

RECORDS OF *PRIMULA* SPECIES PRESERVED IN "ALEXANDRU BELDIE" HERBARIUM

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INTRODUCTION

Primula L. is the most varied and numerous genus of *Primulaceae* Batsch ex Borkh Family (Hu and Kelso, 1996).

Based on numerous estimates, it contains over 500 species included in 38 sections (Bawri et al., 2014; Xu et al., 2014) and is widespread in the North hemisphere where it vegetates in temperate and subpolar climate areas (Bawri et al., 2015; Richards, 1989).

Furthermore, the *Primula* genus is well represented in mountains from tropical regions where numerous biodiversity hotspots were identified (Ghosh, 1981; Kovtonyuk and Goncharov, 2009; Basak et al., 2014).

The majority of species are perennial herbaceous plants, rarely annually or biannual, with petiolate or sessile leaves gathered in the basal sockets (Trift et al., 2002). They are extremely appreciated for their colored flowers, being used for decorative purposes (Kovtonyuk et al, 2009), as well as for their high content of phytochemical compounds (phenols, flavonoids, triterpenoids) (Aslam et al., 2014). As such, they are widely used for ornamental purposes and in the pharmaceutical industry.

From an etymologic point of view, the name is a diminutive of the Latin word *primus*, meaning *the first one*, and refers to the fact that these plants bloom in early spring (Skeat and Skeat, 1993).

Amongst the first studies of the *Primula* genus realized in Romania we can find the ones initiated by P. Cretzoiu (1930; 1934).

These were continued by E. I. Nyárady and M. Gușulenc (Nyárady and Gușulenc, 1960) who have described a total number of 14 species, from which 11 are spontaneous while 3 are cultivated as flower pot plants.

„Marin Drăcea” National Institute for Research and Development in Forestry from Bucharest holds an Herbarium created in the year 1929 – “Alexandru Beldie” Herbarium. Containing approximately 40.000 vouchers, the Herbarium is

inscribed in Index Herbariorum and has the BUCF international code (Ciontu and Dincă, 2019; Dincă et al., 2018).

Amongst the species present in this Herbarium we mention: 58 *Cornus* species (Vechiu and Dincă, 2019), 49 *Alnus* species (Dincă and Peticilă, 2019), 15 *Ornitogalum* species (Enescu et al., 2017), 130 *Campanula* species (Dincă and Vechiu, 2020), 69 *Potentilla* species (Crișan et al., 2017), 29 *Allysum* species (Cântar et al., 2018), 31 *Acer* species (Enescu et al., 2020), 41 *Polygonum* species (Vechiu et al., 2018).

MATERIALS AND METHODS

The study material was composed of a number of 180 vouchers belonging to the *Primula* genus. In the first stage, an electronic database was created from the information inscribed on the identification tag of each voucher.

This database is important as it allows further analyses. At the same time, the conservation degree of each specimen was appreciated based on the following criteria: well-conserved plant, entire and correctly attached to the voucher =1, plant detached from the voucher with striped but present parts=2, detached plant with missing parts=3, detached and fragmented plant with over 50% of its parts missing=4 (Tudor and Dincă, 2019).

Afterward, it has been verified that the scientific name is internationally accepted, otherwise it has been updated accordingly to The Plant List database (<http://www.theplantlist.org>).

In the end, a database was obtained with the following entries: drawer number, voucher number, scientific name, collection name, harvesting date, harvesting place, the name of the person who has collected or identified the plant, conservation degree (Table 1).

The bibliographic study and the analysis of conserved specimens were used in order to describe the main species.

