rosso intenso"). The glandular hairs have always three cells. The subterminal

cell is about as long as wide and the glandules carry an abundant golden secretion (not colourless). The withered leaves are brown and persistent. Therefore, we share the opinion of Dübi-Cortivallo and identify these populations as *P. hirsuta*, although we noticed that the hairs on the blade margins are very long (up to c. 0.5 mm in our collection of 1.10.1997). Dübi-Cortivallo (1952-53) observed that these plants are luxuriant and, indeed, some specimens collected on 1.10.1997 have leaves up to 10 cm. The plants of Monte Nudo exhale a slight scent similar to that of *P. recubariensis*, particularly by rubbing the rhizome. The clearly basic habitat is more thermoxeric than those of *P. recubariensis*. The thickness of the rhizome parenchyma cell walls is very similar (6-8 µm) to that of *P. hirsuta* growing on siliceous substratum.

Specimens seen: Zwischen S. Antonio e Cuvignone (Val Travaglia), ca. 300 m E Casa Pianizza auf Dolomit-Klippe in Nordexposition, 16.4.1952, *Dübi-Cortivallo* (LUG); M. Nudo bei Laveno, westlicher Vorgipfel, 1123 m, 28.6.1951, *Dübi-Cortivallo* (LUG); am westlichen Vorgipfel 1123 m des M. Nudo auf Dolomit-Klippen! stets in Nordexposition, 16.4.1952, *Dübi-Cortivallo* (LUG); westlichsten Gipfel der P.ni di Laveno, 27.6.195, *Dübi-Cortivallo* (LUG); Pizzoni di Laveno, auf Gipfel 1013 m, am W Ende des Gipfelfirstes auf Dolomit! Kleines Felswändchen von 6.5 m Länge und 0.50-2.5 m Höhe in NNW Exposition, 16.6.1952, *Dübi-Cortivallo* (LUG); presso la Bocca di Cuvignone verso il M. Nudo, roccetta calcarea esposta a Nord nella faggeta, 1120 m, 1.10.1997, *Prosser & Scortegagna* (ROV); ibid., roccetta calcarea esposta a Nord al di fuori della faggeta, 1125 m, 1.10.1997, *Prosser & Scortegagna* (ROV).

2) The populations on the Grigna Massif

Due to the high elevation, the habitat of the populations growing on Grigna Massif should be similar to that of *P. recubariensis*. Nevertheless, the shape and dimensions of the glandular hairs are similar to those of *P. hirsuta* from siliceous substratum. The glandules are colourless, with exception of the specimens collected on 22.8.1889, which have red glandules. The plant on the top of the sheet of the Schibler's collection is *P.* ×*pubescens*. The rhizome shows 5-7 µm thick parenchymatical cells walls, intermediate between *P. recubariensis* and *P. hirsuta* from siliceous substratum.

Specimens seen: Grigna settentrionale, Westseite, Felsen, 12.7.1904, *Geilinger* (Z); Ob. Rifugio Moncodeno, Felsen, 1900 m, 11.8.1906, *Geilinger* (Z); Grigna meridionale o di Campione, Val Sassina, Felsspalten gegen den Gipfel, 2000 m, Kalk!, mit *Saxifraga vandellii*, 6.1913, *W. Schibler* (Z); Flore de Lecco, rochers calcaires (dolomite) du M. Grigna, 22.8.1889, *coll. ignot.* (NEU).

We think that in both localities each a peculiar genotype of *P. hirsuta* is found, adapted to basic substratum. Situated on the southernmost side of the Alps, the localities suggest an ancient origin. Although these two populations do not seem identical to each other, both are very similar to *P. hirsuta* from siliceous substratum. In contrast, the differences to *P. recubariensis* are evident. Hence these basiphilous populations of *P. hirsuta* prove that the differences between *P. hirsuta* and *P. recubariensis* are definitely not a mere modification caused by the substratum.

## Key to the species of *Primula* subsect. *Erythrodrosum* and *Brevibracteatae*

We provide this key to discriminate *P. recubariensis* from similar species. The part of the key concerning critical species of *P.* subsect. *Erythrodrosum (P. apennina, P. daonensis, P. hirsuta, P. villosa)* is tentative, using rather subtle hair characters (e.g. the shape of the subterminal cell), but should work at least for typical populations. However, the taxonomy of this group is not completely stabilized yet (see, e.g., the proposals by Kreß 1981).

