

## SHORT CHARACTERIZATION OF PLANT SPECIES FROM *CENTAUREA* GENUS PRESENT IN "AL. BELDIE" HERBARIUM FROM "MARIN DRĂCEA" NATIONAL INSTITUTE FOR RESEARCH AND DEVELOPMENT IN FORESTRY - BUCHAREST

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### ABSTRACT

"Al Beldie" herbarium from "Marin Drăcea" National Institute for Research and Development in Forestry is an important herbarium with a significant role in the present research paper. This herbarium is listed in Index Herbaria and is composed of approximately 60.000 sheets with dried specimens of plants. From those 60.000 sheets, 71 belong to the genus *Centaurea*, with 19 species to be more precise. All of these species were collected by known personalities in the field of systematic botany, most of them being Romanian. The species were collected between 1855 and 1951 from the entire world, with a great majority from Romania. The aim of this article is to describe some species of *Centaurea* that are present in this herbarium. In this way it can be observed how important it is to collect, identify and preserve sheets with dried species in herbarium, given that these species of plants can be very hard to identify.

### INTRODUCTION

Many natural processes could scarcely be described or analysed without the use of plant collections (Lavoie et al. 2007).

Biological collections, namely Herbariums, play a major role in society as most herbarium specimens have information-rich labels, are used to define conservation priorities (MacDougall et al., 1998), to document the decline of species (Hedenäs et al., 2002), to reconstruct the recent evolution of phenological phenomena (Primack et al., 2004; Bolmgren & Lönnberg, 2005; Lavoie & Lachance, 2006) and to reconstruct the spreading of invasive plants in biogeographical studies (Stuckey, 1980; Pyšek, 1991; Pyšek & Prach, 1993, 1995; Weber, 1998; Lambrinos, 2001; Mihulka & Pyšek, 2001).

A herbarium with remarkable specimens that can offer important information can be found in Bucharest at *Marin Drăcea* National Institute for Research and Development in (INCDS). The herbarium has approximately 60.000 plates of certain plant species, kept in their original maps and deposited in 20 modules each with 20 drawers (Vasile et al., 2017). This collection is composed of donated private collections and pieces of foreign collections that were bought through exchanges. Furthermore, the herbarium is listed in the Index Herbarium.

The majority of these plants were collected by renowned personalities from the domain of systematic botanic. A great part of this collection belonged to the academician Alexandru Beldie (the reason for which the herbarium is named after him), who has studied the flora of Bucegi mountains (Beldie 1967, Beldie 1972). Due to this fact, the herbarium has numerous plates with plants from the mountain area such as the 32 species of the *Arabis* genre (Dincă L. et al., 2017) or the 112 species from the *Hieracium* genre (Dincă L. et al., 2017). These plants are completed by plants collected from other parts of the country (such as those collected especially by S. Paşcovschi in Bazoş Dendrological Park from Timișoara- Chisăliță et al., 2017) or from other countries from all around the globe.

## MATERIALS AND METHODS

The research material is composed of the 71 plates belonging to the *Centaurea* genre. The plates were systemized based on the type of species (the herbarium has 19 species of this genre), gathering year, place of harvest and the specialist that has gathered them. An extract of the *Centaurea* genre inventory is rendered in Table number 1.

### *Centaurea* genre inventory from Alexandru Beldie Herbarium at INCDS București (extract)

Table

1

Dra wer num ber	Plate numb er	Herbarium/ Botanic collection/ Institution	Name of species	Harvest date	Harvest place	Collected/ Determined by:	Conserv ation degree (1..4)
8	6	ICS	<i>Centaurea stereophilla</i>	1942.07.12	Comorova forest Constanța	C.C. Georgescu	1
8	20	Bucharest Polytechnic Herbarul, Silviculture Faculty	<i>Centaurea stenolepis</i>	1943.07.27	București Băneasa forest	I. Morariu	1
8	39	R.Horte Herbarium Romani	<i>Centaurea sphaerocephala</i>	1889.05.29	Roma Nettuno	R. Pirolla	1
8	42	Bucharest Polytechnic Herbarul, Silviculture Faculty	<i>Centaurea spinulosa</i>	1942.09.08	Bucovina Cacica	C.C. Georgescu	1
8	49	Bucharest Polytechnic, Silviculture Faculty	<i>Centaurea atropurpurea</i>	1937.07.01	Alba County Almașul Mic de Munte	Traian Buneș	1
8	61	Bucharest Polytechnic School Herbarium	<i>Centaurea spinulosa</i>	1935.08.22	Mureș District Săbed	S. Pașcovschi	1
8	69	Museum Botanicum Universitates Cluj	<i>Centaurea solstitialis</i>	1937.07.14	Basarabia District Bălți Soroca	M. Godvinski	1