Table 1: *Primula* Inventory (excerpt from the database)

| Drawer no. | Plate no. | Herbarium/ Botanic Collection/ Institution | Species Name | Harvesting Date | Harvesting Place | Collected/ Determined by: | Conser-vation degree (1..4) |
|------------|-----------|--|--|-----------------|--|----------------------------------|--------------------------------|
| 97 | 6 | Flora Norvegica | <i>Primula scotica</i> Hook. | 1885.07.01. | Kongsvold | P. Olsson | 3 |
| 97 | 11 | Cluj University's Herbarium | <i>Primula kitaibeliana</i> Schott | 1909.06.02. | Croația | A. Richter | 2 |
| 97 | 21 | Forestry Research Institute's Herbarium/ Agriculture and Silviculture Ministry | <i>Primula veris</i> L. | 1941.04.27. | Dumbrava Forest, Prahova | C. Georgescu | 1 |
| 97 | 34 | ICEF, Forestry Research and Experimentation Institute | <i>Primula veris</i> subsp. <i>canescens</i> (Opiz) Hayek ex Ludi | 1934.05.14. | Rez. C. Roșu | Haralamb, Cretzoiu / J. Neuwirth | 1 |
| 97 | 70 | Polytechnic's School Herbarium/Bucharest/Botanic Laboratory | <i>Primula minima</i> L. | 1937.06.10. | Maramureș, Borșa 1925 m alt | A. Coman | 1 |
| 97 | 84 | Museum Botanicum Universitatis, Cluj / Flora Romaniae Exsiccata | <i>Primula elatior</i> subsp. <i>leucophylla</i> (Pax) Hesl.-Harr. ex W.W.Sm. & H.R.Fletcher | 1921.07.10. | Transilvania, Ciuc County, Hășmașul Mare Mountains | E. I. Nyárády | 1 |
| 97 | 97 | Al. Beldie Herbarium, Bucharest | <i>Primula halleri</i> J.F.Gmel. | 1948.05.25. | Bucegi: Turbăria Lăptici | Al. Beldie | 2 |
| 97 | 113 | Dr. C.Baenitz/ Herbarium Europaeum | <i>Primula glutinosa</i> Wulf | 1987.07.11. | Knappenhau am hoben Goldberg | C. Baenitz | 2 |
| 97 | 114 | Flora Alpinum Maritimarum | <i>Primula hirsuta</i> Vill. | 1890.07.13. | Madonna delle Finestre | W. Bernoulli, Basil | 2 |
| 97 | 118 | Museum Botanicum Universitatis, Clusienis edita / Flora Romaniae Exsiccata | <i>Primula farinosa</i> L. | 1956.05.13. | Transsilvania, Brașov County, Hărman 500 m alt | I. Morariu | 1 |
| 97 | 145 | Polytechnic's School Herbarium/Bucharest/Botanic Laboratory | <i>Primula elatior</i> (L.) Hill | 1909.07.27. | Bucegi: Brăul Mare al Jepilor | M. Haret | 1 |
| 97 | 159 | Polytechnic's School Herbarium/Bucharest/Botanic Laboratory | <i>Primula columnae</i> Ten. | 1939.07.01. | Prahova County, Ciucaș Mountains 1400 m | P. Cretzoiu | 1 |
| 97 | 170 | Museum Botanicum Universitatis, Clusienis edita / Flora Romaniae Exsiccata | <i>Primula vulgaris</i> Huds. | 1930.05.22. | Bucovina, distr. Storojineț | M. Gușuleac, E. Țopa | 2 |
| 97 | 190 | Cluj University's Herbarium | <i>Primula auriculara</i> L. | 1911.05.24. | Germania. Spitzenstein Eishole | Mus. Bot. Cluj | 2 |

RESULTS AND DISCUSSIONS

After the *Primula* genus conserved in the "Al. Beldie" Herbarium was inventoried, the following representatives were identified: *Primula allionii* Loisel., *P. auricula* L., *P. auricula* L. subsp. *serratifolia*, *P. carpathica* Fuss., *P. elatior* (L.) Hill, *P. elatior* subsp. *intricata* (Gren. & Godr.) Widmer, *P. elatior* subsp. *leucophylla* (Pax) Hesl. - Harr. ex W.W. Sm. & H.R. Fletcher, *P. farinosa* L., *P. glutinosa* Wulf, *P. halleri* J. F. Gmel., *P. hirsuta* All., *P. integrifolia* L., *P. kitaibeliana* Schott, *P. latifolia* Lapeyr., *P. marginata* Curt., *P. minima* L., *P. minima* L. f. *alba*, *P. nutans* Georgi, *P. pedemontana* Thomas ex Gaudin, *P. x polyantha* Mill., *P. scotica* Hook., *P. spectabilis* Tratt., *P. stricta* Hornem, *P. veris* L., *P. veris* subsp. *canescens* (Opiz) Hayek ex Ludi, *P. veris* subsp. *genuina* (Pax), *P. veris* subsp. *macrocalyx* (Bunge)

Lüdi, *P. veris* subsp. *suaveolens* (Bertol.) Gutermann & Ehrend., *P. vulgaris* Hus. and *P. vulgaris* f. *genuina* (Pax).