Discrepances between literature data and the dimensions of the hairs given in the key result from different methods of measurement. For instance, according to Becherer (1943) and Kreß (1967), *P. villosa* and *P. daonensis* can be distinguished by means of the glandule width. These authors probably considered only maximal values of the glandule width (the same procedure

was used also by Kreß 1973). Measuring only glandules without irregular secretion masses, we found no difference between the two species (Tab. 2).

The differentiation by the depression of the shrunken glandules follows Valentine & Kreß (1972). Kreß (in litt.) points out the general validity of the depression – lateral or apical – of the glandules for delimiting *P. hirsuta* and recommends its usage in identification keys.

1. Plant farinose, at least on the corolla throat . . . . . 2
– Plant efarinose . . . . . 4
2. Plant farinose only on the corolla throat . . . . . *P. latifolia* Lapeyr.
– Green parts farinose . . . . . 3
3. Green parts glabrous or with very short (c. 0.01 mm) glandular hairs . *P. marginata* Curtis
– Green parts ± covered with long (c. 0.15 mm) glandular hairs . . . . . *P. albenensis* Banfi & Ferlinghetti
4. Green parts glabrous, sometimes with rare three-celled hairs c. 0.1 mm long . . . . . *P. carniolica* Jacq.
– Green parts ± covered with glandular hairs . . . . . 5
5. Glandules colourless (or very pale yellow) . . . . . 6
– Glandules golden to reddish . . . . . 7
6. Hairs slender (ratio length : breadth c. 7:1); besides four-celled hairs (25-100 %) with three-celled hairs whose subterminal cell is more than twice as long as its wide; glandule small (average width 31 µm); corolla with lilac-violet limb, rhizome with few remains of withered leaves, plant with strong aromatic scent . . . . . *P. recubariensis* Prosser & Scortegagna
– Hairs robust (c. 3-4:1), almost exclusively three-celled (four-celled hairs being the exception) with ± isodiametrical subterminal cell and glandule large (average width 42 µm), corolla with lilac-purple limb, rhizome with abundant remains of withered leaves, plant with slight resinous scent . . . . . *P. hirsuta* All.
7. At most single hair tips dark red to blackish; shrunken glandules ± apically depressed . . . . . *P. hirsuta* All.
– Many hair-tips dark red to blackish; shrunken glandules ± laterally depressed . . . . . 8
8. Hairs very short (0.1 mm, rarely up to 0.3 mm), ± densier on the leaf margin than on the blade surface and glandules with abundant red secretion, therefore leaf margins ± red . . . . . *P. pedemontana* Thomas ex Gaudin
– Hairs ± homogeneously distributed on the leaves; leaf margins never ± red . . . . . 9
9. Hairs stout, only c. 0.1 mm long (ratio length to width < 3:1) . . . . *P. apennina* Widmer
– Hairs slender, mainly longer than 0.15 mm (ratio length to width mainly > 3:1) . . . . . 10
10. Leaves oblong-cuneate or lanceolate-cuneate, with few teeth at distal margin; average hair length 0.2 mm (hairs generally > 0.4 mm), subterminal cell little longer than wide (c. 1.3 : 1) . . . . . *P. daonensis* (Leyb.) Leyb.
– Leaves ± obovate, dentate, average hair length 0.3 mm (hairs up to 0.7-0.8 mm), subterminal cell almost twice as long as wide (c. 1.8 : 1) . . . . . *P. villosa* Wulfen

**Notes about further species of *Primula* sect. *Auricula* in the districts of Vicenza and Trento**

According to our recent floristic investigations, the occurrences of *P. hirsuta* next to the Carega Massif are in the Alta Val di Non (N of Trento), Val di Sole (NNW of Trento), on Corno Nero (also known as Cima di Rocca, or Schwarzhorn) [9634/4] and in Val Duron [9536/1] (Fig. 4). All previous records from the Venetian Prealps (generally sub *P. villosa* Jacq.) are certainly wrong, partly by confusion with *P. tyrolensis*, partly by vague locality data. On the Lagorai Massif (ENE of Trento) only *P. daonensis* occurs. The boundary between *P. hirsuta* and *P. daonensis* lies E of the river Adige, following the torrent Avisio and, W of it, the torrent Noce; in the Val di Sole intermediate populations between both are common. The distance between the

Carega Massif and the nearest populations of *P. hirsuta* is thus c. 70 km, towards both the NNE (Corno Nero) and the NNW (Val di Sole). The southeastern limit of *P. hirsuta* is Val Duron in the Val di Fassa (Trento district). The distribution area of *P. daonensis* is closer to the Carega Massif. The distance towards both the NNE (Monte Croce, 9834/1, Lagorai Massif) and the WNW (M. Remà, 0029/3, Judicarian Alps) is about 50 km.

