

A SURVEY OF PRESERVED SPECIMENS OF THE GENUS *FESTUCA* L. (POACEAE) IN ROMANIA

Diana Vasile¹, Lucian Dincă¹, Raluca Enescu^{1*}

¹”Marin Drăcea” National Institute of Research and Development in Forestry – Braşov, Romania



Abstract

The genus *Festuca* L. is a genus of flowering plants belonging to the grass family *Poaceae*, being one of the largest in *Gramineae* with ± 450 species in temperate and alpine regions of both hemispheres with a cosmopolitan distribution occurring on every continent except Antarctica. They are evergreen or herbaceous perennial tufted grasses with a height range of 10–200 cm.

The specimens of *Festuca* are preserved in the Al Beldie Herbarium from INCDS Marin Drăcea Bucharest.

This Herbarium hosted 309 vouchers with 52 *Festuca* species, most of them belonging to *F. gigantea* (28), *F. versicolor* (27) and *F. arundinacea* (22). The oldest specimens were collected in 1773 and 1788. Most of the herbarium specimens were generally in very good (198) and good (76) condition except for a smaller number of specimens which were damaged (35). The aim of this article is to describe some *Festuca* species which are very good preserved.

Keywords: collected, herbarium, plants, preserved, *Festuca*, specimens.

1. INTRODUCTION

The genus *Festuca* L. is a genus of flowering plants belonging to the grass family *Poaceae*, being one of the largest in *Gramineae* with ± 450 species in temperate and alpine regions of both hemispheres (Clayton and Renvoize 1986; Muller and Catalan, 2006) with a cosmopolitan distribution occurring on every continent except Antarctica.

They are evergreen or herbaceous perennial tufted grasses with a height range of 10–200 cm (Ortúñez and Cano-Ruiz 2013).

The collection of the *Festuca* genus specimens preserved in ”Al. Beldie” Herbarium from Bucharest, form an important recorded of where the plants grew over the time. Moreover it was observed that in an herbarium, spores and seeds may remain viable for a long time (Probert et al., 2009; Modoni et al., 2011; Molnar et al., 2015), since some researchers have obtained from herbarium vouchers up to 237 years old, viable spores and seeds (Abeli et al., 2018).

It was proved by some studies on Angiosperms, that the most long-lived seeds preserved in herbaria are from *Poaceae* and *Apiaceae* after those from *Fabaceae* (Molnar et al., 2015).

In determining seed viability of herbarium specimens, the storage conditions are more important than taxonomic or ecological characteristics (Godefroid et al., 2011).

By storage the herbarium specimens in good conditions, these can be used to observe the evolution in introduced species, quantify phenological modifications due to climate change and draws the distribution of plant disease (Hood et al., 2010; Buswell et al., 2011; Davis et al., 2015).

The aim of this article is to inventory all the species of *Festuca* genus from herbarium and to describe those *Festuca* species which have a very good conservation state.

2. MATERIALS AND METHODS

We investigated "Alexandru Beldie" herbarium hosted at the INCDS "Marin Drăcea" in Bucharest, which represents an important source of information for taxonomical research for a lot of genus and species, an important archive to document biodiversity not only for scientific purposes but also medicinal and economic and also an accessible depositary to verify species identification. Herbarium contain over 40 000 vouchers with herbaceous and wood forest species, moss, fern and rare species worldwide, accumulated through the efforts of hundreds of botanists and researchers for over two centuries. (Vasile et al., 2016).

All the vouchers are preserved in their original maps, each voucher having a label that contains: the specie's scientific and popular name; harvesting place; the date when the species was collected; the name of the researcher who collected the sample.

The species preserved in herbarium have received a number from 1 to 4 which represent the conservation state of each preserved specimen: 1 = well preserved plant, entire and attached to the voucher, 2 = plant detached from the voucher, with detached but existing parts, 3 = plant detached from the voucher, with missing parts and 4 = plant detached and fragmented, with over 50% missing.

