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IN SITU AND *EX SITU* CONSERVATION MEASURES FOR THE THREATENED SPECIES *POTENTILLA ASTRACANICA* JACQ. IN THE REPUBLIC OF MOLDOVA

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Abstract

This study of in situ and ex situ activities is aimed at the effective protection of populations of Potentilla astracanica Jacq. - an endangered Eurasian species that grows spontaneously in countries such as Romania, Bulgaria, Türkiye, Southern Ukraine, and South-Eastern Russia. In the Republic of Moldova, it is at the northern limit of its distribution area and is protected by Law, by inclusion in the Red Book of the Republic of Moldova, 3rd edition. Potentilla astracanica was identified in the local flora only in the southeast and southwest of the country. Our investigations in the species' habitat have demonstrated that the numerical strength of the populations is very low and consists mainly of mature specimens that grow solitary, but also in small groups of 2-3 specimens. In order to establish viable and sustainable populations of Potentilla astracanica, it is necessary to cultivate an effective species through conservation actions in natural habitats, but also by strengthening existing populations. Therefore, a series of measures to improve in situ conditions is imperative, as well as the identification of new specific habitats for its repatriation actions.

Key words*: Potentilla astracanica, rare taxa, habitat, repatriation, population.*

INTRODUCTION

A thorough knowledge of the biological specificity and ecological preferences of rare species, as well as their constant monitoring, allows us to identify the factors that influence their existence and helps us to develop more effective conservation strategies and measures. *Potentilla astracanica* Jacq. is an endangered Eurasian species, which grows spontaneously in countries such as Romania, Bulgaria, Türkiye, Southern Ukraine, and South-Eastern Russia (Figure 1) (POWO). The habitat of the species is represented by steppe slopes, pubescent oak forests, shrubberies, and forest edges, dry, rocky, and sandy places, limestone outcrops, sands, granites, and shales. Subendemic species. Due to the specific habitat, in all these countries the numerical population is reduced, and in Romania, *Potentilla astracanica* is included in the The red list of higher plants in Romania (Oltean, Negrean et al., 1994). In the Republic of Moldova, it is at the northern limit of its distribution area, having a dispersed and fragmented distribution, being found in the South-West of the country on the loess hills of the Emerald Site "Lower Prut," with three growing points, and in the South-East of the republic, with a single growing point in the Emerald Site "Lower Nistru". The low number of individuals and the fragmented distribution on the territory of the Republic of Moldova determined the inclusion of this species in the 3rd edition of the Red Book of the Republic of Moldova, being classified in the Endangered category [EN] (Tofan-Dorofeev, 2015).

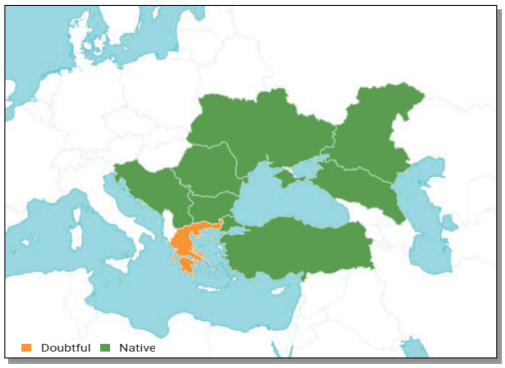

Figure 1. The distribution range of the species Potentilla *P. astracanica* Jacq.

Potentilla astracanica Jacq. grows spontaneously in the flora of the Republic of Moldova in glades

and forest edges among phytocenoses of subarid downy oak thickets, scrublands, and slopes with steppe vegetation. Populations of the species have been identified only in the northwest of the Răscăieți commune in the Ştefan-Vodă district and in the communes of Giurgiulesti, Văleni, Slobozia Mare, and Cîşliţa-Prut in the Cahul district (Figure 2).

