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**RARE VASCULAR FLORA AND MEDICINAL PLANT RESOURCES OF**  
**“SAHARNA” LANDSCAPE RESERVATION IN**  
**REPUBLIC OF MOLDOVA**

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**Abstract:** The research was conducted in order to identify and document the rare and threatened vascular plant species in the Landscape reservation “Saharna”, including the flora with medicinal properties. The spontaneous flora in studied area comprises 501 species of higher vascular plants of 345 genera and 85 families. Among them 263 plant species contain a wide variety of chemical compounds, making them important from pharmacological viewpoint, used to treat different ailments. There are 46 rare species revealed in the floristic composition, protected in Republic of Moldova, 7 of which are included in the Red Book of Romania. Others 20 species are protected in Ukraine. Six rarest and the most valuable taxa are included in the Red Book of the Republic of Moldova, 3rd edition.

**Keywords:** flora, ex-situ conservation, “Saharna” reservation, medicinal plants, Republic of Moldova

## INTRODUCTION

The conservation status of plants is one of most widely used indicators for assessing the condition of ecosystems and their biodiversity. It also provides an important tool in establishing priorities for species conservation. At the global scale, the best source of information on the conservation status of plants is the *IUCN Red List of Threatened Species*. The Red List is designed to determine the relative risk of extinction, with the main purpose of cataloguing and highlighting those taxa that are facing a higher risk of extinction. It provides taxonomic, conservation status and distribution information on taxa that have been evaluated using IUCN Red List Categories and Criteria: Version 3.1 [13, 14].

Medicinal plants are both a source of income and a source of affordable healthcare. In Republic of Moldova as a developing country, in some areas local healthcare needs are satisfied primarily using raw materials from medicinal plants. The collection of medicinal plants must be guided by an accurate knowledge of the biology of the species concerned, and steps must be taken to avoid over-exploitation, and the collection of rare or otherwise endangered species [16].

The breeding of medicinal plants with desirable agronomic and therapeutic chemical derivatives makes it possible to conserve and selectively utilize highly valuable *in-situ* germplasm and *ex-situ* germplasm in botanic gardens, and in field seed banks. Cultivation allows production of uniform materials whose properties can be standardized and from which crude drugs can be obtained unadulterated. Data on plants held in botanic gardens is most readily accessible and a useful starting point. However, the knowledge and collaboration with farmers and traditional health practitioners would be very helpful in identifying, implementing and managing future medicinal plant cultivation. Many medicinal plants grow well on marginal, remote and degraded lands with low monetary inputs. Intensive studies are needed on selected medicinal plants in order to determine optimum environmental requirements for sustainable production.

Introduction of medicinal plants, at present, takes on special importance because it allows one to enlarge the cultivated flora with new valuable species and to use wild useful plants in a more rational way. In this context accumulation and maintenance of medicinal plants in collections or herb gardens allows to reduce anthropogenic pressure on natural populations, creating a source of vegetal material for future reintroduction in their natural habitat in order to increase the number of populations. On the other hand, this objective let to obtain scientific outcome and practical requirements for introduction into the culture of therapeutically important species improving assortment of medicinal plants used in the national economy [11].

## MATERIALS AND METHODS

The research was conducted during 2007-2017 in the Landscape reservation “Saharna” situated in the north-eastern central part of Moldova (Rezina district). All selected plant species are native to local flora and the taxonomy followed by the recent taxonomical literature. [3, 5, 10, 19, 23] Voucher specimens of the plants are lodged in the Herbarium of Botanical Garden (Institute) of ASM (Chisinau). In parallel with the collection of the material for herbarium the specialty literature was studied.