In the Venetian-Trentine Prealps other species to *Primula* sect. *Auricula* are present: *P. spectabilis* (*P.* subsect. *Arthritica*), *P. auricula* (*P.* subsect. *Euauricula*) and *P. tyrolensis* (*P.* subsect. *Rhopsidium*). The first two species are widespread on the Carega Massif and often grow together with *P. recubariensis*. *P. tyrolensis* has an eastern distribution area, but also grows in a small area on the top and the N side of the Altipiano di Asiago, about 40 km NE of the Carega Massif. This species is morphologically very different from *P. recubariensis*, as it has very long bracts, leaf margins with little and distanced teeth, very short hairs (only c. 0.05 mm long) with the basal cell deeply sunken in epidermis.

*P. auricula* is widespread in the Carega Massif, represented only by subspecies *ciliata* (Moretti) Lüdi. In contrast to *P. recubariensis*, this taxon has yellow flowers, always three-celled hairs, no aromatic odour and usually a different habit (the plants grow much bigger and the ratio of pedicel to scape length is higher). Nevertheless, in the distribution area of *P. recubariensis*, dwarf, non-flowering plants of *P. auricula* subsp. *ciliata* can easily be mistaken for *P. recubariensis*; in this case, the different odour, the membranaceous leaf margin and the different shape of the hairs are useful differential characters.

## Ecology and distribution of *Primula recubariensis*

The cliffs where *Primula recubariensis* grows are of triassic dolomite (dolomia principale). They are very unstable and rockfalls are frequent. The species grows mainly on N facing (more rarely E or W facing) and shady vertical cliffs between 1400 and 2030 m, thus in the montane and subalpine-(alpine) belt. *P. recubariensis* is associated mainly with the following species: *Carex firma* Host, *Paederota bonarota* L., *Viola biflora* L., *Rhodothamnus chamaecistus* (L.) Reichenb., *Sesleria sphaerocephala* Ardoino, *Potentilla caulescens* L., *Aquilegia einseleana* F. W. Schultz, *Primula auricula* subsp. *ciliata* (Moretti) Lüdi, *Saxifraga caesia* L., *Physoplexis comosa* (L.) Schur, *Silene pusilla* W. & K., *Festuca alpina* Suter, *Valeriana saxatilis* L.

The climate in the distribution area is characterised by abundant precipitation. In Recoaro Terme (at 445 m) the precipitation exceeds 2000 mm/yr, and we estimate at least 2500 mm/yr in the higher localities where *P. recubariensis* grows. The rainfalls occur mainly in spring and autumn. The wet climate is due to the position of these mountains as the first higher elevation facing the Venetian plain. In Rovereto, only 20 km northeastwards, the precipitation decreases to about 1000 mm/yr.

The Carega Massif was only partially covered by local glaciers during cold quaternary periods, particularly on N facing slopes (e.g. on the N side of Il Fumante and Tre Croci chain, see Barbieri & al. 1980). During the Würm glaciation, the average lower limit of perennial snow was at c. 1450 m in the Venetian Prealps (Bevilacqua 1957), and we can assume that the S facing cliffs of the Carega Massif were free from glaciers. Therefore *P. recubariensis* could have survived the glacial age, or has been originated during it, in this locality. However, also a postglacial speciation is possible, as a result of an adaptation to the very wet climate in the area. The recent description of the diploid *Biscutella praealpina* Raffaelli & Baldoin (1997) underlines the importance of this massif for speciation.

The distribution area of *P. recubariensis* outlines a semicircle of peaks and ridges, all belonging to the SE Carega Massif and facing Recoaro Terme northeastwards (Fig. 5.). The area has a maximal length of 7 km (between Boale dei Fondi in the NW and Passo della Porta in the SE). Most populations are situated in the districts of Trento (Vallarsa commune) and Vicenza (Recoaro Terme commune), whereas we found only two small populations in the district of Verona (Selva di Progno commune) on the NE side of Monte Terrazzo.

