

DOCUMENTING *ACHILLEA* L. GENUS USING HERBARIUM RECORDS

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INTRODUCTION

Achillea L. Genus also known under the generic name of „yarrow”, is one of the most frequent and rich genus from the *Asteraceae* Family (*Asteroideae* subfamily, *Anthemideae* tribe, *Achilleinae* sub-tribe). The Genus is composed of approximately 140 species (Tutin, 1976; Nemeth, 2010; Turkmenoglu et al., 2015; Tosun & Kürkçüoğlu, 2018), spread out on the entire Earth, in different vegetation areas and floors (Ehrendorfer 2003; Celik & Apukulat, 2008). However, it prefers the temperate regions from Eurasia (Boskovic et al., 2005; Motavalizadehkakhky et al., 2013).

The Genus is represented by herbaceous perennial plants renowned for their varied therapeutic usages (Lietava, 1992; Magiatis et al., 2002; Benedek, 2007; Toncer et al., 2010). Furthermore, some species are highly appreciate in Europe and North America for their landscape qualities, being cultivated in ornamental purposes (Rahimmalek et al., 2009).

The scientific name originates from Greek mythology and relates to the legendary Achilles (or Akhilleus) who is said to have used this plant during the Troy wars as remedies for healing injuries (Chandler, 1982; Mitich, 1990; Nemeth & Bernath, 2008; Mohammadhosseini et al., 2017).

A number of 28 species were identified and described in Romania's spontaneous vascular flora, complemented by numerous intraspecific units (varieties, shapes) or a considerable number of hybrids (Prodan 1931; Prodan & Nyárády, 1964).

„Alexandru Beldie” Herbarium is hosted at „Marin Drăcea” National Institute for Research-Development in Forestry, Bucharest and has approximately 40.000 vouchers from which approximately a quarter were realized by Alexandru Beldie (Vasile et al., 2017). The Herbarium is also inscribed in *Index Herbariorum* (Chisăliță et al., 2017; Dincă et al., 2018) and can be identified after the BUCF acronym (***Thiers).

Amongst the species present in the Herbarium we mention: 112 *Hieracium* species (Dincă et al.,

2017a), 29 *Allysum* species (Căntar et al., 2018), 19 *Androsace* species (Dincă et al., 2017d), 69 *Potentilla* species (Crișan et al., 2017), 15 *Ornitogalum* species (Enescu et al., 2017), 16 *Abies* species (Enescu et al., 2018), 19 *Scorzonera* species (Dincă & Căntar, 2017), 15 *Veronica* species (Dincă et al., 2017c), 32 *Arabis* species (Dincă et al., 2017b), 41 *Polygonum* species (Vechiu et al., 2018), 80 *Trifolium* species (Căntar & Dincă, 2018) or 40 *Alchemilla* species (Deleanu et al., 2019).

MATERIALS AND METHODS

The present study was realized on the vegetal material kept and preserved within the „Al. Beldie” Herbarium and consisted of 226 vouchers belonging to the *Achillea* L. Genus.

The research methodology has targeted the sorting of vouchers based on the information inscribed on the identification tag (scientific name, the name of the collection to whom it belongs, research data, harvesting place, collector name and the name of the person who has identified the plant). This was followed by the creation of a database, easy to access and processe.

The terminology for each entry was verified and updated with the international *The Plant List* database (<http://www.theplantlist.org/>).

Furthermore, the conservation degree was established for each specimen, based on a four-level evaluation: 1 = very well preserved plant, kept in its entirety and correctly attached to the voucher, 2 = plant detached from the voucher, with detached parts but still present, 3 = plant detached from the plate, with missing parts and 4 = detached and fragmented plant, with over 50% of its parts missing (Vasile et al., 2017).

A partial inventory of the *Achillea* Genus is rendered in Table 1.

Subsequently, based on an ample bibliographic study, the main *Alchillea* species were described, with a focus on their corologic, morphologic and ecologic requests.