The present account includes all the taxa that are listed under: Environmental legislation of the Republic of Moldova (1996-1998) [17]; The Red Book of the Republic of Moldova (3<sup>rd</sup> edition) [22]; Red Data Book of Ukraine [20]; Red Book of vascular plants of Romania [6]; under The Convention on International Trade in Endangered Species of Wild Fauna and Flora. [4]

The designation of Habitat type was made according to the Interpretation Manual of EU Habitats, Directive 92/43/EEC on the basis of scientific criteria defined in Annex III of the Directive. [12]

Studies for rare plant species acclimatization in *ex situ* conditions were carried out at the Experimental subdivision of the Collection of medicinal plants in the Botanical Garden (Institute) of ASM. The genetic resource mobilization of rare medicinal plants was achieved by collecting seeds and plant material from the indigenous flora during field expeditions. Phenological observations and biometric measurements were performed annually during the entire vegetation period according to widely used methodological guidelines [18].

## RESULTS AND DISCUSSIONS

Landscape reservation “Saharna” is a protected area of national interest, located in Rezina district, in vicinity of Saharna village (geographic coordinates: N 47°42'23"; E 28°56'55"; surface of the site is 674 hectares), territory in administration of Șoldănești Forestry. The reservation is located within the boundaries of the Euro-Siberian woods with *Quercus* spp. – \*9110 [12], belonging to the Continental Biogeographical Region of the European continent that covers over a quarter of the European Union and extends in a broad band from west to east, starting in central France and continuing to the eastern edge of Poland in the north and Romania in the south. Outside the EU it stretches to the Ural mountains, on the border with Asia. In the south, the region is almost split in two by the high mountain ranges of the Alpine zone and the steppic plains of the Pannonian Region. [8]

The climate is very continental, with a large temperature range. The substrate consists of ‘Loess’ (a sedimentary unconsolidated aleurite rock, unstratified, loose, with high porosity, generally having 12-25% calcium carbonates. [9] The following tree species – *Quercus robur* and *Q. petraea* dominate in the tree layer of this habitat type, which is rich in continental stepic vegetation species: *Achillea setacea* Waldst. et Kit., *Agrimonia eupatoria* L., *Ajuga genevensis* L., *Amoria fragifera* (L.) Roskov, *Astragalus glycyphyllos* L., *Ballota nigra* L., *Briza media* L., *Bromopsis inermis* (Leyss.) Holub, *Crataegus monogyna* Jacq., *Daucus carota* L., *Dianthus membranaceus* Borb., *Inula germanica* L., *Medicago falcata* L., *Melilotus albus* Medik., *Melilotus officinalis* (L.) Pall., *Otites moldavica* Klok., *Plantago lanceolata* L., *Poa angustifolia* L., *Potentilla impolita* Wahlenb., *Prunus spinosa* L., *Ranunculus polyanthemos* L., *Rosa canina* L., *Teucrium chamaedrys* L., *Thalictrum minus* L., *Thymus marschallianus* Willd., *Tragopogon major* Jacq., *Urtica dioica* L., *Verbascum lychnitis* L., *Verbascum speciosum* Schrad., *Veronica arvensis* L., *Vicia tenuifolia* Roth, *Vicia tetrasperma* (L.) Schreb., *Viola arvensis* Murr. etc.

The spontaneous higher vascular flora in studied area comprises 501 species, belonging to 345 genera and 85 families, most of which (57,9%) are forest and grassland (steppe) plants. The analyses show the following number of largest families: *Asteraceae* (with 63 species), *Lamiaceae* (40), *Fabaceae* (37), *Poaceae* (36), *Brassicaceae* (32), *Rosaceae* (25), *Apiaceae* (23), *Scrophulariaceae* (21), *Caryophyllaceae* (17), *Boraginaceae* (16),

*Ranunculaceae* (12), *Rubiaceae* (12) and *Violaceae* (with 11 species) make up 68,86% of the floristic richness.

Among the ecotopologic elements (figure 1) predominate steppe and sylvestrian species comprising more than half (57,68% – 289 species) of all groups of taxa growing in the surveyed area. This amount is represented by: the typical steppe species (149 species) and those of *Quercus* spp. forested habitats (140 sp.). The share of other groups is irrelevant, except of ruderal weeds, with total number of 125 species (24,95%), which disclose the disturbance nature of this particular habitat.