3. RESULTS AND DISCUSSIONS

In the herbarium there are storage 309 vouchers with 52 species of *Festuca* genus. Of each species there are one or two or maximum six specimens, but there are some species that have between eight and 28 specimens (Fig. 1)

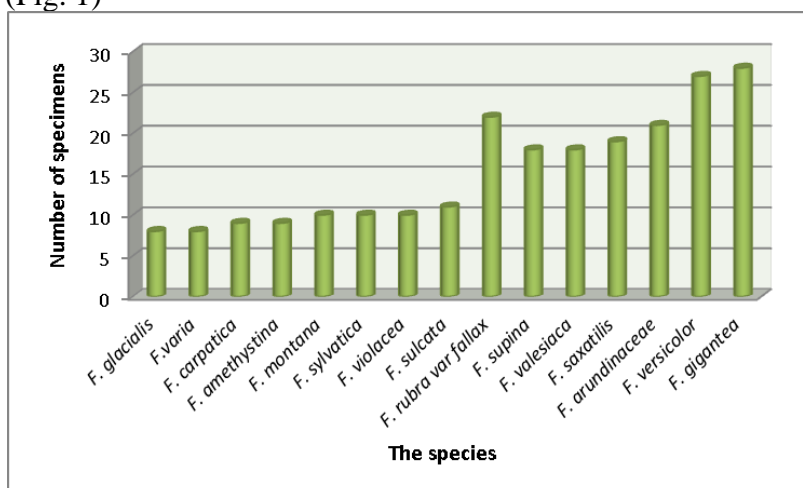


Fig.1. The species with the most specimens

As it can be seen only four species have over 20 specimens in the herbarium: *Festuca arundinacea*, *F. rubra var fallax*, *F. versicolor* and *F. gigantea*.

The state of preservation

From the 309 vouchers 64% have well preserved plants (1), 23% have plant detached from the voucher (2), and a very small percentage, respectively 11% plant detached from the voucher, with missing parts (3) and 0,32% plant detached and fragmented, with over 50% missing (4) (Fig.2).

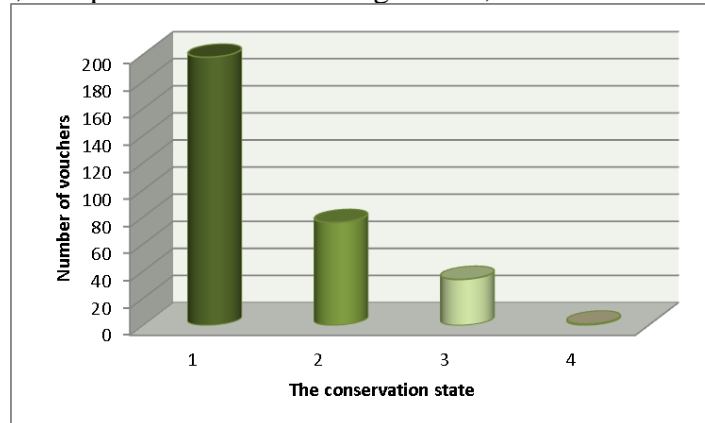


Fig.2. The state of preservation

The years in which the species were harvested

F. meleala and *F. varia* are the oldest specimens having an age of 250 years respectively 230 years, being harvested in 1773 from Romania (Maramureş county), respectively in 1788 from Germany. Both of them are well preserved, *F. meleala* - the plant is entire and attached to the voucher and *F. varia* - the plant is detached from the voucher but it is entire.

The largest number of specimens (between 23-29 specimens) was collected at the end of the 1937 and in the years 1943 and 1947 (Fig.3). As expected, in the herbarium can be seen a high seasonality: more species are harvested in spring and summer. Thus, the months with most species harvested are April, May, June, July and August.