Table 1. *Achillea* Genus Inventory (excerpt from the database)

Drawer number	Voucher number	Herbarium/ Botanic Collection/ Institution	Species Name	Harvesting Date	Harvesting Place	Collected/ Determined by:	Conservation Degree (1..4)
8	8	Herbarium Normale	<i>Achillea aegyptiaca</i> L.	1898.06.01	Makaria Island	Chr. Leonis	2
8	10	Dr. C. Baenitz, Herbarium Europaeum	<i>Achillea alpina</i> L.	1988.08.01	St. Bernard	F. O. Wolf	1
8	11	Flora Romaniae Exsiccata	<i>Achillea asplenifolia</i> Vent.	1939.07.24.	Basarabia	E. I. Nyárády	1
8	29	Herbarium from the Forest Research Institute	<i>Achillea collina</i> (Becker ex Rchb.f.) Heimerl	1940.08.12.	Almasu Mare	Bunea T.	2
8	41	ICEF Forestry Research and Experimentation Institute	<i>Achillea distans</i> W et. K.	1943.08.13	Caras County	S. Pascovschi, Al. Beldie	2
8	47	Herbarium from the Forest Research Institute	<i>Achillea getica</i> Grec.	1933.07.28	Lehliu	C. C. Georgescu	1
9	5	ICEF Forestry Research and Experimentation Institute	<i>Achillea millefolium</i> L.	1934.07.01	Clabucet	P. Cretzoiu	1
9	22	ICEF Forestry Research and Experimentation Institute	<i>Achillea millefolium</i> L.	1936.07.14	Cainelui Peak	At. Haralamb	2
9	77	Bucharest's Polytechnics School Herbarium, Botanic Laboratory	<i>Achillea ptarmica</i> L.	1938.08.01	Baia Mare	M. Badea	1
10	15	Herbarium from the Forest Research Institute	<i>Achillea setacea</i> W et. K.	1955.06.18	Tandarei	Al. Beldie	1
10	39	Paul Cretzoiu Herbarium, Bucharest	<i>Achillea setacea</i> W et. K.	1842.06.26	Cernauti	P. Cretzoiu	2
10	57	Flora Romaniae Cluj University Herbarium	<i>Achillea setacea</i> W et. K.	1938.07.04	Turda	E. I. Nyarady	1
10	78	Dr. C. Baenitz, Herbarium Europaeum	<i>Achillea tometosa</i> L.	1888.06.28	Basses-Alpes	E. Reverchon et A. Derbez	2

RESULTS AND DISCUSSION

The *Achillea* L. Genus representatives preserved in „Alexandru Beldie” Herbarium are: *Achillea aegyptiaca* L., *Achillea ageratifolia* var. aizoon (Griseb.) Heimerl, *Achillea ageratum* L., *Achillea alpina* L., *Achillea asplenifolia* Vent., *Achillea barrelieri* (Ten.) Sch. Bip., *Achillea chamaemelifolia* Pourr., *Achillea coarctata* Poir., *Achillea collina* (Becker ex Rchb.f.) Heimerl, *Achillea crithmifolia* Waldst.&Kit., *Achillea clypeolata* Sibth. & Sm., *Achillea distans* Waldst. & Kit. ex Willd., *Achillea distans* subsp. *stricta* Janch., *Achillea erba-rotta* All., *Achillea erba-rotta* subsp. *moschata* (Wulfen) Vacc., *Achillea nobilis* L., *Achillea getica* Grec., *Achillea grandifolia* Friv., *Achillea impatiens* L., *Achillea* × *joannis* Prod., *Achillea leptophylla* M. Bieb., *Achillea ligustica* All., *Achillea ligulata* Waldst. & Kit., *Achillea macrophylla* L., *Achillea micrantha* M. Bieb., *Achillea millefolium* L., *Achillea millefolium* subsp. *sudetica* (Opiz) Oborny, *Achillea nana* L., *Achillea nobilis* subsp. *neilreichii* (A.Kern.) Velen., *Achillea ochroleuca* Ehrh., *Achillea odorata* L., *Achillea oxyloba* subsp. *schurii* (Sch.Bip.) Heimerl, *Achillea pseudopectinata* Janka, *Achillea ptarmica* L., *Achillea seidlai* J.Presl & C.Presl, *Achillea*

setacea Waldst. & Kit., *Achillea thracica* Velen., *Achillea tometosa* L. and *Achillea umbellata* Sm.