The geographic component of studied flora is referred to 13 types of floristic elements (figure 2). The prevalent is Eurasian element, which sums up – 42% (212 species). A significant proportion 25% (123 sp.) of European and Mediterranean-European species. They are mostly sylvestrian species. The southern geoelements (Pontic, Pontic-Mediterranean, Mediterranean-pontic-sarmatian, Pannonian-Pontian, Pannonian-Sarmatian, etc.), characteristic of steppe and petrophytic biotopes, are represented by 107 species (25%). The share of circumboreal (7%), adventive (3%) and cosmopolitan (2%) is insignificant.

The main characteristic value of the territory is the fact that it supports species at the boundaries of their natural distribution areas. An analysis of the geographical distribution of species of the site showed that 39 species are growing in the region at the limits of their distribution areas (figure 3). A number of 11 species are of arid regions: *Arum orientale* Bieb., *Astragalus glaucus* Bieb., *Astragalus glycyphyllos* L., *Aurinia saxatilis* (L.) Desv., *Centaurea marschalliana* Spreng., *Centaurea trinervia* Steph., *Galanthus nivalis* L., *Hyacinthella leucophaea* (C. Koch) Schur, *Oberna schottiana* (Schur) Tzvel., *Piptatherum virescens* (Trin.) Boiss., *Stipa lessingiana* Trin. et Rupr., with the northern limit of distribution area.

There are twenty-two species – *Actaea spicata* L.,

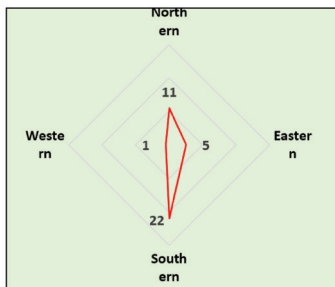


Figure 3. Representation of species (% of total)

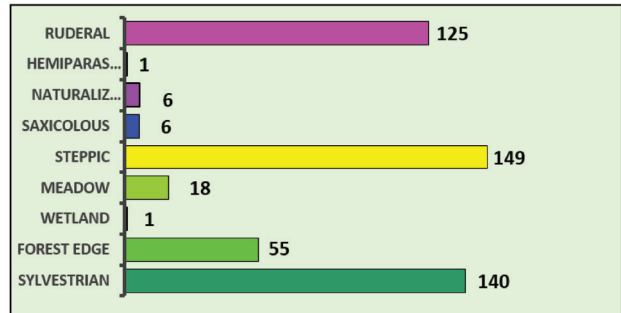


Figure 1. Ecotopologic species component (by number of taxa)

