

# Medicinal plants in the Ropotamo Reserve and coastal biodiversity conservation

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**Abstract:** The Ropotamo Reserve is located in southeastern Bulgaria on the Black Sea coast and has been recognized as a wetland of international importance according to the Ramsar Convention of Wetlands, as a nationally significant wetland and as a part of Natura 2000 network protected area. The main goal of the present study was to identify the diversity of medicinal plants and the state of the habitats in regard to their protection as a part of the coastal biodiversity. Totally 550 vascular plants were identified and 199 of them were medicinal plants from 171 genera and 63 families. The medicinal plants were enlisted in the Supplement 1 of the Bulgarian Medicinal Plants Act. Five species with high conservation status were included as Endangered in the Red Data Book of the Republic Bulgaria, 13 species were in the Red List of Vascular Plants in Bulgaria, 16 species were in the Biological Diversity Act, one was in Bern Convention and four were in CITES. The Reserve territory and protective regime favor the conservation of the flora complex, but yet the medicinal plants there have a medium to high degree of vulnerability to the anthropogenic impact and to the processes occurring in the habitats. Some species were characterized by medium to high degree of rarity in the country.

**Key words:** Protected species, habitats, risk assessment, Black Sea coast, Bulgaria

## Introduction

From floristic point of view, the Ropotamo Reserve is one of the most interesting in Bulgaria. Its territory combines in a unique way the landscape diversity with natural beauty and it was recognized as a wetland of international importance according to the Ramsar Convention on Wetlands, as a nationally significant wetland complex and as a part of Natura 2000 network protected area (MICHEV & STOYNEVA 2007, VASSILEV et al. 2013). The Reserve is characterized by the diversity of habitats (e.g. dense forests along the river banks, swamps, rocky shores, dunes, open spaces and oak forests), which leads to a significant floristic diversity.

Until recently some reports on the spread of certain medicinal species have been published: BONDEV & VELCHEV (1984) – on *Phillyrea latifolia* L., GUSSEV et al. (2003) – on *Leucojum aestivum*

L. and SIDJIMOVA (2007) - on *Galanthus nivalis* L. Contemporary data on the species diversity of medicinal plants in the nearby Strandja Nature Park were published by GUSSEV (2008). Studies of plant communities regarding their conservation in the Ropotamo Nature Park (MESHINEV et al. 1982) and the Arkutino Reserve (KOCHEV & ALEXANDROV 1982) were carried out. Data on species with conservation status distributed in the Reserve could be found in the Red Data Book of Bulgaria, Plants (PEEV 2015) and in the Red Data Book of Bulgaria, Habitats (BISERKOV 2015). All these publications provide valuable information about medicinal plants in these plant communities. However, according to the available literature, no purposive study on the distribution and resources of medicinal plants in the Ropotamo Reserve was conducted so far.

The aim of the present study was to protect the medicinal plants in the Ropotamo Reserve as a part of the coastal biodiversity in relation to the use of the reserve territory for recreation. This required a study of the species diversity and the resources of the medicinal plants. An important task of the study was to identify the threats and assess the risk for populations of species with conservation status.

## Material and methods

Ropotamo Reserve is located in Southeastern Bulgaria on the Black Sea coast in the territory of Bourgas District, Primorsko Municipality. It occupies a territory of 1000.7 ha and is situated between 1 and 150 m above sea level (a.s.l.) with the altitude decreasing from West to the East. The climate is characterized by mild winter and warm, dry summer. Ropotamo River (48.5 km long with catchment area of 248.7 km<sup>2</sup>) runs through the Reserve. In the reserve the terrain is separated from numerous long ridges, which are lowered in the form of small plates and a dense network of deep valleys with steep slopes. In the process of the development of the ROPOTAMO RESERVE MANAGEMENT PLAN (2015-2025, available at <http://www.moew.government.bg> and abbreviated hereafter as RRMP), the diversity of the medicinal plants and the state of their populations were investigated in the autumn of 2014. For these purposes, the Route method and Method for monitoring of higher plants (GUSSEV et al. 2008) were applied. Representative habitats were visited, using existing information on the digital boundaries of the reserve. During the field trips, a list of medicinal plants was prepared, according Application to Art. 1 of the MEDICINAL PLANTS ACT (2000). The determination of the species followed DELIPAVLOV & CHESHMEDZHIEV (2011) and Flora of Bulgaria I-XI (YORDANOV 1963-1979, VELCHEV 1982, 1989, KOZUHAROV 1995, KOZUHAROV & ANCHEV 2012). The conservation status of the species was determined according the Red List (PETROVA & VLADIMIROV 2009, abbreviated here after as RL) and the Red Data Book on plants (PEEV 2015, abbreviated here after as RB). The legal protection of the species with conservation significance followed the MEDICINAL PLANTS ACT (2000, abbreviated here after as MPA), BIOLOGICAL DIVERSITY ACT (ACT ON AMENDING AND SUPPLEMENTING THE BIOLOGICAL DIVERSITY ACT (2007 abbreviated here after as BDA) and international documents (BERN CONVENTION 1979, CITES 1973). In the course of the study, important features of the populations were taken into account, such as area, horizontal structure,

number, projected coverage. The studied habitats of European significance were classified according EUNIS (2007).