Amongst them, the most present ones are *Achillea setacea* (41 vouchers), *Achillea millefolium* (38 vouchers), *Achillea distans* subsp. *stricta* (19 vouchers), *Achillea seidlai* (17 vouchers), *Achillea oxyloba* subsp. *schurii* (14 vouchers), *Achillea distans* (13 vouchers), *Achillea collina* (9 vouchers), *Achillea coarctata* Poir. (7 vouchers), *Achillea ptarmica* (6 vouchers), *Achillea asplenifolia* (5 vouchers), *Achillea crithmifolia* (5 vouchers) and *Achillea getica* (5 vouchers).

***Achillea setacea* Waldst. & Kit.** (Fig. 1) is found in the central and south-estic part of the European continent, from where it expands towards West Asia (Richardson, 1976; Shauro, 1997). It is a hoarse-harry species, with a tall stem that can reach 60 cm, linear-lanceolate leaves, while the laciness have a mucronate cartilaginous terminal (Danilhelka, & Rotreklová 2001).

The calatides are grouped in corymbs, with marginal ligulate white flowers, while the tuberos ones are yellow. In our country, the plant grows abundantly on sunny arid meadows, on soils with sandy texture, contributing to their strengthening (Ștefan & Oprea, 2007).

Achillea millefolium L. is the most important and frequent species from this Genus. Present initially in the Eurasian areal, the species expanded in other regions as well, becoming cosmopolite (Ehrendorfer & Guo, 2006). In Europe, the plant is well represented in the alpine fields (Pecetti et al., 2012).

Well renowned for its anti-inflammatory, antiseptic, tonic and stimulant properties, the plant is recommended in treating bleedings, digestive, biliary or rheumatologic affections (Chandler et al., 1982; Shawl et al., 2002; Benedek et al., 2007). The plant can be recognized through its erect stem that can reach 90 cm in height, while the leaves are generally glabrous, elongated and lanceolate. The flowers are white, grouped in corymbs and with a specific smell. From an ecologic point of view, it prefers shadowy and relatively humid places.

Achillea distans Waldst. & Kit. ex Willd. is spread out in Central and South-East Europe, preponderantly in Alps, Carpathians and Balkans (Daniehelka & Rotreklová, 2002). The species can be identified through its 2-3 penat-sectate leaves, with over 10 pairs of primary segments and wide winged rachis, serrated on the superior part.