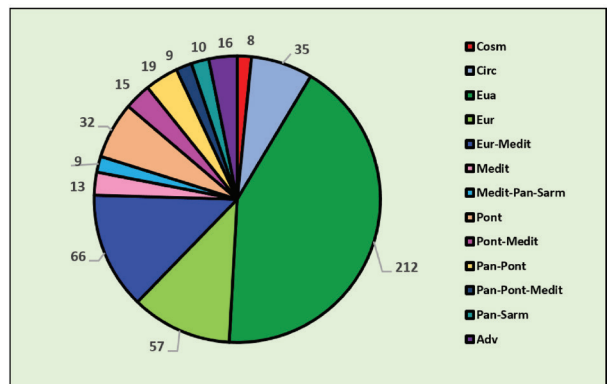


Figure 2. The distribution of species by types of floristic elements

*Anemonoides ranunculoides* (L.) Holub, *Asarum europaeum* L., *Carex alba* Scop., *Carex humilis* Leyss., *Cleistogenes bulgarica* (Bornm.) Keng, *Dentaria bulbifera* L., *Dictamnus albus* L., *Dryopteris filix-mas* (L.) Schott, *Equisetum telmateia* Ehrh., *Fragaria vesca* L., *Helianthemum nummularium* (L.) Mill., *Lilium martagon* L., *Melampyrum nemorosum* L., *Melica nutans* L., *Minuartia setacea* (Thuill.) Hayek, *Omphalodes scorpioides* (Haenke) Schrank, *Phyllitis scolopendrium* (L.) Newm., *Scrophularia vernalis* L., *Stipa pennata* L., *Stipa pulcherrima* C. Koch found on the southern limit of distribution, thus their main areas mostly expand to the north, north-west and north-east of the region. On the western there is one species – *Anthemis subtinctoria* Dobroc. and on the eastern borders, there are 5 taxa – *Carpinus betulus* L., *Glechoma hirsuta* Waldst. et Kit., *Millium vernale* Bieb., *Sorbus torminalis* (L.) Crantz

and *Viola alba* Bess.

There are 46 rare taxa protected by the state in the Republic of Moldova [17]:

- 7 species of category II – *Amygdalus nana* L., *Asparagus officinalis* L., *Asparagus tenuifolius* Lam., *Helichrysum arenarium* (L.) Moench, *Platanthera bifolia* (L.) Rich., *Seseli tortuosum* L., *Veratrum nigrum* L.;
- 2 species of category II-III – *Galanthus nivalis* L. and *Phyllitis scolopendrium* (L.) Newm.;
- 9 species of category IV – *Cerastium glutinosum* Fries, *Cotoneaster melanocarpus* Fisch. ex Blytt, *Dryopteris filix-mas* (L.) Schott, *Goniolimon besserianum* (Schult.) Kusn., *Lathyrus venetus* (Mill.) Wohlf., *Lonicera xylosteum* L., *Scrophularia vernalis* L., *Staphylea pinnata* L., *Tulipa biebersteiniana* Schult. et Schult. fil.;
- 16 species of category VIII – *Actaea spicata* L., *Asparagus verticillatus* L., *Asplenium ruta-muraria* L., *Asplenium trichomanes* L., *Aurinia saxatilis* (L.) Desv., *Cystopteris fragilis* (L.) Bernh., *Epipactis helleborine* (L.) Crantz, *Hyacinthella leucophaea* (C. Koch) Schur, *Iris pumila* L., *Lilium martagon* L., *Neottia nidus-avis* (L.) Rich., *Scorzonera purpurea* L., *Sorbus torminalis* (L.) Crantz, *Stipa lessingiana* Trin. et Rupr., *Stipa pulcherrima* C. Koch, *Stipa pennata* L.

Six rarest and the most valuable species are included in the Red Book of the Republic of Moldova, 3rd edition [22]: 1 species of category Critically Endangered (CR) – *Monotropa hypophegea* Wallr.; 2 species categories Endangered (EN) – *Cotoneaster melanocarpus* Fisch. ex Blytt, *Phyllitis scolopendrium* (L.) Newm.; and 3 species of category Vulnerable (VU) – *Galanthus nivalis* L., *Dryopteris filix-mas* (L.) Schott and *Nepeta parviflora* Bieb.

In the Operational Checklist of threatened and extinct species of the Republic of Moldova [7, 15, 21], created with the development of the Concept of National Ecological Network of the Republic of Moldova [1, 2, 7] there are 35 species included (Figure 4).

Some of the registered in the site species are also rare in the neighboring countries. For example, there are 7 species of plants included in the Red Book of Romania [6] – *Caragana frutex* (L.) C. Koch, *Centaurea trinervia* Steph., *Meniocus linifolius* (Steph.) DC., *Nepeta parviflora* Bieb., *Otites exaltata* (Friv.) Holub, *Seseli tortuosum* L., *Symphytum tauricum* Willd. Twenty species are included in the Red Book of Ukraine [20]: *Allium ursinum* L., *Arum orientale* Bieb., *Astragalus glaucus* Bieb., *Carex alba* Scop., *Dictamnus albus* L., *Epipactis helleborine* (L.) Crantz, *Galanthus nivalis* L., *Lathyrus venetus* (Mill.) Wohlf., *Lilium martagon* L., *Neottia nidus-avis* (L.) Rich., *Platanthera bifolia* (L.) Rich., *Scrophularia vernalis* L., *Sorbus torminalis* (L.) Crantz, *Staphylea pinnata* L., *Stipa capillata* L., *Stipa lessingiana* Trin. et Rupr., *Stipa pennata* L., *Stipa pulcherrima* C. Koch, *Tulipa biebersteiniana* Schult. et Schult. fil. and *Viola alba* Bess.

