CASE STUDY ON THE EVALUATION OF MEDICINAL AND FOOD USE POTENTIAL OF WILD FLORA SPECIES – MONEASA AREA (ARAD COUNTY)

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Abstract

Of all ecosystems, those in mountain regions are most exposed to climate change and are difficult to assess. Studies to date show profound changes in vegetation composition, migration, and thermophilisation phenomenons. This is a concern because mountain ecosystems are an extremely important resource in terms of biodiversity and ecosystem services. In this study, the floristic inventory of some mountain regions in Romania was analyzed according to several criteria (taxonomic, ecological indices, bioforms, geographical range, etc.). Special attention was paid to plants with medicinal value, which were grouped according to the dominant active principles for which they are used in phytotherapy while analyzing their share in the plant cover. The study also includes data on species used in gastronomy and industry. The resulting data provide a basis for predicting possible responses of local flora to climate change and anthropogenic pressure, according to their physiological limits.

Keywords: *wild flora, medicinal plants, food plants, mountain ecosystems.*

INTRODUCTION

Evaluating the impact of climate change and conserving biodiversity represents a global level priority. The research and conservation measures should be focused not only on temperature rises and other stress factors but also on the synergies between the various pressures which together form the biggest challenge for biodiversity conservation today (Root *et al.,* 2003).

A study of reference and also the biggest study at a continental level with a high resolution regarding the impact of the XXI Century climate changes over biodiversity was done by Engler *et al.* (2011). One of the estimations shows that until 2070–2100, over 80% of the habitat will be lost for 36–55% of alpine species, 31–51% of the subalpine species, and 19–46% of the mountain species. The most affected are the species living at high altitudes (Engler *et al.,* 2011). The risk distributions are disproportional, the areas in which the warming comes along a drop in precipitations are more affected than the areas in which the warming is less pronounced and precipitations rise. The mountain ecosystems are particularly difficult to evaluate because they are disproportionally exposed to climate changes. Cumulated data from various studies show the ascending trend of plant distribution as a response to global warming. The fingerprint of climate changes is already discernable at a population level, and the direction of these changes complies with the predictions made based on the knowledge about plants' physiological restraints. The warming tendencies from the last 50 years and the plant's phenological responses are more accentuated towards the poles (Root *et al.,* 2003; Walther *et al.,* 2002). As a consequence, a species migration is anticipated, especially of thermophilous ones, in a process called termophilisation, taking place towards the poles and higher altitudes, respectively, between the limits of resources availability (Gottfried *et al.,* 1999; Walther *et al.,* 2002; Pauli *et al.,* 2012). The species that already live in these areas are in danger of extinction thanks to the gradual disappearance of living conditions, intense competition between species, and reduction of resources. The reaction of a living organism isn't towards the global averages but towards the local changes which are characterized by high spatial heterogeneity (Walther *et al.,* 2002). The fragmented habitats are most exposed, especially mountain habitats where the natural fragmentation is accentuated by the anthropical one (Stoica, 2017; Gottfried *et al.,* 1999, 2012; Root *et al.*, 2003; Walther *et al.,* 2002). The synergy between climate change and other stress factors disrupts the connection between species, leads to a reformulation of plant communities, and extinctions. The species response is different and asynchronous, the most affected being the species found in intimate interactions, in competition, and those exploited by humans. In this context, even the species that were previously considered without statistical significance, taken together, gain statistical significance (Root *et al.,* 2003). Engler's study holds a limited relevance in projecting risks over biodiversity in mountain systems because of pronounced microclimatic variations and doesn't allow the evaluation of specific dangers that species in different regions may face, making study cases indispensable. The majority of research that evaluates the climatic impact on plant distribution use distribution models. These are based on species observation in terms of presence or absence, abundance, environmental variables, and niche models of some species with potential distributions in the field.

In Romania, the first reference studies were done by Vădineanu *et al.* (2008), and continued by other specialists (Sârbu *et al.,* 2014; Piticar Michaiel, 2017). The comparative analysis of some Romanian mountain sites, performed between 1998–2005 shows 78% changes in the vegetation composition, particularly of subordinate and transition species (migration tendencies) (Vădineanu *et al.,* 2008). Romanian flora contains numerous endemic, rare, and endangered species, which must represent a priority of conservation measures. The mountain flora in particular is rich in medicinal and wild food plants. It is necessary to perform a multicriterial evaluation of flora, of the dangers it faces, to take protective measures and introduce rare and endangered plants in cultures, as well as to take specific exploitation measures for the species used by the local population.