Studies of *Centaurea* genus began with the first appearance of floristic research, made by various botanists in Transylvania. At the national level, the most important research of the genre belongs to Professor Dr. Julius Prodan, from the Academy of Agriculture Cluj (today UASVM Cluj-Napoca). He described in the first monograph of *Centaurea* genus (1930) many taxons and hybrids form Cluj surroundings and Dobrogea area. This monograph contains 168 taxa identified in Romania, including hybrids. For a long time, this monograph, which was the result of Prodan's work, has been a major resource (even the only way) for botanists. This aspect is caused by the fact that the description of species includes detailed graphics of the inflorescence items, which are a very important aspect in species recognition.

Besides the work of Prodan, the Nyárády's studies have a great importance in the evolution of the *Centaurea* genus study at national and Transylvanian level. Nyárády E. I. tried to solve the "mystery" of this type of morphological variability, describing many taxa and hybrids of *Centaurea* species (Nyárády, 1943(a), 1943(b)).

Currently, the floristic research made on the *Centaurea* genus, focuses on determining species in Romania and Transylvania Plateau and is based on information provided by foreign papers, thus raising the quality of the information related to the *Centaurea* genus issue. These works draw attention to the morphological variability and hybridization of these species, indicating that the information provided by morphological determination and separation are often insufficient and research must be completed with molecular and chorological information. By taking into consideration these aspects, several species of Romanian flora were put in synonymy or were misidentified (Ciocârlan, 2009). Nevertheless, the studies of Ciocârlan (2009), compared with Prodan's research (1930), reduce the number of certain species of the Romania flora, from a few hundred to 54 species and he considers the presence of introduced species as doubtful or wrong in Romanian flora (Ciocârlan, 2008, 2009).

Regarding the systematic species of *Centaurea* genus, the last approach of this kind of research was made in Romania by Julius Prodan, in the 1930's and was based on the Augustus von Hayek view (1901), which was a less conservative approach, dividing the genus into seven genera.

In Europe, the *Centaurea* genus has been extensively studied, proved by numerous studies on the systemic group, which updated the name of the species and the geographic distribution of *Centaurea* species (Bentham & Hooker, 1873; Bremer, 2004; Cassini, 1829; Flann *et al.*, 2010; Greuter, 2006–2009; Kouteký *et al.*, 2012. Pétit *et al.*, 2001; Tutin *et al.*, 1964-1980; EURO+MED, 2006; Flora Europaea -<http://rbg-web2.rbge.org.uk>). Likewise, the taxa with uncertain positions have been the subject of thorough studies from a genetic and palynology point of view, which relieved the positioning decision in phylogenetic system. In Europe, the most important studies have adopted the conservationist classification of the *Centauries* genus, bringing the seven types of Bentham and Hooker (1873) in three subgenera (*Centauries* s. str., *Cyanus*, *Lopholoma*), a boundary classification which has been confirmed by molecular-palynological studies and biogeographically patterns (Font, 2007; Garcia-Jacas *et al.*, 2001; Susanna *et al.*, 1995; Wagenitz & Hellwig, 1996). *Centaurea* genus has caught the attention of specialists due to the ornamental quality and healing importance. At the national level, only one or two native species of *Centaurea* were introduced as ornamental species, the remaining species being exotic and adapted more easily to climatic and soil conditions.