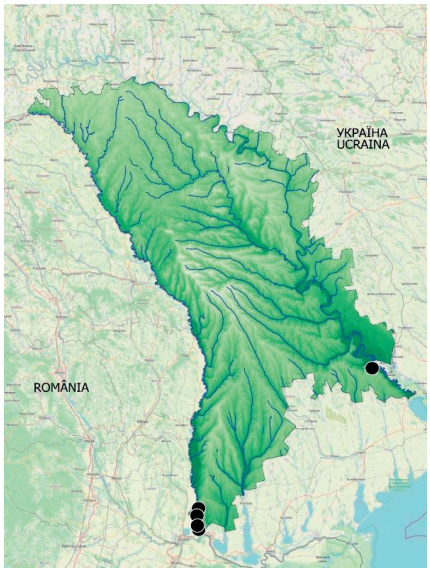

Figure 2. Geografical location of the species *P. astracanica* Jacq. in the Republic of Moldova

Investigations carried out by us in the habitat of the species have shown that the numerical strength of the populations in all the places of growth is very low and is mainly made up of mature specimens, which grow solitary, but also in small groups. Our monitoring has established that, although the size of the populations is extremely small, the number of individuals remains constant from one year to the next. However, it was found that the condition of the habitats in all sites is precarious due to various pressures, the plants being strongly affected by drought, intensive grazing, but also by soil erosion, which has been increasingly severe in recent years. The biological particularities and environmental requirements of the species, combined with the existing threats to its populations and habitats, determine the need for prompt protection measures. In order to have viable and sustainable populations of *Potentilla astracanica*, it is necessary to increase the number of the species through repopulation and conservation activities in its natural habitats, as well as the consolidation of existing populations. Therefore, a series of measures to improve the *in situ* conditions is imperative, as well as the identification of new specific habitats for its repatriation actions. Thus, within the project "Research and *ex situ* and *in situ* conservation of plant diversity in the Republic of Moldova", we aim to offer solutions for the efficient protection of *P. astrachanica* populations by applying *in situ* and *ex situ* activities that consist of actions to strengthen existing populations, but also the creation of new populations in natural habitats and/or by repatriating them to previously known growth sites.

MATERIALS AND METHODS

The present study was conducted during 2023-2025 and was based on the populations of *P. astrachanica*, a rare species on the territory of the Republic of Moldova. The seeds were collected in the summer of 2022 from the natural habitat near Slobozia Mare, Cahul district. The seeds were germinated on filter paper in Petri dishes without prior processing. After germination, they were transferred to chernozem (black soil) mixed with peat in a ratio of 3:1, in seedling trays for one month, after which they were taken out of the greenhouse for growth and acclimatization to outdoor conditions. The exact location of the sites was determined using Google Maps. Population parameters were established on site according to accepted methods (Akeroyd and Jackson, 1995; IUCN Guidelines for Re-introductions, 1998, Godefroid et al., 2011; Gorbunov et al., 2008), and the detailed description is based on collected live plants, but also on data from the specialized literature (Nicolayeva, 1986; Tofan-Dorofeev, 2020). The general distribution, chorology, ecology, and phytocoenology of the species *P. astrachanica* were established by the authors, supported by data from the specialized literature (Gibbs, 1972; Nicolayeva, 1986; POWO). The conservation status of the species was assessed according to the methodology (Combroux & Schwoerer, 2007). Taxon identification was performed using the determiner (Negru, 2009).