In the analyzed area the highest altitude goes up to cca. 900m (Momuța Peak, 930 m). The lithologic structure is complex, composed of metamorphic, sedimentary, and magmatic rocks, in a veritable mosaic. Soil classes identified in these mountains include luvisol, cernisols, cambisol, protisol, and andisol (Pășcuț, 2012). The climate is characterized by the annual average temperatures of cca. 8°C, with variations between –2.1°C (January) and 16.9°C (July), and annual average precipitations of cca. 1,150 mm, reaching peaks in the May-June months (Moneasa Meteorological Station).

The vegetation of the Codru-Moma Mountain Massif made the topic of some of the oldest phytosociological Romanian studies led by Ana Paucă in the years 1940.

MATERIALS AND METHODS

For this study, we analyzed the cormophyte flora from the Moneasa area, Codru-Moma Mountains (southern half, the part from Arad county) (Figure 1), between the years 2015–2020. Determination of species was done mainly after Sârbu *et al.* (2013), and the species nomenclature respects *Flora Europaea, Med-Checklist*. Categories of bioforms, floristic elements, and autecological indices (humidity, temperature, soil reaction) are according to Sanda et al. (2003) and Sârbu *et al.* (2013). Medicinal species were considered the ones presented as such in the Romanian Pharmacopeia and European Pharmacopeia. Edible species were selected according to the works of Drăgulescu (1991) and Dénes *et al.* (2012).

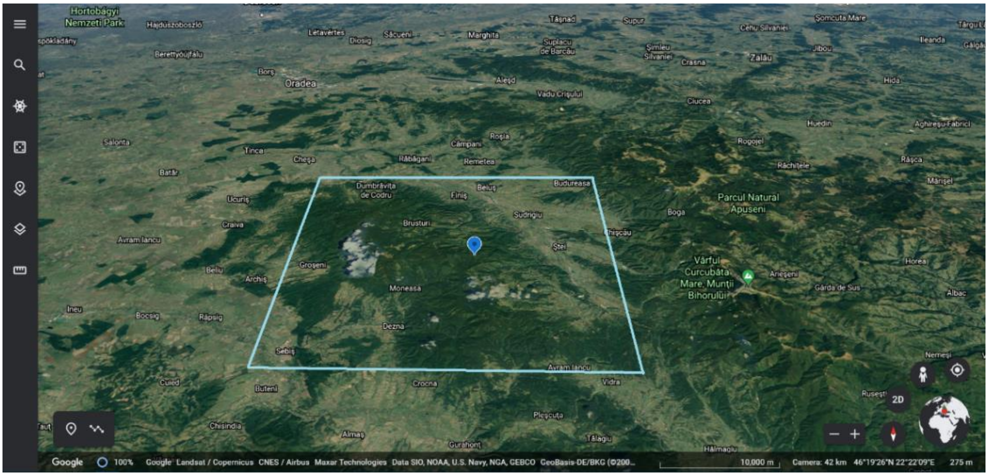

Fig. 1. Position and limits of the Codru-Moma Massif, after Buz in Pășcuț (2012)

Source: the authors – 2021

RESULTS AND DISCUSSIONS

In the area of study, we identified a total number of 396 species, belonging to 81 families. The best represented is the Asteraceae family (13.13% of the total identified species), along with other 6 families (Fabaceae, Lamiaceae, Poaceae, Scrophulariaceae, Apiaceae și Ranunculaceae). The rest of 74 families are individually represented by a much lower number of species. The complete list of families for which we identified species is composed of: Ageraceae, Iridaceae, Alismataceae, Juglandaceae, Alliaceae, Juncaceae, Amaranthaceae, Juncaginaceae, Amaryllidaceae, Lamiaceae, Apiaceae, Lemnaceae, Apocynaceae, Liliaceae, Araliaceae, Linaceae, Aristolochiaceae, Lythraceae, Asclepiadaceae, Malvaceae, Asparagaceae, Moraceae, Asphodelaceae, Najdaceae, Asteraceae, Oleaceae, Betulaceae (s.l.), Onagraceae, Boraginaceae, Orchidaceae, Brassicaceae, Orobanchaceae, Butomaceae, Oxalidaceae, Campanulaceae, Papaveraceae, Cannabaceae, Parnassiaceae, Caprifoliaceae, Pinaceae, Caryophyllaceae, Plantaginaceae, Celastraceae, Poaceae, Cistaceae, Polygalaceae, Chenopodiaceae, Polygonaceae, Convolvulaceae, Potamogetonaceae, Cornaceae, Primulaceae, Crassulaceae, Ranunculaceae, Cuscutaceae, Rutaceae, Cyperaceae, Rhamnaceae, Dipsacaceae, Rosaceae, Dryopteridaceae, Rubiaceae, Elaeagnaceae, Salicaceae, Equisetaceae, Santalaceae, Euphorbiaceae, Scrophulariaceae, Fabaceae, Solanaceae, Gentianaceae, Tiliaceae, Geraniaceae, Typhaceae, Haloragaceae, Urticaceae, Hyacinthaceae, Valerianaceae, Hypericaceae, Verbenaceae.