## RESEARCH RESULTS

***Centaurea* genre** belongs to the *Asterales* order, *Asteraceae* family. With a number of species ranging between 350 and 600, the plant can be mainly found in the Eastern Hemisphere. However, this genre is known for becoming an invasive weed in regions where they are not native. Furthermore, in the regions where this happens, the plant can cause significant problems because of their fast spread. For example, some species produce in their roots powerful toxins that can affect the growth of nearby plants (Hierro & Callaway, 2003, Vivanco *et al.*, 2004). Other species (like the yellow starthistle) are inedible and poisonous for equines. However, this damage can be caused if they are allowed to spread without control. The majority of these species are not harmful and even decorative. They also have an important nutritive role for certain insects such as butterflies (including the [endangered Karner blue](#) (*Lycaeides melissa samuelis*) and moths ([Zygaena loti](#), *Z. filipendulae*). Their nutritive role is extended towards humans as well. As its flowers attract many pollinators, the honey resulted from these plants is considered one of the finest type of honey produced in the Appalachian Mountains and United States

Some species are representative only for certain areas (like the area between Italy and the Caucasus) or are even very rare ([C. leptophylla](#) and [C. straminicephala](#)) or considered endangered (*Centaurea akamantis*). Another important characteristic is

represented by the fact that this plant usually grows beside other types of plants (herbs or grasses) such as [cock's-foot](#) (*Dactylis glomerata*), the [crested dog's-tail](#) (*Cynosurus cristatus*), [false oat-grass](#) (*Arrhenatherum elatius*), [glaucous sedge](#) (*Carex flacca*), [sheep's fescue](#) (*Festuca ovina*), [tor-grass](#) (*Brachypodium pinnatum*), hawkbit (*Leontodon hispidus*), brome (*Bromus erectus*).

Most *Centaurea* species can be recognized by their leaves which are divided into elongated lobes and sometimes with spines. The flowers range in color from yellow to red, blue and even white. Each inflorescence is situated on top of a cluster of bracts. Due to its aspect, some plants are used in gardens as ornamental features. Furthermore, *C. Cyanus* is the emblem of a Swedish province ([Östergötland](#)), and in Finland ([Päijänne Tavastia](#)).

The usage of these species is extended also to medicine. For example, *C. foliosa* roots are used in Turkish medicine, Albanians use *C. calcitrapa* as a food source, while the same plant is recognized for its antioxidants. Some plant's leaves are commonly eaten in Greece and Italy (Stavridakis, 2006).

The present herbarium contains the following types of *Centaurea* species: *C. stenolepis* (26 plates), *C. spinulosa* (23 plates) and *C. stereophilla* (10 plates).

***Centaurea stenolepis* A. Kerner** (Fig.1) - a species which never acts like a ruderal and is characteristic for primary well preserved grasslands, usually on rocky substratum. The typical species *stenolepis* seems to be frequent in Romania only in Zarand Mountains and Lipova Tableland, and very rare in Transylvania. It is a mesic taxon from the forests' clearings. In Moldavia the exact presence of this species should be checked due to confusions with some varieties of *Centaurea phrygia* with recurved involucram appendages (<http://www.floraofromania.transsilvanica.net>)



Fig. 1. *Centaurea stenolepis* A. Kerner



Fig.2. *Centaurea spinulosa* Rochel ex Spreng.

***Centaurea spinulosa* Rochel ex Spreng.** (Fig.2) – a perennial plant that usually reaches a height of 80-150 cm. The appendage of the average envelope little leaves is on the top with soft cilia, rarely with spine shorter than 1.5 mm, or in general without spine.

Baskets are ovoid with a diameter of 1.8 to 2.0 (1.3 to 1.5) cm. Flowering Time: June to October. The plants are growing in grassy, rocky and barren places on the Black Sea Coast, in northeastern Bulgaria, the Danube Valley, Fore, Middle and Western Stara Planina, Sofia Region, Central Rhodopes, Thracian lowland and Tundzha plane up to over 1000 meters altitude (Delipavlov et al. 1983).



The herbarium also contains plates of the following species:

***Centaurea atropurpurea* Waldst. & Kit.** (Fig. 3) - a species of *Centaurea* usually found in Romania and the Balkan Peninsula. It is considered a beautiful plant, along with *Centaurea clementei* Boiss from Spain, the most beautiful in the whole subgenus *Acrocentron*; species spread in the whole west Balkan peninsula on rocks at lower altitudes, from Albania up to west of Cluj-Napoca. The species is wrongly reported from Ukraine in the former USSR. *Centaurea kotschyana* Heuffel is its subalpine and boreal counterpart, somehow similar but different in any subtle character.