RESULTS AND DISCUSSIONS

In the flora of the Republic of Moldova, *P. astracanica* grows on steppe slopes in priority habitats with conservation value represented by steppe meadows – 62C0* Ponto-Sarmatian steppes and habitats with shrub and forest edges – 40C0* Ponto-Sarmatian deciduous shrubs (Interpretation ... 2013). Within the Emerald Site "Lower Prut", *P. astracanica* grows on a very rugged relief consisting of loess hills with quite steep southwest and west exposures, in some places up to 45 degrees, rising to almost vertical walls, with numerous ravines washed by water and landslides. To reduce the pronounced erosion, some slopes are planted with allogeneic tree species - *Robinia pseudacacia*, *Elaeagnus angustifolia,* and *Gleditschia triacanthos* L. On these slopes, together with *P. astracanica*, a rich flora grows, consisting of significant populations of rare plants, including species included in the Red Book, such as: *Ephedra distachya* L., *Scorzonera mollis* M. Bieb., *Convolvulus cantabrica* L., *Allium guttatum* Stev., *A. inaequale* Janka, *Ornithogalum amphibolum* Zahar. The populations of the species in this location are in an unfavourable conservation status, taking into account the small number of specimens and the significant pressures affecting the species' habitat, related to the presence of intensive grazing and its ruderalization. Also, the habitat around the Slobozia Mare locality is subject to a potential negative impact caused by the construction of a viewing platform. The other locations in the Site are used as pastures, but, due to landslides and difficult accessibility, these areas where the species studied grows have recently become impracticable for grazing, which offers some protection to the habitat. The population of *P. astracanica* in the South-East of the Republic of Moldova is located on the steppe hills of the lower Dniester, near the Răscăieți commune, Ștefan-Vodă district, which grows on a slope with a southwest exposure, alongside other valuable species such as *Achillea coarctata* Poir., *Amigdalus nana* L., *Asparagus verticillatus* L., *Allium paniculatum* L., *Hyacinthella leucophaea* (K. Koch) Schur, *Helichrysum arenarium* (L.) Moench, *Crocus reticulatus* Stev. ex Adams. The population of this site is in real danger of extinction caused by the construction of a pilgrimage site and landslides that have created gaps in the vegetation where ruderal and weed species are invading.



Figure 3. *P. astracanica* Jacq. in natural habitat near Slobozia Mare locality, Emerald Site "Lower Prut"

Potentilla astracanica is a herbaceous, perennial plant. The entire plant is densely villous, with long, soft, and patent hairs mixed with short hairs, as well as with long glandular hairs. Erect stems 10-30 cm tall, thick. Lower basal and cauline leaves long-petiolate, 5-foliolate, upper ones subsessile, ternate. Leaflets oblong-oblanceolate to obovate, serrate. Stipules of the lower leaves are cuneate, often untoothed; those of the upper cauline leaves are lanceolate. Inflorescence corymbiform. Flowers are short-pedicellate, actinomorphic, bisexual, 20-40 mm in diameter. The lacinia of the inner calyx are triangular-ovate; the lacinia of the outer calyx are triangular-lanceolate, long-acuminate, 2 times longer than the lacinia of the inner calyx, but

with the base of the same-width base. Petals broadly obcordate, by the length of the outer sepals, pale yellow. Androecium composed of about 30 stamens. Carpels numerous, cylindrical. Style conical. Fruit ovoid, broadly carinate, wrinkled nutlets. Pontic hemicryptophyte. Xeromesophilic, moderately thermophilic, drought-resistant, photophilous, weakly acid-neutrophil species; prefers xerophytic forest chernozems. It blooms from late April to June; it is pollinated by insects. The fruits ripen towards the end of June to July. Decorative species (Figure 3).