The overall ecological particularities of the cormoflora in the area of study allow the establishment of ecologic specificity of the vegetal cover. Concerning humidity, the majority of identified species are either xero-mesophyll (37.30%), or mesophyll (33.86%), so the flora in the area of study presents medium requirements for this factor (Figure 2).

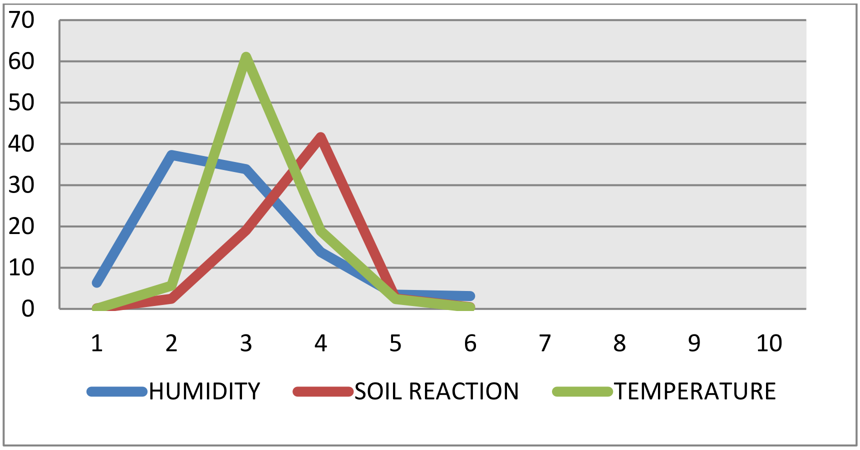

Fig. 2. The ecologic spectrum of humidity, temperature, and soil reaction for the cormoflora of Moneasa area (on the ordinate: percentage of the total number of species; on the abscissa: values of ecological indices

Source: the authors – 2021

In case the precipitation quantities drop, the majority of species here have average adaptability, the rest of 28.84% of species might be affected negatively. In relation to the temperature conditions, most elements belong to the continental-temperate climate. The most represented are micro-mesothermal elements (61.11%), medium thermophilous (17.19%), and eurythermal elements. Microthermal species are weakly represented (6.34%). Regarding the requirements for the soil reaction, almost half of the species are weakly acid-neutrophils (41.64%). A significant number of species are euryionic (33.42%), and acido-neutrophils (19.04%).

For the characterization of flora, the plant's biological forms highlight the traits of the biotope and the cumulated actions of environmental factors. Hemicriptophytes (58.31%) represent the main component of the herbal layer from forests and meadows and show the area's appurtenance to the temperate climate. Terophytes hold a secondary presence (18.99%).

The geographical-area analysis of flora has shown a large number of elements with different florogenetic origins in various proportions. Eurasiatic species are well represented (23.48%), to which in time other elements came along, like european (12.13%), paleotemperate (10.29%), eurosiberian (10.02%), circumboreal (<10%), ponto-pannonic (<10%) etc. (Table 1). The presence of a significant number of mediterranean species (9.76%) could be explained by some conditions from the postglacial period.

Table 1. The share of phytogeographical elements in the identified flora of the Moneasa area

Floristic elements	Number of species
Arct-Alp	1
Asiat	4
Circum-bor	31
Dac-balc	5
Eur	50
Trans (end)	1
Eua	91
Eur-Cauc	32
Med	37
Eurosib	39
Oroph	6
Paleot	39
Pont-Pann	22
Adv	8
Cosm	29

Species with medicinal value

Of the total of identified species (396), 164 are medicinal. They are found especially on the southern slopes, devoid of forests, where we have identified species like *Adonis vernalis, Dictamnus albus, Cichorium intybus, Iris germanica, Orchis morio, Salvia transsilvanica, Vinca herbacea*.