*Centaurea atropurpurea* is a xeromesophyte species rarely encountered in the SW of the Transylvanian depression. The species prefers rocky areas or meadows with southern exposure and a rich substrate in  $\text{CaCO}_3$ . Morphological studies have singled out the existence of two different groups. The first morphological group is characterized by vigorousness while the second morphological group presents certain characters different from the type of the plant. Morphological differentiation of this species in the habitat upon which it develops highlights the adaptability of this species to certain soil conditions. This adaptation has been described by some botanists as a form of the species *C. atropurpurea*. Morphological differentiation is actually given by the  $\text{CaCO}_3$  content of soil, moisture and the habitat in which the species is encountered (Vonica et al.2012).



Fig. 3. *Centaurea atropurpurea* Waldst. & Kit.

***Centaurea montana* L.:** with a height of 20-60 cm, chamephyte or hemicryptophyte, the plant blooms from May up to September. The stem, usually simple has a single capitulum, sessile lanceolate leaves, rich involucre and blue flowers. A plant of semi-shade, is characteristic for mul humus, soils rich in nutritive elements and basic to weakly acid pH. The plant is spread on mountain pastures, beech, fir, hornbeam forests, outskirts and embankments. It is usually cultivated as ornamental plant (Rameau *et al.*, 1989) and contains inulin and glucose, especially in the subterranean parts. It usually grows at altitudes between 900 and 1900 m in Central Europe, from the Pyrenees up to South Russia and Italy. Outside Europe it is cultivated in different temperate regions, especially in North America.

***Centaurea pullata* L.** is a species of *Centaurea* found in Europe and North Africa. This plant can be encountered only in some cities from the Mediterranean region where it was naturalized for a long time. The plant can be recognized by its height (5-30 cm), purple-blue flowers, unequally divided leaves and white fruits covered with delicate shin-

leaves. It usually blooms between May and June, being a biennial green-gray plant (Dob et al. 2009).

***Centaurea solstitialis* L.** (Fig.4) – is an annual herb belonging to the Asteracea family, native to the Mediterranean region which can be recognized by its non-spiny leaves and yellow flowers. Considered a weed, it can be found on roadsides or margins of cereal crops. The plant was introduced as an exotic species in Australia, Chile or the USA and as such, adapted to the local conditions (Hierro et al., 2009; Graebner et al., 2012). However, the plant maintained its invasive aspect, continuing to grow on degraded areas, wildlands and crops. It is considered harmful for horses, causing a neurological condition (nigropallidal encephalomalacia or "chewing disease"). The plant has a positive impact also. For example, it is a major source of pollination for certain butterflies or moths. Furthermore, it plays an essential role in establishing and restoring the soil by increasing vital micronutrients.



Fig. 4. *Centaurea solstitialis* L.



Fig. 5. *Centaurea sphaerocephala* L.

***Centaurea sphaerocephala* L.** (Fig. 5) - is a species of *Centaurea* found in the Iberian Peninsula.

***Centaurea scabiosa* (L)** – perennial plants that can reach 20 cm -1 m, whose purple flowers bloom between July and August, and sometimes September. The main root is elongated, robust and persists for many years. The plant is a rich source of food for horses, sheep, goats and pigs. It can grow on all types of fields although in certain areas it prefers limestone or clay soils. It is very spread in almost all Europe, with the exception of the Arctic area and can grow at altitudes of 2600 m. Outside Europe, it can be found in West Asia and Siberia (Lack, 1981).

**Plant's harvesting year.** The plants were gathered in a time period ranging from 1855 until 1951. The oldest plants of this genre are *Centaurea spinosa* and *Centaurea splendens*, harvested in the year 1855. The periods in which most plants were gathered were 1930-1939 and 1940-1949 (Fig.6).