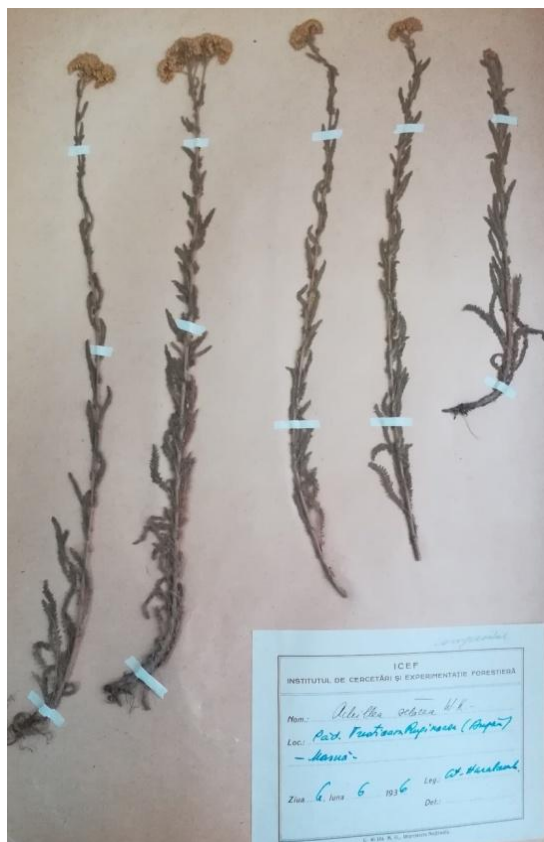


Fig. 1. *Achillea setacea*

The involucre has lacerated leaflets on the top, while the radial flowers are white. It vegetates well on soils rich in nutritive substances (mesotrophic-eutrophic), tolerating a certain degree of dryness (xeromorphic-mesophytic).



Fig.2. *Achillea distans* subsp. *stricta*

Achillea distans subsp. *stricta* Janch (syn. *Achillea stricta*) (Fig. 2) is similar with the previous species due to its involucre leaflets that have a thin brown-reddish line on the margins. On the other hand, the rachis is wider, winged and dented on all its length.

Achillea seidlai J.Presl & C.Presl (syn. *Achillea pannonica*) can be found from East Central Europe up to the South-East region (Werner et al., 2003) from where it goes to Minor Asia. The plant has a vigorous stem, strongly sericeous, woolly villous. The leaves are linear lanceolate, with an unequal un-winged rachis, equally wide on all its length. The radial flowers are white, with sub-rounded ligules, half of the involucre. The plant can be frequently found in our country on meadows, on soils with sandy texture.

Achillea oxyloba subsp. *schurii* (Sch.Bip.) Heimerl (syn. *Achillea schurii*) is an endemic species for East and South Carpathians (Bendeac et al. 2016). The plant is of average height (10 – 30 cm) with solitary stems and elongated obovate or oblong-

obovate leaves. The inferior ones have glabrous, narrow laciness. Radial flowers are white and as along as the involucre. The involucre folios are adorned on the sides with a dark brown or black stripe that is in contrast with the interior light parts (Prodan & Nyárády, 1964). The plant grows on grassy, cliffy areas, near rivers.

***Achillea collina* (Becker ex Rchb.f.) Heimerl** is a species present in European alpine areas. The stem can reach 80 centimetres in height and has large hairs. The stem leaves are wide, short, with rigid wings and closely crowded laciness. The species grows spontaneous in our country, frequently on sunny cliffs and only rarely on weak salty soils.

***Achillea coarctata* Poir.** has a maximum distribution in South-East Europe (Balkans) and Minor Asia (Simic et al., 1999). The wool stem can reach 20-90 cm, while the leaves are sericeous villouse, with a dented rachis. The stem leaves are bipennate partite, with divided or dented segments, while the medium and superior ones are bi-pennate. The radial flowers are small, yellow and reduced as number. The plant can be sporadically found in Banat, Mehedinți, or Dobrogea, where it grows on well dried soils, in plain light.

***Achillea ptarmica* L.** is a perennial plant, tall (it can reach 1,5 m), lacking elasticity and glabrous up to the top. The leaves are complete, linearly lanceolate, serrated, sessile and acuminate on the margins. The flowers have white wide-elliptical, tri-crenate ligules. It is well adapted on peat soils with humidity excess.

***Achillea asplenifolia* Vent.** is a native species for Central Europe (Danihlka, 2003). The erect or ascending stem is initially pubescent and then glabrous. The leaves are relatively wide, with the base one lanceolate, while the median ones are narrowly lanceolate, with close or overlaying wings. Generally speaking, the flowers are red, but can also be white. In our country, the plant is conditioned by the existence of moderately saline, humid or temporary humid stations.

***Achillea crithmifolia* Waldst. & Kit.** is located in the Balkan Peninsula from where it advances up to the South-East part of Slovakia (Teodorova et al. 1998). The plant has numerous stems with elongated lanceolate 2-3 pennate divided leaves at the basis, while on the medium or superior side they become bi-pennate and linearly lanceolate. The leaves rachis is complete and undented. The flowers are white or yellow and grouped in a wide compound corymb.