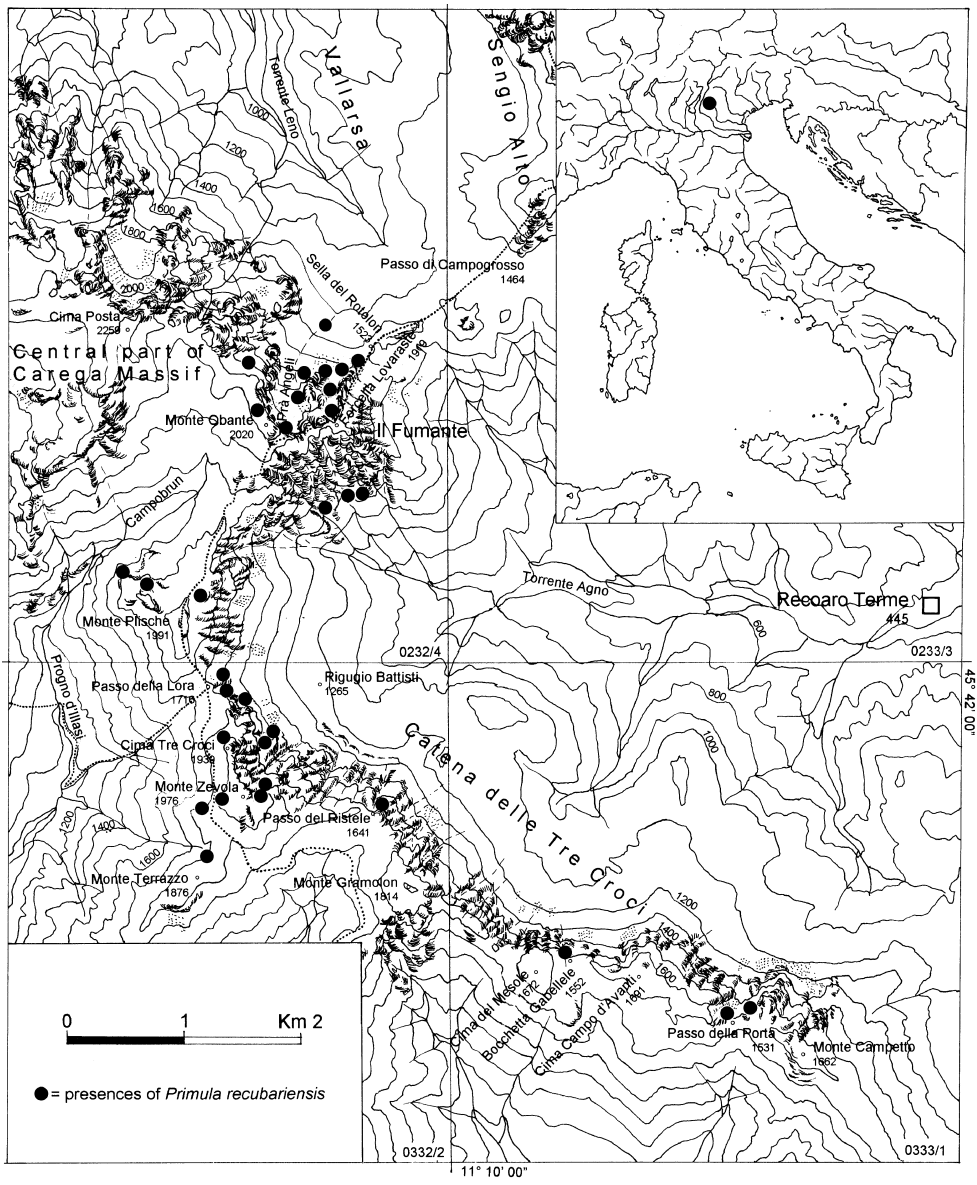


Fig. 5. Distribution of *Primula recubariensis*. – The dot line represents the boundary between the districts of Trento (in the NW), Vicenza (in the E), Verona (in the SW); paths, roads and villages are not indicated.

*Primula recubariensis* is not common in the SE Central Carega (Monte Obante, 2030 m, highest occurrence) and more widespread on the Fumante chain, where on the S side small populations downwards to 1400 m (lowest occurrence) occur. Further south, *P. recubariensis* grows on the cliffs of the NW and N side of Monte Plische (1730-1850 m) and at Passo della Lora. On the Tre Croci chain, SE of Passo della Lora, *P. recubariensis* seems to be widespread

on Monte Zevola but is moire rare in less elevated localities. Further surveys in the Central and N Carega Massif and the neighbouring Sengio Alto Chain gave no result.