Depending on the main active principles for which these species are used in traditional medicine and phytotherapy, respectively, there were categorized as follows: 12.41% containing volatile oils, 12.19% tannins, 9.75% flavonoids, 8.53% mucilage, 7.92% coumarins. The species with anti-inflammatory and antioxidant activity are well represented. Other important medicinal categories include species containing saponins (7.31%), alkaloids (6.70%), iridoids (5.48%), phenol glycosides (4.87%), organic acids, vitamins, and provitamins (3.04%), anthocyanins (2.43%), anthraquinone derivates, glycoresines (1.21%), glycosides cardio-tonic (3.65%), bitter principles (2.43%), bitter-aromatic principles (4.26%), homoglycans, naphthodianthrones, senevolic glycosides, depsides, fatty oils, allantoin resins, sulphurous compounds, and fluoroglucine (0.60% each).

From the 164 medicinal species, 29 are used for vegetal products included in the Romanian Pharmacopoeia and European Pharmacopeia: *Achillea millefolium*, *Malva sylvestris, Agrimonia eupatoria*, *Matricaria recutita, Artemisia absinthium*, *Melilotus officinalis, Carum carvi*, *Ononis arvensis, Centaurium erythraea*, *Origanum vulgare, Chelidonium majus*, *Papaver rhoeas, Crataegus monogyna*, *Plantago lanceolata, Datura stramonium*, *Polygonum aviculare, Equisetum arvense*, *Primula veris, Filipendula ulmaria*, *Rosa canina, Frangula alnus*, *Salix alba,* *Hedera helix*, *Sambucus nigra, Humulus lupulus*, *Valeriana officinalis, Hypericum perforatum*, *Urtica dioica, Lythrum salicaria*.

The majority of these plants are still represented to a level that allows their rational harvest without the danger of extinction.

Wild food species

From the total of 396 species identified in the area of study, 129 are edible species, belonging to 49 families. Most species belong to the Asteraceae family (18 species – 14%), followed by Rosaceae (13 species), Lamiaceae (12 species), Fabaceae (9 species), Poaceae (8 species), Brassicaceae (7 species), Apiaceae (6 species), Polygonaceae (5 species), Boraginaceae, Caprifoliaceae, Plantaginaceae (3 species each). The rest of the families are represented only by 1–2 edible species.

From the Asteraceae family, the species Achillea millefolium, Artium lappa, Cichorium intybus, Cirsium arvense, C. canum, Galinsoga parviflora, Hypochoeris radicata, Leontodon hispidus, Matricaria recutita, Scorzonera purpurea, Taraxacum officinale, Tragopogon pratensis, and Tussilago farfara are used especially for their leaves and stems, in salads, soups, ciorba, stews, and sauces, or for seasoning. Species of Artemisia genus are alimentary-aromatic, used for preparing aromatic alcoholic beverages (absinthe, vermouth, wormwood wine), as well as condiment herb for fat meats (pork, goose). Flower buds of Bellis perennis and Tanacetum vulgare preserved in vinegar were used as caper surrogates in various dishes (Drăgulescu, 1991). From the Rosaceae family, different species are used mainly for their fruits, which enter the composition of various sweet products and aromatic alcoholic beverages (Sõukand et al. 2015). From Filipendula vulgaris the roots, rich in starch and tannins, are collected and consumed fresh or prepared like potatoes. The flowers can be used too, bearing a pleasant smell similar to orange blossoms (Drăgulescu, 1991). From among the Lamiaceae family, Crambe tataria is a species with a long history in traditional European gastronomy. The fleshy roots, rich in starch and sweet compounds, were used for preparing a Tatar bread; during the Roman era were cooked in milk in a dish called „Chara Caesarius". The sprouts are prepared similarly to asparagus and the leaves like spinach.

CONCLUSIONS

For the floristic inventory of the Moneasa area, we identified 396 species, belonging to 81 families. The majority of species belong to the Asteraceae, Fabaceae, Lamiaceae, Poaceae, Scrophulariaceae, and Apiaceae families, the rest being represented through a much lower number of species, which may be considered a vulnerability. The vegetation from the area of study has medium requirements towards humidity, temperature, and soil reaction factors. The herbal layer is dominated by hemicryptophytes and therophytes. From a geographic-area perspective, it was noticed a richness of elements of different origins, in various proportions, the eurasiatic species being dominant. Over one-third of species are medicinal, used mainly for their volatile oils, tannins, flavonoids, mucilages, coumarins, saponins, and alkaloids content. Collected rationally, they are present in a large enough percentage as to not pose a threat to their species survival. It is a suitable moment for the implementation of conservation measures and introduction in cultures. Out of the total identified species, 129 are edible, belonging to 49 families. Most edible species belong to Asteraceae, Rosaceae, and

Lamiaceae families. They are collected mainly for their aerial organs (leaves, stems, flower buds, fruits) that are used in various traditional products and dishes, presenting interest for the development of specific mountain products.

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