The field investigations and the survey of the scientific references allowed identifying 263 plant species in the area that contain a wide variety of chemical compounds making them very important from pharmacological point of view. The most representative families are *Asteraceae* (32 species), *Lamiaceae* (29), *Rosaceae* (19), *Brassicaceae* (19) and *Fabaceae* (15 species). Most of them are herbaceous, mainly perennial plants. The raw materials are used in many different forms: fresh, powdered, infusions, decoctions, tincture etc. In the most of the cases the vegetal matter is used as infusion. The most important medicinal properties of species in the area are anti-inflammatory, astringent, expectorant, diuretic, cholagogue, hypotensive, cicatrizing. The vast majority of them are mainly used for the diseases related to digestive system followed by urinary and respiratory disorders.

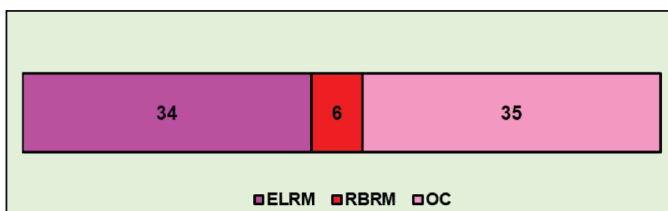


Figure 4. Representation of rare species protected on National level in Republic of Moldova (ELRM – Ecological Legislation of Republic of Moldova, RBRM – The Red Book of Republic of Moldova, OC – Operational Checklist)

Table 1.

## Threatened medicinal species in "Saharna" reservation

Plant Family	Species	ELRM	RBRM	OC	RBVPR	RDBU	CITES	Medicinal properties
Alliaceae	<i>Allium ursinum</i> L.					+		antiviral, antibacterial, antiseptic, tonic, vermifuge
Amaryllidaceae	<i>Galanthus nivalis</i> L.	III	VU	+		+	II	emmenagogue
Araceae	<i>Arum orientale</i> Bieb.					+		sedative, hemostatic, cicatrizing
Asparagaceae	<i>Asparagus officinalis</i> L.	II		+				antispasmodic, cardiac, diuretic, demulcent
Asparagaceae	<i>Asparagus tenuifolius</i> Lam.	II		+				young shoots used as vegetable
Asparagaceae	<i>Asparagus verticillatus</i> L.	VIII		+				young shoots used as vegetable
Aspleniaceae	<i>Asplenium ruta-muraria</i> L.	VIII						astringent, ophthalmic, emmenagogue
Aspleniaceae	<i>Asplenium trichomanes</i> L.	VIII						expectorant, laxative, emmenagogue
Aspleniaceae	<i>Phyllitis scolopendrium</i> (L.) Newm.	III	EN	+				purgative, astringent, analgesic, hemostatic
Asteraceae	<i>Helichrysum arenarium</i> (L.) Moench	II		+				cholagogue, diuretic, stomachic, skin
Athyriaceae	<i>Cystopteris fragilis</i> (L.) Bernh.	VIII						anthelmintic
Berberidaceae	<i>Berberis vulgaris</i> L.			+				antibacterial, antirheumatic, cholagogue, hepatic
Brassicaceae	<i>Aurinia saxatilis</i> (L.) Desv.	VIII						kidney and urinary affections, cicatrizing
Dryopteridaceae	<i>Dryopteris filix-mas</i> (L.) Schott	IV	VU	+				anti-inflammatory, anti-rheumatic, antiviral
Lamiaceae	<i>Calamintha nepeta</i> (L.) Savi			+				antibacterial, diuretic, gastric, sedative
Lamiaceae	<i>Nepeta parviflora</i> Bieb.		VU		EN			antioxidant, anti-inflammatory
Liliaceae	<i>Lilium martagon</i> L.	VIII		+		+		cardiac, expectorant, diuretic, emollient,
Melanthiaceae	<i>Veratrum nigrum</i> L.	II		+				analgesic, vermifuge, emetic, expectorant
Orchidaceae	<i>Platanthera bifolia</i> (L.) Rich.	II				+	II	purgative, hipotensive, diaphoretic