Further specimens seen (the coordinates of the grids corresponding to the floristic mapping of Central Europe (Ehrendorfer & Hamann 1965) are given; toponymy after Pieropan (1978)):
District of Trento: Nel Boale dei Fondi ai piedi della Torre Giordani (alta Vallarsa), 0232/4, 1850 m, su rupi di Dolomia Principale esposte a Nord, 26.10.1997, *Prosser* (ROV); lungo il Sentiero Alto tra la Forc. del Fumante e il M. Obante, 0232/4, 2030 m, su rupi di Dolomia Principale, 26.10.1997, *Prosser* [only two leaves] (ROV); Forcella Lovaraste nel sottogruppo del Fumante, 0232/4, 1920 m, roccette dolomitiche di cresta, 24.9.1997, *Prosser & Scortegagna* (ROV); sottogruppo del Fumante, ai piedi della parete Nord della Guglia Cesareo (alta Vallarsa), 0232/4, 1750 m, su rupi di Dolomia Principale esposte a Nord, 24.9.1997, *Prosser & Scortegagna* (ROV); ibid., ai piedi della parete Nord della Guglia Berti, 0232/4, 1700 m, su rupi di Dolomia Principale esposte a Nord, 27.5.1998, *Prosser & Scortegagna* (B, ROV); ibid., ai piedi della parete Nord della Guglia Berti (alta Vallarsa), 0232/4, 1640-1660 m, su rupi di Dolomia Principale esposte a Nord, 26.10.1997, F. Prosser, ROV; ibid., ai piedi della parete Nord della Guglia Cesareo presso la lapide, 0232/4, 1750 m, rupe dolomitica, 27.5.1998, *Prosser & Scortegagna* (FI, ROV); [Guglie del Fumante, 0232/4; really in Trento District?], fessure della roccia, 1600 m, 20.5.1989, 28.5.1989, *S. Sandri*, sub *P. hirsuta* [previous determination: *P. tyrolensis*] (PAD); versante NW del M. Plische ovvero 750 m a SW di Malga Campobrun, 0232/4, 1700 m, su rupe di Dolomia Principale esposta a Nord, 7.8.1998, *Prosser* (ROV).
District of Vicenza: Catena delle Tre Croci, sotto il crinale tra il Passo di Lora (o Tre Croci) e il Sasso Molesse, 0332/2, 1650-1680 m, rupi dolomitiche esposte a Nord, 7.8.1998, *Prosser* (ROV); ibid., sul versante Nord del Monte Tre Croci, 0332/2, 1850 m, roccette dolomitiche esposte a Nord, 7.8.1998, *Prosser* (ROV); ibid., subito sotto la Bocchetta Gabellele, 0333/1, rupi dolomitiche esposte a Nord, 26.8.1998, *Prosser & Scortegagna* (ROV); ibid., lungo il vaio che scende dal passo del Ristele verso NE, 0332/2, 1550 m, rupe dolomitica esposta a Nord, 26.8.1998, *Prosser & Scortegagna* (ROV); ibid., presso il Passo della Porta verso il Sassolongo del Campetto, 1550 m, rupi dolomitiche esposte a Nord, 26.8.1998, *Prosser & Scortegagna* (ROV).

### *Primula ×vallarsae*

We found three single plants that are ± intermediate between *P. recubariensis* and *P. auricula* subsp. *ciliata*. They have lilac-violet flowers with a yellow throat or yellowish flowers with a narrow lilac-violet limb margin and the hairs show character states intermediate between *P. recubariensis* and *P. auricula.* We interpret these plants as the hybrid between these two species and formally describe it.

***Primula ×vallarsae*** Prosser & Scortegagna, **nothosp. nova** – Fig. 6.
Holotypus: Vallarsa, Piccole Dolomiti, sottogruppo del Fumante, lungo il sentiero che dal Passo del Rotolon sale alla Forc. Lovaraste ai piedi della Guglia G.E.I., 1650 m, con entrambi i genitori, 27.5.1998, *Prosser & Scortegagna* (ROV).

Diagnosis: Hybrida inter *Primulam auriculam* et *P. recubariensis* colore corollae et compage pilorum intermedia, a prioris faucibus corollae luteis, a secondo limbo corollae lilacino.

Etymologia: Epitheton ex Vallarsa, in Tridentina provincia.