The loss of habitats and the reduction in their surface area, determined by anthropogenic impact but also by climate change in recent decades, have led to the initiation of *ex situ* conservation actions, by collecting seeds and multiplying the species, with the aim of consolidating existing populations. Thus, in the summer of 2023, a series of field investigations were carried out to assess the conservation status of the species, to collect seed material, and to identify potential habitats for the creation of new populations. The population around the commune of Slobozia Mare was taken into study as the “donor population” from which seeds were taken; geographical coordinates: 45°35'35.3"N, 28°09'50.0"E. It occupies an area of about 500 m2 and consists of about 30 generative specimens that grow isolated and in small groups of 2-3 phytoindividuals. The habitat of the species is represented by primary steppe communities with *Stipa capillata* L., *Stipa lessingiana* Trin. et Rupr., *Stipa ukrainica* P. Smirn., *Festuca valesiaca* Gaudin, with companion species such as *Poa bulbosa* L., *Euphorbia cyparissias* L., *Linum austriacum* L., *Medicago falcata* L., *Muscari neglectum* Guss. ex Ten., *Falcaria vulgaris*, *Teucrium chamaedrys* L., *Sideritis montana* L., *Thymus marschallianus* Willd., *Gagea ukrainica* Klokov, *Allium paniculatum* L., *Allium rotundum* L., *Eryngium campestre* L., *Marrubium peregrinum* L., including rare species *Hyacinthella leucophaea* (K. Koch) Schur, *Helichrysum arenarium* (L.) Moench, *Achillea coarctata* Poir., *Iris pumila* L., *Crocus reticulatus* Stev. ex Adams, *Amygdalus nana* L.

In the spring of 2024, the previously collected seeds were germinated in Petri dishes on filter paper soaked in distilled water. 100 seeds were placed in each Petri dish, and after 7 days 93% of the seeds germinated (Figure 4). The seedlings were transferred to a substrate of black soil and peat in a ratio of 3:1. As the seedlings developed, they were placed in the shade and watered regularly until they adapted. After 30 days of growth and adaptation, the plantlets were transferred to the experimental sector of the National Botanical Garden (Institute) "Alexandru Ciubotaru" (GBNI).

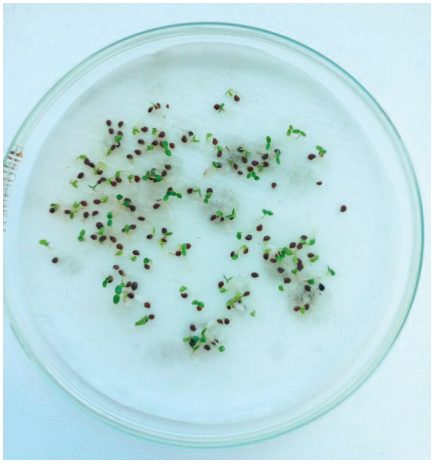

Figure 4. *P. astracanica* seed germination

The plants developed rapidly, and in the summer of 2025 several specimens bloomed (Figure 5). In the autumn of the same year, 20 specimens were extracted with a soil ball and translocated to a natural habitat previously identified during field expeditions. The habitat chosen for the creation of a new population was selected taking into account the distribution area of the species, the history of its detection in nearby locations or, at least, in the given area, the presence of compatible species, and the area with protection status. Thus, the location chosen by us is part of the Emerald Site “Lower Nistru". Thus, we opted for a clearing in a pubescent oak forest, near the village of Grădinița, Căușeni District, geographical coordinates: 46°39'02.5"N, 29°35'31.5"E.

The selected habitat is in the proximity of the *P. astracanica* population from the vicinity of the Rascaieti commune and represents a pubescent oak clearing (species-specific habitat) with Ponto-Sarmatian steppe vegetation that corresponds to the Habitat of Community

Interest – 91AA* Ponto-Sarmatian Forest vegetation with pubescent oak. In the gaps formed by oaks, the vegetation cover is dominated by *Stipa lessingiana* Trin. et Rupr., *Stipa penata* L., *Melica transilvanica* Schur, *Thymus marchallianus* Willd., *Salvia nutans* L., *Hypericum perforatum* L., *Betonica officinalis* L., including rare species protected by law: *Amigdalus nana* L., *Asparagus verticillatus* L., *Adonis vernalis* L., *Pulsatilla montana* (Hoppe) Reicheinb., *Crocus reticulatus* Stev. ex Adams., *Iris hungarica* Waldst. et Kit. (Figure 6).