***Achillea getica* Grec.** is an endemic Romanian plant, present in Comana National Park (Dumitrașcu et al., 2011) and in Bucharest's metropolitan area (Grigorescu & Felciuc, 2005). The strongly odorant plant has white-ash wool villouse leaves and an undented rachis. The first-degree laciness has secondary long and deeply divided

laciness. The radial flowers are white, rounded, complete and slightly tri-crenate. It usually grows in sunny, dry areas, near roads.

Amongst the indigenous species of this Genus, the Herbarium also includes some species present on the „Red list of superior plants from Romania” (Oltean et al., 1994). These are situated in the following vulnerability categories: rare (*Achillea clypeolata*, *Achillea leptophylla* and *Achillea oxyloba* subsp. *schurii*) and vulnerable (*Achillea ptarmica* L. and *Achillea ochroleuca*).

***Achillea clypeolata* Sibth. & Sm.** also known under the common name of “yellow yarrow”, is an endemic species for the Balkan Peninsula (Nedelcheva, 2012). From a morphological perspective, it is similar with *Achillea coarctata* (Saukel et. al., 2003), with the difference that it has an undented rachis. The species was sporadically signalled in Dobrogea where it prefers grassy hills. The plant was identified by C.C. Georgescu in Covasna (drawer number 8, voucher 16).

***Achillea leptophylla* M. Bieb.** is a species with European and Asian areal, found in South-East Europe and up to West Kazakhstan (Richardson, 1976). The leaves are doubly penned, sected, linear, woolly and narrow. The radial flowers are yellow and grouped in a small, lax corymb. It is a species with very rare sightings, on sunny cliffs, clearings or clay substratum.

***Achillea ochroleuca* Ehrh.** (syn. *Achillea pectinata* Willd.) is a species that prefers limestone arid soils from South-East Europe (Nedelcheva & Tzonev, 2006). It can be found under the name of *Achillea kitaibelliana* Soó in older specialty papers from Romania (Prodan 1931; Prodan & Nyárády, 1964). The stem is tomentous, with simple sected penned leaves, with linear laciness and radial white flowers.

The plant's harvesting periods. The oldest voucher from the Herbarium dates back to the year 1842 and contains an *Achillea setacea* sample harvested from Cernăuți by P. Cretzoiu. Among the oldest vouchers are included also samples of *Achillea ageratum*, *Achillea ligustica*, *Achillea pseudopectinata*, *Achillea thracica* (Fig. 3), *Achillea tomentosa* L. (Fig. 4), etc.

The first *Achillea* sample was harvested in Romania forty years later and is represented by an *Achillea crithmifolia* exemplar gathered from Deva County. Up until the 1900s, the collection amounts to 47 vouchers, from which only three were gathered from our country (Bucegi and Deva), all the others coming from abroad, from countries such as Italy, Greece, Serbia and so on. As the database indicates, after the year 1900, the collection was progressively enriched with species. Over 50% of the number of vouchers was collected between the years 1930-1949 (Fig. 5).

Furthermore, certain time intervals do not have any entries. The Herbarium was created by renowned specialists from the domain, such as Al. Beldie, At. Haralamb, C. C. Georgescu, P. Cretzoiu, I. Prodan, S. Paşcovschi, I. Morariu, E.I. Nyárády, G. P. Grinţescu, L. Leandru, M. Badea, M. Petcut, M. Ciucă, A. Coman, T. Bunea, Wolff, Adamović, P. Savi, etc.

The collection includes mainly species gathered from Romania (Fig. 6), especially from Alba, Argeş, Bihor, Braşov, Buzău, Caraş Severin, Cluj, Constanţa, Dolj, Gorj, Hunedoara, Ialomiţa, Ilfov, Prahova, Mehedinţi, Mureş, Sibiu, Teleorman, Timiş, Vâlcea and Vrancea Counties.