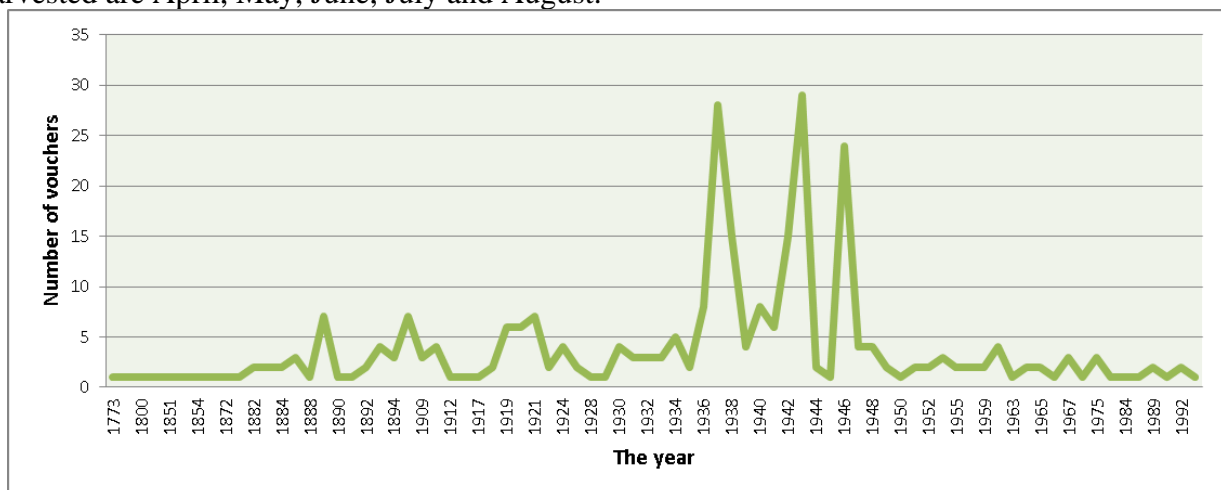


Fig. 3. The number of specimens collected over the years

The harvest location

Most of the specimens in the collection are from Bucegi Mountains (126 specimens; 41%), being the best represented. Less than 2% of the specimens come from Rodnei, Retezat, Făgăraş, Ciucaş and Piatra Craiului Mountains. The specimens collected elsewhere in Counties: Argeş, Bistriţa Năsăud,

Cluj, Covasna, Gorj, and from other countries, Swizerland, Sweden and France have a symbolic presence, representing only 0,9 % of the collection.

The researchers who collected the species

The researchers who had a significant contribution to the collection of *Festuca* species are Al Beldie (34% of the specimens are harvested by him), C.C. Georgescu (9%), E.I Nyarady (5%), Al. Borza (2%).

Also important contributions to this collection had the researchers like M. Gandoger, E. Reverchon, F.A. Tschering, E.Th. Fries, O. Holberg, Wolf, etc, the collection being enhanced by exchanges with or donations by other herbaria.

Festuca species with a very good conservation state

Festuca carpatica F. Dietr, *F. drymeia* Mert. & W. D. J. Koch, *F. elatior* L., *F. fallax* Thuill (synonym with *F. rubra* L.) or *F. rubra* subsp. *fallax*, are some of the 198 vouchers with well-preserved plants, entire and attached to the voucher, the leaves, inflorescences and seeds being very visible, easy to analyzed and studied.

The *Festuca carpatica* species has 9 vouchers very well preserved, majority of the specimens being harvested by the researcher Al. Beldie from Bucegi Mountains in August, between the years 1917 and 1946.

Festuca carpatica F. Dietr (Fig. 4) is characterized by the possession of caryopsis free from palea and lemma with scarios and involute margins (Torrecilla and Catalan, 2002).