The most numerous recordings were found for *P. veris* (32 vouchers) and *P. elatior* (31 vouchers), followed by *P. minima* (16 vouchers), *P. halleri* (15 vouchers) and *P. vulgaris* (12 vouchers).

***Primula veris* L.** (syn. *P. officinalis*) or cowslip is an indigenous species widespread in the temperate regions from Eurasia (Apel et al., 2017). In the West it reaches North Spain, while in the East enters in the Siberian regions up to North Manchuria (Brys & Jacquemyn, 2009). It is a small plant (10-25 cm), with ovate or elongated-elliptical leaves, with a concave limb, hairy on the inferior part and abruptly contracted in the winged petiole. The flowers are yellow gold, odoriferous, disposed of in a terminal umbrella, lengthy pedunculated. The calyx is compulped with triangular-ovate dents, while the

corolla is campanulate up to infundibular, with 5 lobes and an orange macula at the basis (Brys & Jacquemyn, 2009). Under an ecological aspect, it prefers sunny, dry stations, with calcareous substratum and moderately acid soils up to weakly alkaline ones (pH=5,0-8,0), poor in nutrients (Hill et al., 2004). Furthermore, this species is characterized by very high variability, having many subspecies like subsp. *canescens*, subsp. *macrocalyx*, *suaveolens* (Bertol.) (Halliday et al., 1983; Länger and Saukel, 1993; Brys & Jacquemyn, 2009), as well as a large number of infraspecific units.

***Primula veris* subsp. *canescens* (Opiz) Hayek ex Ludi** (figure 1) is a spontaneous and common species in the low regions from Central Europe, while in the West it advances towards the mountain area of the Alps and Pyrenees (Brys & Jacquemyn, 2009). The leaves are elliptical or elliptically-elongated, gradually contracted in the winged petiole, tomentose on the outside, with long hairs often twisted, ramified and tangled, while the corolla's limb is flatter. The species is common in Romania, with 8 vouchers in the Herbarium collected from Ciucaș, Buceaș and Trascău Mountains.



Figure 1. *Primula veris* subsp. *canescens*

***Primula veris* subsp. *macrocalyx* (Bunge) Lüdi** is a subspecies with a natural areal in Ukraine, Turkey, Crimea, Transcaucasia, from where it extends towards East Siberia (Brys & Jacquemyn, 2009). In comparison with the previous subspecies, the leaves are narrower in the winged petiole, while the hairs are straight and non-ramified.

***Primula veris* subsp. *suaveolens* (Bertol.) Gutermann & Ehrend** (syn. *P. columnae*) habituates in mountain regions from West and South-East Europe from where it goes in Asia Minor (Brys & Jacquemyn, 2009). The leaves have a cordate basis and are suddenly narrowed in narrow petioles. They are thick and tomentose white on the outside, while the corolla's limb is concave. Furthermore, the specialty literature records a series of *P. veris* hybrids with other related species, such as *P. x polyantha* (= *P. veris* x *P. vulgaris*) (Gurney et al., 2007; Lim,

2014; Tendal et al., 2018) or *P. x media* (= *P. veris* x *P. elatior*) (Hill, 1907; Brys & Jacquemyn, 2009; Gurney et al., 2007)

***Primula x polyantha* Mill.** or false oxlip is a natural hybrid resulted from the crossing of *P. veris* with *P. vulgaris*, signaled in the interference areal areas of parental species. The flowers have an intermediary phenotype between the two parents: are pedunculated and longer than *P. veris*, similar in shape with *P. vulgaris* and not oriented in the same directions, a characteristic inherited from *P. veris* (Gurney et al., 2007).