Figure 5. *P. astracanica* in the experimental plot of the "Al. Ciubotaru" National Botanical Garden (I)

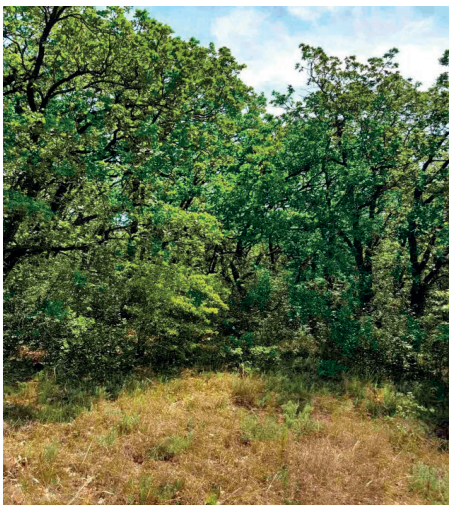

Figure 6. Habitat selected for the creation of a new population of *P. astracanica*

In the following period, the newly established population will be monitored to assess the capture rate, growth, and survival of individuals, as well as possible interactions with environmental factors and other species in the habitat. Most likely, we will complete the population with new specimens in the following period to consolidate the population and increase the number of individuals. Our goal is to integrate the species into the respective habitat and contribute to the long-term conservation of the species under study.

At the same time, for the *ex situ* conservation of the *P. astrachanica* species, in the spring of 2025 an experimental collection was established on the plot designated for conservation studies within the GBNI. This collection represents an important element in the conservation plan, with the role of ensuring the maintenance and multiplication of the biological material of the species under controlled conditions, outside its natural habitat. The plants grown in this collection can be used to consolidate existing populations of the *P. astrachanica* species, but their main role is to serve as "seed-source plants." Seeds will be periodically harvested from these specimens, which can be preserved in the gene bank, or will be used to produce new seedlings under *ex situ* conditions. Thus, we will have planting material at hand for actions to reintroduce the species into the natural habitats from which it has disappeared in recent decades, thereby contributing to the restoration of natural populations and the restoration of the balance of affected habitats. We also intend to strengthen existing natural populations by introducing new specimens obtained under *ex situ* conditions in order to increase the density and stability of these populations. At the same time, research will be oriented towards identifying and analysing the limiting factors that have determined the decline of *P. astrachanica* populations in natural habitats. These factors may include habitat degradation, changes in land-use designation, anthropogenic pressure, competition with other species, especially alien ones resulting from tourism, and, last but not least, the influence of climate change. In this context, studies will aim to both assess the ecological conditions of the species' historical habitats and identify the management measures necessary for their restoration and protection.

The results of this research will contribute to the development of effective conservation and management strategies aimed at ensuring the long-term survival of the species in the spontaneous flora.

CONCLUSIONS

P. astracanica is a rare species in the Republic of Moldova and is included in the Red Book of the Republic of Moldova, 3rd ed., with the category Endangered [EN]. Most of the populations are located in the South-West of the country, while in the South-East there is only one population. The populations of the species are not very large in terms of area, and the main threat factors for the *P. astracanica* species are the destruction of the habitat caused by various anthropogenic factors, such as overgrazing and uncontrolled tourism, as well as soil erosion and climate change in recent years. It is necessary to respect the protection regime in the Emerald sites where the species grows, as well as to reinforce and strengthen existing populations. As a result of the study, the habitat of the species in the vicinity of Slobozia Mare was investigated, its condition was assessed, which has a high potential for conservation actions. A new population was established in the South-East of the country, which will be monitored over the next 10 years to assess the success of this initiative. An experimental plot was established within the GBNI for conservation and research under *ex situ* conditions, as well as for its use as a seed source, which will allow us to systematically collect data on phenology, productivity, and seed viability, contributing to the development of protocols for the conservation and multiplication of the *P. astracanica* species. The seeds obtained can be subsequently used for reintroduction or fortification of existing populations, or even in ecological restoration programs.

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