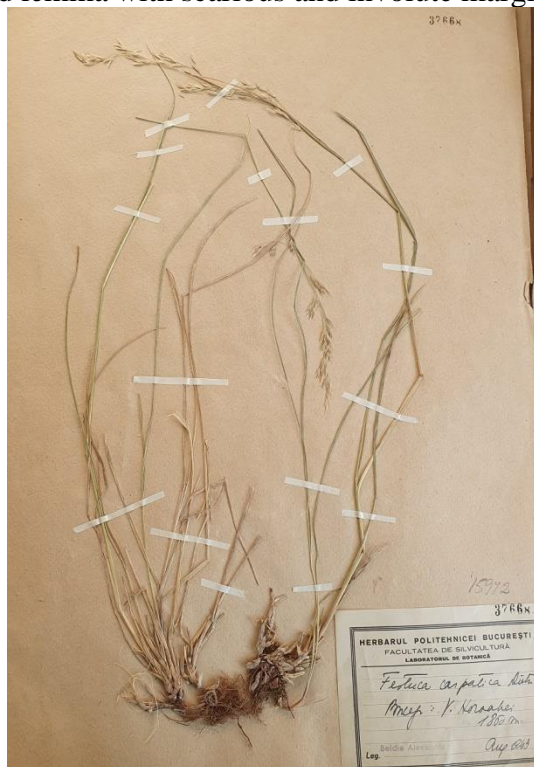


Fig.4. *Festuca carpatica* from Bucegi Mountains



Fig.5. *Festuca drymeia* from Caras-Severin

Festuca drymeia Mert. & W. D. J. Koch species has 5 vouchers well preserved, the specimens being harvested in June - July between the years 1851 - 1967, from Bucegi Mountains and from Braşov, Gorj and Caraş-Severin counties, by the researchers Al. Beldie, M. Păun, St. Gurelean and Al. Borza.

The leaves of *F. drymeia* (Fig.5) have 2 mm width and have no ribs and furrows and stomata are distributed on both sides of leaf surfaces. Adaxial surface is smooth (Zarinkamar and Jouyandeh, 2011; Namaganda and Lye, 2008; Aryanvand and Panahi, 2003).

Festuca elatior species has 4 vouchers very well preserved, they were not harvested from our country, these vouchers were obtained by exchanges with or donations by other herbaria. The specimens were harvested in June and August between the years 1891 - 1910 by the researchers Heiland, Wolff and O.R. Holberg.

Festuca elatior L. (*F. arundinacea* Scribe.) (Fig.6) is one of the most widely used perennial, cool-season, bunch grasses in the world. It remains green in winter. It is tolerant of grazing and is superior to many other cool-season grasses (Botha et al. 2004; Hannaway et al, 1999; Bacon, 1995).



Fig.6. *Festuca elatior* - Flora der Mark



Fig.7. *Festuca fallax* from Bucegi Mountains

There are 22 vouchers very well preserved with *Festuca fallax* Thuill. Species (Fig.7). The specimens were harvested in June, July, August and September, between the years 1918 and 1967, from the Mountains: Bucegi (17 specimens), Retezat (1 specimen), Piatra Craiului (1 specimen), Rodnei (1 specimen) and from the counties Hunedoara (1) and Bistriţa Năsăud (1). Twelve

specimens were harvested by the researcher Al. Beldie, eight specimens by the naturalist M. Haret and two specimens by the botanist E.I. Nyarady.

Festuca fallax grows in drier and poor habitats in nutritive components. This species is useful covering some lands and protecting them against the erosion (Sawicki, 1999).

4. CONCLUSIONS

Due to the storage conditions, the majority of the *Festuca* specimens are good and very good preserved.

Storage the herbarium vouchers in very good condition is very important due to the role of herbaria to ensure the availability of flowering and fruiting plants to collect their pollen and seeds to be used in different domains such as: global change biology, ecophysiology, environmental chemistry, etc.

Moreover the herbarium can support restoration programs, by providing important information such as dates of occurrence, distribution, and about the habitat of an extinct species.

Few researches and botanists collecting plant species, were conscious about the potential of the herbarium species to be used in such different fields.

It is essential to continue the collection and preservation the specimens in herbarium due to many uses and due to the great potential that these biological collections have.

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