***Primula elatior* (L.) Hill** or true oxlip is a Euro-Asian element, with an areal that overlaps *P. veris* (Pozwińska, 1965). Occupied important territories in Central and West Europe, from where it extends towards East up to South Russia (Woodell, 1969). From a latitudinal perspective, it advances up to South Sweden, while in the South it lowers up to South Carpathians (Taylor and Woodell, 2008). On restricted surfaces, in alpine meadows from the Pyrenees, South Alps and Carpathians is replaced by the *intricata* subspecies (Gren. & Godr.) Widmer (Richards, 1989) (figura 2).



Figure 2. *Primula elatior* subsp. *intricata*

Moreover, isolated populations represented by the *leucophylla* subspecies (Pax) Hesel-Harr. ex W.W.Sm. & H.R. Fletcher are present in the Oriental Carpathians (Taylor and Woodell, 2008) (figure 3). In Romania, the two subspecies are included in the *Red List*, being considered rare, with the last one having an endemic character (Oltean et al., 1994). It is a perennial plant, with ovate leaves, dented on the margins, with a flat limb, steadily narrower in the winged petiole. The corolla is rarely fragrant, with yellow sulfuric petals that can be red, purple, light blue, brown or pink for its subspecies. The calyx is cylindrical, with sharp-lanceolate dents on the margins, equal to length with the corolla's tube. The flowers are grouped 8-10 in an umbrella at the end of a pubescent peduncle. It is a common species in our country, being spread out from the Holm sublevel up to the subalpine one, generally on moist soils.



Figure 3. *Primula elatior* subsp. *leucophylla*

Primula minima L. (figure 4) grows in mountain areas from high altitudes, in the Carpathians, Alps and Balkans, being a saxicolous species (Kobiv et al., 2017).



Figure 4. *Primula minima*

The stem is shorter than the leaves, 0,2-1cm in height, with a light red flower. The leaves are wide and cuneate, chopped and dented at the peak. Its small dimensions are an adaptation to the climatic conditions specific to alpine banks. As a consequence, it blooms later in comparison with the other species of this Genus (June-July) (Cretzoiu, 1930). In Romania, the species was sporadically signalled together with *f. alba*, which can be recognised by its white flowers.

Primula halleri J.F.Gmel. (syn. *P. longiflora*) has a fragmented distribution, being found in certain mountain and subalpine regions from Europe (Alps, Carpathians, Pyrin, Rila) (Zhang et al.,2013). It reaches 10-30 cm in height and has red flowers disposed of in groups of 3-19 (de Vos et al., 2012). The young leaves are revolute, then glabrous, white-floury on the inferior side, with entire margins or slightly dented. It prefers sunny stations, not too dry, especially on the calcareous substratum (Nyárády and Guşulenc, 1960). More than that, in countries such as Switzerland or Romania it is rarely found, being considered a vulnerable species (Moser et al.,2002; Oltean et al., 1994). However, due to the lack of sufficient information regarding its distribution area, the species is not officially registered as vulnerable in IUCN's Red List (<http://www.iucnredlist.org>)

Another rare species for Romania is *Primula farinosa* L. (Oltean et al., 1994). Unlike the previous species to which is related (sect. *Aleuritia* Duby) (Guggisberg et al., 2006), the flowers are smaller, pink-pale in colour and blooms earlier. As *P. halleri*, it has an irregular distribution in the mountain territories from Europe (Richards, 2003), preferring humid or swampy areas.

Primula vulgaris Hus (syn. *P. acaulis* (L.) Hill) or primrose has a large distribution area, being a European species, as well as South-West Asian and North-African (Jacquemyn et al., 2009). It can reach approximately 10-15 cm, with a vigorous rhizome and elongated obovate leaves, gradually narrower in the winged petiole, with hairs on the inferior side along the veins. The flowers are yellow-sulphur (when dried they become green) and usually present an orange spot in the corolla's centre. It is usually installed in plain light, near rivers, orchards and broad-leaved forest meadows, on wet and fertile soils.