Additional specimens seen:
On the path between Guglia G.E.I. and Guglia Cesareo (Vallarsa), c. 1700 m, 9.6.1998, *Luciano Maffei* (photo., see Fig. 6, not collected); in Vajo Scuro (Recoaro), c. 1700 m, 10.6.1998, *Scortegagna* (ROV).

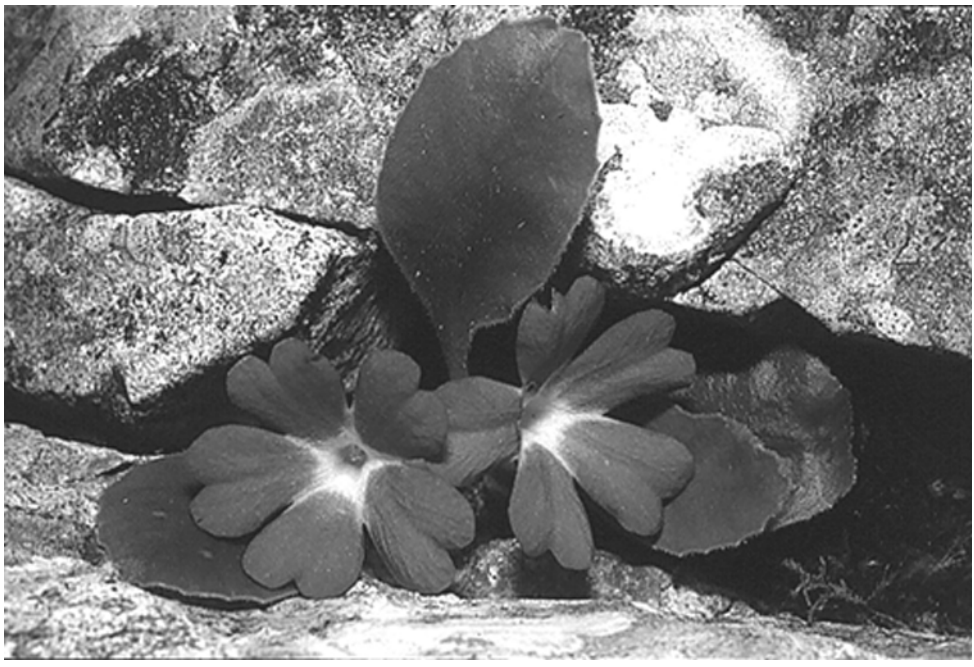

Fig. 6. *Primula* ×*vallarsae* – plant on path between Forc. Rotolon and Forc. Lovaraste, at c. 1700 m. – Photograph by Luciano Maffei, 9.6.1998.

When *Primula hirsuta* and *P. auricula* grow close to each other, the occurrence of the fertile hybrid *P.* ×*pubescens* seems to be frequent (Widmer 1891, Lüdi 1927, Pax & Knuth 1905). With respect to the hybridization with *P. auricula*, *P. recubariensis* and *P. hirsuta* seem to have the same behaviour.

## Protection

After the recent discovery of a second distribution area of *Primula albenensis* (Valtorta, see Brissoni 1997), *P. recubariensis* could be the alpine primrose with the smallest distribution area. For this reason and since the primroses are very popular among botanists and gardeners, the new species should be protected and plant collection avoided. The more accessible populations of *P. recubariensis*, as well as of *P. albenensis*, are in danger to be plundered by gardeners and primroses collectors. For this reason, we suggest inclusion of *P. recubariensis* in the IUCN Red List (Walter & Gillet 1998) with the status "vulnerable". Fortunately, many plants grow on vertical, several meter high rock walls. Here, only climbers can, without purpose, damage them, as we observed it at some rock faces of the Fumante chain.

## Acknowledgements

We thank the Curators of the herbaria FI, G, HBBS, LUG, M, MRSN, NEU, PAD, ROV, WU, Z for sending us many hundreds of specimens, Fabrizio Martini (University of Trieste, Biology Department) for many suggestions, Sergio Sgorbati (University of Milan, Biology Department) for making the quantitative analysis of DNA (flow cytometry method) of *P. recubariensis* and

of two collections of *P. hirsuta*, Renato Ferlinghetti for providing us with specimens of *Primula albenensis* and chorological data of *P. hirsuta* and *P. daonensis* from Bergamo district, Innocenzo Bona for giving us chorological data of the latter two species from Brescia district and Luciana Pozzer for translating the diagnosis into Latin. Finally, we are grateful to the referees A. Kress (Munich) and A. J. Richards (Newcastle upon Tyne) for their constructive criticism.