Especially important is the fact that most of the vouchers are in a good conservation state (first and second conservation degree) (Figure 7). Among

the vouchers that have obtained a third conservation degree we can find the ones obtained between 1930-1949. The fourth-degree vouchers are the fewest and include the ones created 100 years ago (period 1890-1899).

An essential role in the collection's development was represented by certain exchanges with national or foreign herbariums. Most vouchers come from the following institutions:

Bucharest's Polytechnic School Herbarium from the Silviculture Faculty from Bucharest (64 vouchers), Forest Research and Experimentation Institute (45 vouchers), Museum Botanicum Universitatis, Cluj Flora Romaniae Exaiccata (14 vouchers) and Forestry Research Institute Herbarium (11 vouchers).

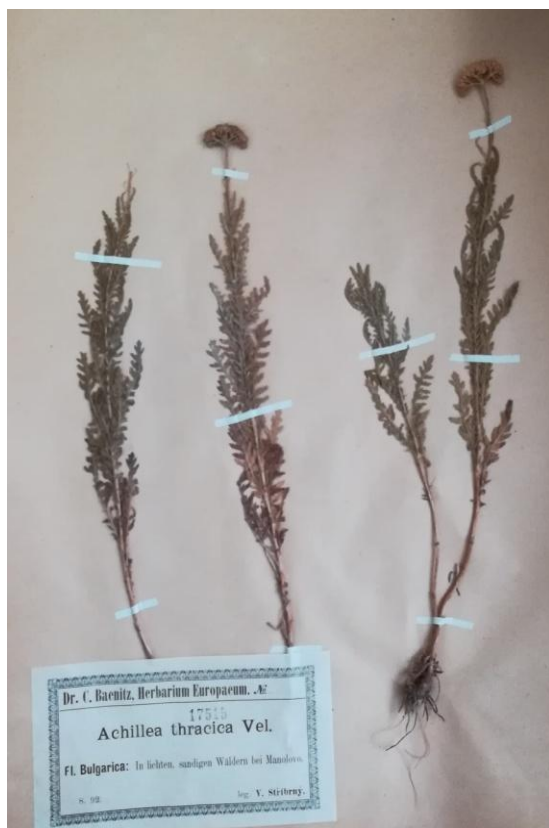


Fig. 3. *Achillea thracica*

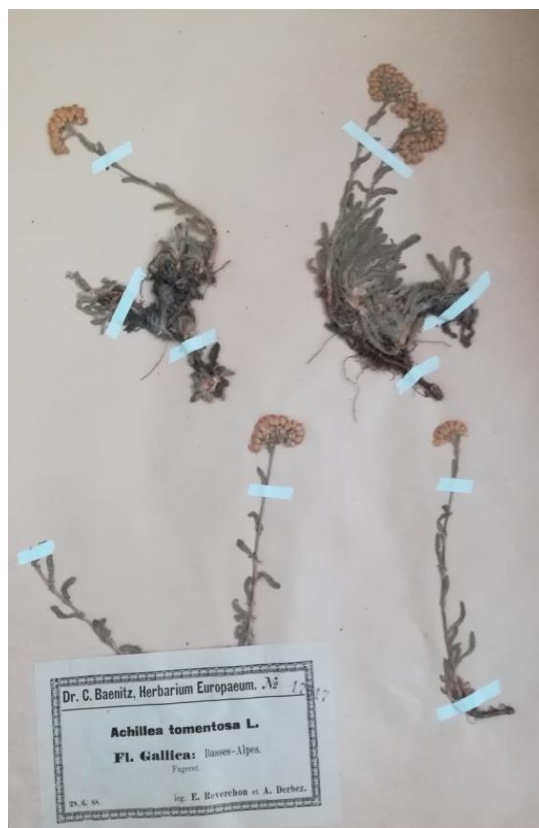


Fig. 4. *Achillea tomentosa*

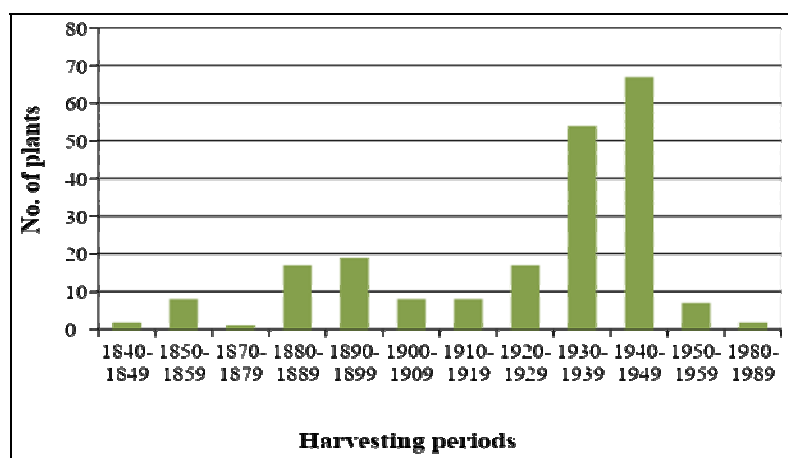


Fig. 5. Harvesting periods of *Achillea* plants from “Alexandru Beldie” Herbarium



Fig. 6. The place of harvest for *Alchillea* Genus in Romania

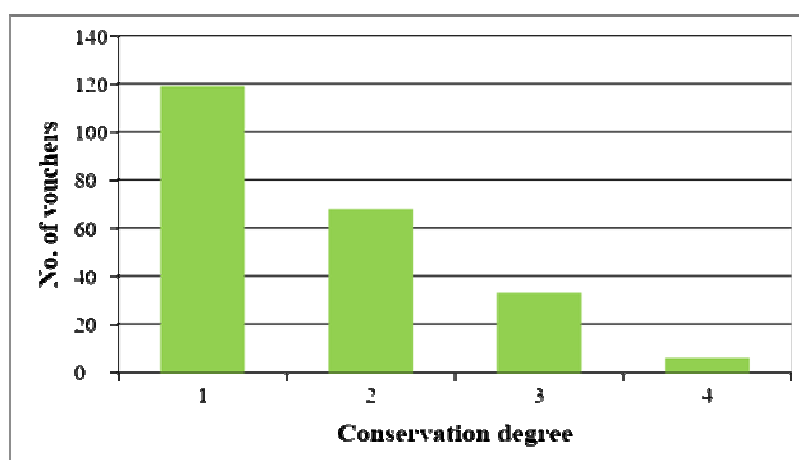


Fig. 7. Conversation degree of plants from “Alexandru Beldie” Herbarium

CONCLUSIONS

The inventory of the *Achillea* Genus from "Alexandru Beldie" Herbarium has facilitated the obtaining of the following conclusions:

- the 226 vouchers inventoried for the *Achillea* Genus belong to a number of 39 species, both native and non-native;
- the best represented species of this Genus are *Achillea setacea* (41 vouchers) and *Achillea millefolium* (38 vouchers);
- endemic species inscribed in the Red List of Superior Plants from Romania are also included;
- the vouchers were collected between 1842-1988, by renowned specialists among whom we mention Al. Beldie, At. Harlamb, C.C. Georgescu, I. Prodan, or Wolff;
- the best period for enriching the collection was between 1940-1949;
- the collection is kept in very good conditions, over 80% of the vouchers having a first or second degree of conservation;
- exchanges with different herbariums proved to be extremely valuable for the collection's history
- *Achillea* species are remarkable through their pharmaceutical properties but can also be used for the creation of green spaces.

ABSTRACT

"Alexandru Beldie" Herbarium owns one of the most important and rich plant collections from Romania. The present article intends to update the database concerning the *Achillea* L. Genus, as well as to describe the main species, focusing on their corological, morphological or ecological particularities. The study material was composed of 223 vouchers harvested between 1842-1988 by renowned Romanian and foreign specialists. The vouchers originate from our country, as well as from abroad and are in a very good conservation state.

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