The plant's harvesting periods. The species present in the Herbarium were collected during the years 1844-1992, with the oldest conserved *Primula* taxon being a *P. farinos* exemplar, while the most recent a *P. veris*, *suaveolens* subspecies. The majority of vouchers date previous to the year 1900 and were received from international profile institutions (e.g. Flora Norvegica, Flora helvetica, F. Schultz, herbarium normale, nov. Ser. Cent. 17., etc.). The first two vouchers with plants collected from our country dateback to 1892 (drawer 97, vouchers 108 and 149) and originate from N. Al. Iacobescu Herbarium. The first voucher contains the species *P. halleri*, while the second one the species *P. elatior*, both of them being gathered from the Prahova district, namely Sinaia. After 1900, the number of recordings varies from one period to another, with the most number of plants being harvested in the interval 1930-1939 (figure 5). These, cumulated with the number of recordings from the immediately subsequent period, represents

approximately half of the total number of vouchers dedicated to this genus.

From the entire collection, 90% were harvested from our country (figure 6), especially from mountain regions belonging to the following Counties: Alba, Argeş, Braşov, Buzău, Caraş-Severin, Cluj, Dâmboviţa, Dolj, Gorj, Hunedoara, Iaşi, Maramureş, Mehedinţi, Mureş, Neamţ, Prahova, Suceava and Timiş. Amongst them, approximately one third (53 vouchers) were gathered from different areas of Bucegi Mountains (Omu Peak, Coştila Peak, Piatra Arsă Peak, Mălinilor Peak, Ialomiţei Valley, Jepilor Valley, Lăptici peatland, etc.).

The difference of 10% contains different species or taxonomic subunits collected from abroad, generally from high altitude mountain areas (Alps, Pyrenes, Carpathians, Kongsvold, etc.).

The main contribution to the creation of the *Primula* genus collection was given by Al. Beldie who has collected and established over 25 vouchers. Together with him, an important share was offered by other experts as: M. Haret (20 vouchers), C. Georgescu (20 vouchers), A. Coman (9 vouchers), S. Paşcovschi (7 vouchers), T. Bunea (6 vouchers), I. Morariu (5 vouchers), P. Cretzoiu (5 vouchers) or

Golescu (5 vouchers). Amongst the foreign specialists, Wolff is remarked as having seven vouchers, all with different species. Besides the collection itself (33 vouchers), “Al. Beldie” Herbarium was enriched through exchanges and donations with other herbariums and institutions. As such, a considerable number of vouchers come from Bucharest’s Polytechnic Herbarium from within the Silviculture Faculty/Botanic Laboratory (64 vouchers) and from Museum Botanicum Universitatis from Cluj/ Flora Romaniae Exsiccata (18 vouchers). Furthermore, the collection also holds vouchers obtained from international institutions from Austria, Estonia, Norway, Switzerland, Germany or France.

With a few exceptions, the *Primula* specimens are very well conserved, a fact emphasized in figure number 7, where the large number of vouchers situated in the 1st and 2nd conservation categories can be observed. The voucher that has obtained the 4th degree as well as most of the ones situated in the 3^d degree of conservation date back to the nineteenth century, with the age influencing the conservation degree.

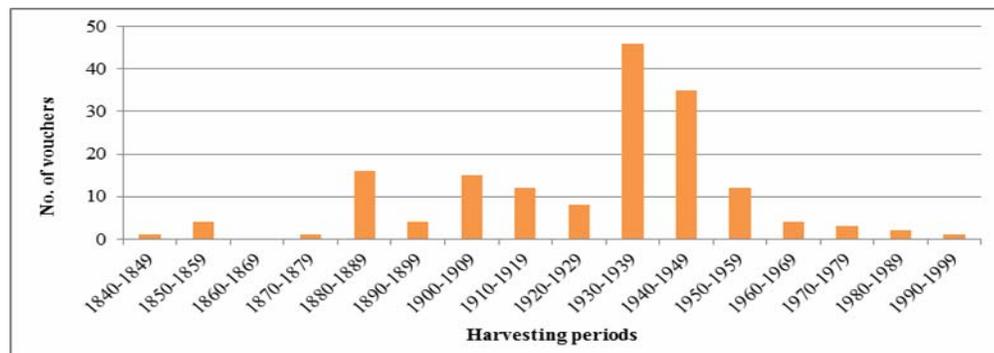


Figure 5. Harvesting periods of *Primula* plants from “Alexandru Beldie” Herbarium