<i>Ranunculaceae</i>	<i>Actaea spicata</i> L.	VIII		+				sedative, purgative, hipotensive, antimalaric
<i>Rosaceae</i>	<i>Amygdalus nana</i> L.	II		+				simulates respiration and improves digestion
<i>Rosaceae</i>	<i>Sorbus torminalis</i> (L.) Crantz	VIII		+		+		anti-rheumatic, hypoglycemic
<i>Staphyleaceae</i>	<i>Staphylea pinnata</i> L.	IV		+		+		seeds are edible

In the Table 1 the rare medicinal plants are given in alphabetical order, each with the indication of the list (or lists) which it is included in, as follows: Environmental Legislation of the Republic of Moldova – ELM; The Red Book of the Republic of Moldova (3rd edition) – RBRM; Operational Checklist – OC; Red Data Book of Ukraine – RDBU; under The Convention on International Trade in Endangered Species of Wild Fauna and Flora – CITES; and therapeutic effects.

Some rare and threatened therapeutically important species (*Amygdalus nana* (Box 1, Photo 1), *Asparagus officinalis*, *Dryopteris filix-mas*, *Galanthus nivalis* (Box 1, Photo 2), *Helichrysum arenarium* (Box 1, Photo 3), *Lilium martagon*, *Nepeta parviflora* (Box 1, Photo 4), *Veratrum nigrum*, etc.) were brought and are cultivated in *ex-situ* conditions in the collection of Medicinal plants of Botanical Garden (I) of ASM (Figure 5) in order to protect them and to observe their reproductive behavior and accumulate experience on their agro technology.

The field investigation concluded that biological indicators of populations are increasingly deteriorating and all these taxa became threatened with extinction. The *ex-situ* conservation in the Botanical Garden (I) of ASM is a significant way to preserve these endangered species and to accumulate experience on their behavior in culture conditions.

Recognizing the need for medicinal species preservation it has been initiated a research program referring

#### Box 1. Threatened therapeutically important species the Landscape reservation “Saharna”



Photo 1. *Amygdalus nana* L.



Photo 2. *Galanthus nivalis* L.



Photo 3. *Helichrysum arenarium* (L.) Moench



Photo 4. *Nepeta parviflora* Bieb.

to their *ex-situ* conservation. The analyzed taxa were planted in the collections of the Botanical Garden in similar conditions of natural habitat.



Figure 5. Collection of medicinal plants  
(experimental subdivision)

The investigations regarding cultivation of these species were carried out at the experimental fields in the Botanical Garden. Adult plants were transplanted from their native populations under similar ecological conditions. Investigations include propagation aspects and research into cultivation techniques and conservation methods. In *ex situ* conditions the studied rare species undergo a complete ontogenetic cycle, which demonstrates their ecological plasticity, high adaptive potential and *ex situ* conservation perspective.

## CONCLUSION

The spontaneous higher vascular flora in Landscape reservation “Saharna” comprises 501 species, belonging to 345 genera and 85 families. There are 46 rare taxa registered, protected by the state. Six rarest and the most valuable species are included in the Red Book of the Republic of Moldova (3rd ed.): *Monotropa hypophegea*, *Cotoneaster melanocarpus*, *Phyllitis scolopendrium*, *Galanthus nivalis*, *Dryopteris filix-mas* and *Nepeta parviflora*.

The field investigations and the survey of the scientific references allowed identifying 263 medicinal plant species. The most valuable from pharmacological point of view are introduced to the Experimental subdivision of the Collection of Medicinal plants.

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