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Tab. 2 – Hair characters of the species of *Primula* subsect. *Erythrodrosum* and *Brevibracteatae* (without *P. marginata* and including *P.* ×*pubescens*) in comparison with those of *P. recubariensis* and *P.* ×*vallarsae*. For taxa marked with an asterisk (*) the values are less reliable due to the low number of measurements.

| | ***Primula*** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | ***recubariensis*** | ***hirsuta*** | | | ***apennina**** | ***pedemontana*** | ***daonensis*** | ***villosa*** | ***latifolia*** | ***albenensis**** | ***carniolica**** | ***×pubescens*** | ***×vallarsae**** |
| Figure | A1, A2 | B1 | B2 | B3 | C | D | E | F1, F2 | G | H | I | J | K |
| Gland colour | colourless | red to colourless | yellow | colourless (red) | red | red | red | red (colourless) | colourless (pale yellow) | colourless | colourless | colourless | colourless |
| average ratio length : width of subterminal cell in three-celled hairs (µm) | 2.4 : 1 | 1.1 : 0 | 0.9 : 1 | c. 1 : 1 | c. 1 : 1 | c. 1 : 1 | 1.3 : 1 | 1.8 : 1 | c. 1 : 1 | c. 2 : 1 | c. 1: 1 | c. 1 : 1 | c. 2.5 : 1 |
| absolute maximal length the hairs (mm) | 0.6 | 0.5 | 0.48 | 0.42 | 0.12 | 0.3 | 0.4 | 1.1 | 0.3 | 0.3 | 0.1 | 0.25 | 0.32 |
| six-celled hairs (%) | rr | – | – | – | – | – | – | – | – | – | – | – | – |
| five-celled hairs (%) | 0-25 | rr | – | – | – | – | – | rr | – | – | – | – | – |
| four-celled hairs (%) | 25-100 | r | – | r | – | rr | r | r | – | – | – | – | 25 |
| three-celled hairs (%) | 0-75 | 99-100 | 100 | 99-100 | 100 | 100 | 99-100 | 99-100 | 100 | 100 | 100 | 100 | 75 |
| width of hairs near the base (µm) | 40 ± 12 | 55 ± 11 | 67 ± 11 | 69 ± 7 | 46 | 45 ± 8 | 55 ± 9 | 59 ± 15 | 68 ± 15 | 40 | 26 | 50 ± 9 | 39 |
| average maximal length (mm) | 0.17 ± 0.03 | 0.11 æ 0.03 | 0.16 ± 0.04 | 0.12 æ 0.02 | 0.08 | 0.07 ± 0.01 | 0.15 ± 0.03 | 0.15 æ 0.03 | 0.13 ± 0.02 | 0.1 | – | 0.1 ± 0.02 | 0.12 |
| average length of hairs (mm) | 0.29 ± 0.02 | 0.17 ± 0.04 | 0.25 æ 0.04 | 0.23 ± 0.07 | 0.10 | 0.10 æ 0.01 | 0.22 ± 0.03 | 0.31 æ 0.10 | 0.14 ± 0.03 | 0.15 | 0.08 | 0.13 ± 0.04 | 0.23 |
| width of glandule (µm) | 31 ± 3 | 42 ±7 | 45 ± 5 | 38 ± 4 | 41 | 40 ± 7 | 44 ± 7 | 44 ± 8 | 46 ± 7 | 32 | 25 | 38 ± 6 | 29 |
| average ratio length : width of hairs | 6.9 (± 1.7):1 | 3.4 (± 1.1):1 | 4.4 (± 1.3):1 | 4.3 (± 0.8):1 | 2.2:1 | 2.6 (± 0.6):1 | 4.5 (± 1.2):1 | 5.1 (± 1.6):1 | 2.4 (æ 0.9):1 | 3.7:1 | 3.0 : 1 | 2.9 (± 0.7):1 | 5.9:1 |
| number of examined plant collections | 10 | 148 | 6 | 4 | 2 | 20 | 34 | 29 | 30 | 2 | 2 | 19 | 2 |

Fig. 1. *Primula recubariensis* – two plants from Il Fumante on the path between Forc. Rotolon and Forc. Lovaraste, c. 1700 m. – Photographs by Giorgio Perazza, 4.6.1998.