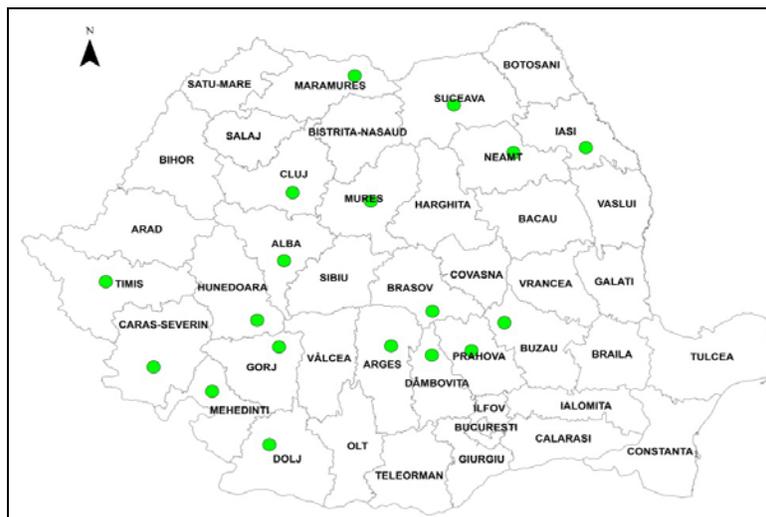


Figure 6. Place of harvest for *Primula* genus in Romania

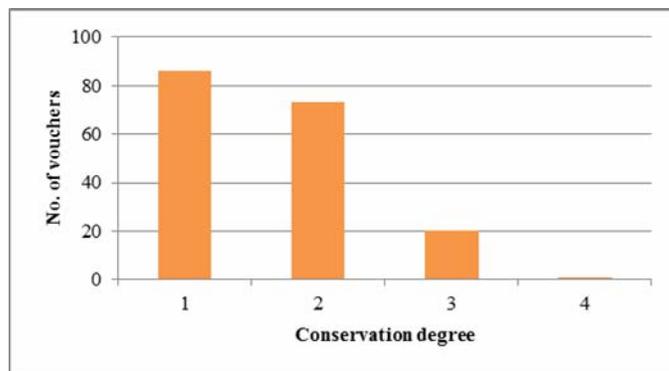


Figure 7. Conservation degree of plants from “Alexandru Beldie” Herbarium

CONCLUSIONS

The inventory of the *Primula* Genus from within “Al. Beldie” Herbarium has emphasized a total number of 30 different taxa, from which 21 are independent species and other 9 are intraspecific units (subspecies, shapes). Amongst them, *P. veris* (32 vouchers) and *P. elatior* (31 vouchers) hold together over one-third of the total number of vouchers.

Furthermore, the vouchers also contain 5 taxa included in the Red List of superior plant from Romania (*P. auricula* subsp. *serratifolia*, *P.* subsp. *intricata*, *P. elatior* subsp. *leucophylla*, *P. farinose* and *P. halleri*).

The vouchers were collected between 1844-1992, with a preponderance on our country’s territory and the most prolific period registered between 1930-1939. Most of the vouchers were realized by Al. Beldie, M. Haret and C. Georgescu, especially with material harvested from Bucegi Mountains. Substantial contributions for the collection’s enrichment were also given by exchanges with different institutions, both national and international. The conservation conditions within the herbarium are amongst the best, a fact that allows the usage of specimens for different studies.

ABSTRACT

Primula Genus is represented within “Alexandru Beldie” Herbarium by 30 different taxa (21 species and 9 intraspecific units) kept in very good conditions, with some of them included even on the *Red List* of superior plants from Romania. The purpose of this present paper was to understand the present situation of the *Primula* L. genus, as well as to create a short description of its main species. The analyzed material was composed of 180 vouchers harvested between 1844-1982, mostly from Romania. The collection was developed by both experts as well as exchanges with specialized national and international institutions.

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