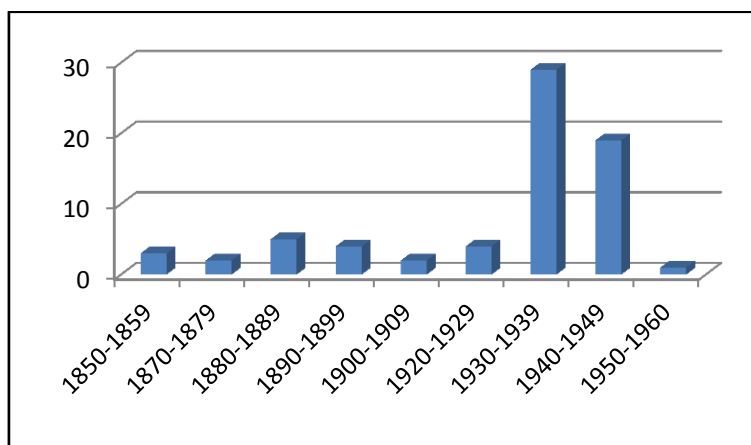


Fig. 6. Harvesting periods for *Centaurea* plants from INCDS Herbarium

**The place of harvest** for most species is represented by our country (Fig. 7):

Between the two world wars, plants of this genre were gathered from areas that do not belong anymore to our country, such as Basarabia (Bălți, Soroca), Bucovina (Cacica), Cadrilater (Durostor). Some plants were gathered even from Hungary, Malta and Greece.

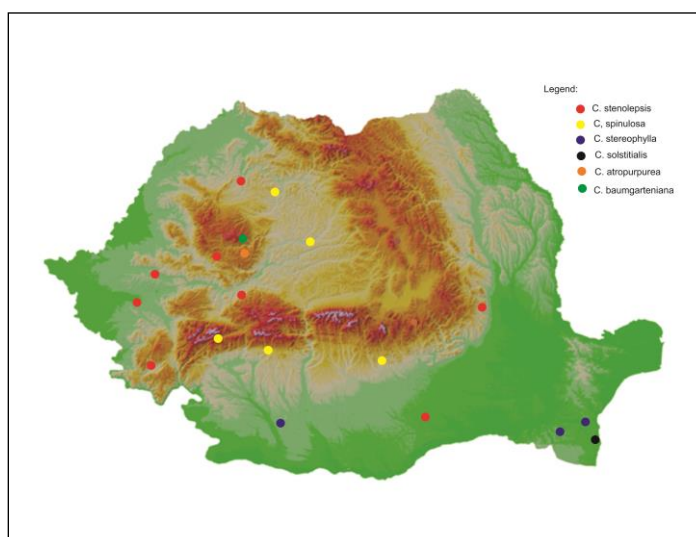


Fig. 7. *Centaurea* plant's harvesting place

**The people that gathered the plants** are mainly Romanian specialists (C.C. Georgescu, I. Morariu, Al. Borza, Badea, P. Cretzoiu, S. Pașcovschi, E. I. Nyarady, N.Al. Iacobescu, T. Buneș). However, some plants were gathered by renowned foreign specialists (Dr. Behrendsen, J. Neuwirth, J. Rovin, M. Godvinski, R. Pirolla).

## CONCLUSIONS

The "Al. Beldie" Herbarium from INCDS "Marin Drăcea" Bucharest, has amongst its 60.000 plates, 71 plates belonging to the *Centaurea* genre – that belongs to a plant genre where polymorphism plays a considerable evolutionary role and causes taxonomy challenges.

Amongst this genre, the herbarium contains 19 species gathered between 1855 and 1951 from the entire world, with most exemplars gathered from our country.

Most plates belong to the species *C. stenolepis* (26 plates), followed by *C. spinulosa* (23 plates) and *C. stereophylla* (10 plates).

The variation model found in some *Centaurea* groups slows down and makes difficult their recognition due to the lack of clear differences in the qualitative character. As such, only some characters can be used in order to determine the species.

Although they are hard to identify, these species were harvested and correctly identified by botanists from the entire world, the majority of them being Romanian botanists.

Maintaining the *Centaurea* species from this herbarium in very good conditions (the exemplars are not deteriorated) and their proper identification represents an important support for many further studies of this genre

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