## Results

In the vegetation cover of Ropotamo Reserve forest communities dominate and occupy 73% of its area (RRMP). The Management Plan states that forests in the reserve are part of a forest complex, which is a remnant of tertiary vegetation. These forests are characterized by the inversion in which the mesophilic forests occupy the valley slopes and the sclerophyll and thermophilic oak forests extend over them. The vegetation cover in the reserve is quite various, with xerothermic oak forests dominated by *Quercus cerris* L., *Q. frainetto* Ten., *Q. pubescens* Willd. and *Q. virgiliana* (Ten.) Ten. often mixed with *Carpinus orientalis* Mill., *Fraxinus ornus* L., in some areas with *Tilia tomentosa* Moench and *Mespilus germanica* L. In these forest there is a grass cover of *Ruscus aculeatus* L. Typical for the reserve are the mixed dense forests dominated by *Fraxinus oxycarpa* Bieb. ex Willd., with numerous lianas and climbing plants. Specificity and high conservation significance is characteristic of the sclerophyllous bushes with predominance of *Phillyrea latifolia*. The characteristic sub-mediterranean appearance of the *P. latifolia* community is complemented by other scrubs as *Paliurus spina-christi* Miller, *Jasminum fruticans* L. and a number of southern herbaceous elements. It was found that meadows covered 14% of the area of the Reserve. Xerothermic grasslands occupy large areas. They refer to secondary vegetation which has appeared in the place of forests destroyed in the past.

More than 550 species of vascular plants were found in the reserve, which represented about 12.5% of the flora of Bulgaria (RRMP). Among them 199 (or 40% of all found species) were medicinal plant species from 171 genera and 63 families. Twenty-two species of them were protected. A large number of the medicinal plants were recorded in habitats of European significance according to EUNIS (2007).

Great part of the reserve territory is covered with mixed oak forests representing the habitat – EUNIS G1.76A1 *Euxino-Thracian [Quercus frainetto]–[Quercus cerris] forests*. This habitat differs with rich plant composition and extends to the area between megalith Begliktash and the sea bay St. Paraskeva, as well as to the slopes of the Kaleto area. There the forests are dominated by *Quercus cerris* and *Q. frainetto*. The most common woody species medicinal plants are: *Acer platanoides* L., *Fraxinus*

*ornus* L., *Sorbus domestica* L., *S. torminalis* (L.) Grantz, *S. aucuparia* L., *Tilia tomentosa*, and the bushes *Corylus avellana* L., *Sambucus nigra* L., *Euonymus* spp., *Cotinus coggygria* Scop., *Prunus spinosa* L., *Rosa* spp. The herbaceous medicinal plants *Ruscus aculeatus* and *Cyclamen coum* Mill were found in high abundance, and *Lathyrus niger* (L.), *Melissa officinalis* L. and *Lithospermum officinale* L. were assessed as common species. In the same habitat we found two species included in BDA and also in the RL and RB with the category Endangered: *Hypericum androsaemum* L. and *Galanthus nivalis*, the last included also in CITES. *G. nivalis* was a rarely spread species in the reserve area and when found, it occupied relatively small territories. Three localities with an area 100-400 m<sup>2</sup> and 17 to 40 plants per 1 m<sup>2</sup> were found near Arkutino (SIDJIMOVA 2007). *H. androsaemum* was found only with single plants in moist and shady valleys. *Primula acaulis* (L.) L. subsp. *rubra* (Sm.) Greuter & Burdet, included in RL with the category Vulnerable, was spread in oak forests and in spring gave a pink aspect to the grass cover. The protected species *Cyclamen coum*, included with the category Least Concern in RL, BDA, BERN CONVENTION and CITES, was found as widespread with a high abundance. Its populations occupied large areas, which reached up to 1 ha and projective coverage up to 4-5%. The valuable species *Ruscus aculeatus*, included in BDA and MPA, was widespread in the oak forests with projected coverage to 50-60%. We found that the population of *R. aculeatus* was drying up in some areas of the Reserve. This requires an urgent study for discovering the cause of plant's dying. Relatively rare species with low abundance were *Primula veris* L. and *Valeriana officinalis* L., both protected by MPA. They grew as small groups in the oak forests.

Especially interesting are the dense forests, habitat EUNIS G1.2232 *Helleno-Balkan ash-oak-alder forest*. These are periodically flooded mixed deciduous forests along the banks of Ropotamo River, in which woody medicinal plants (*Alnus glutinosa* (L.) Moench, *Ulmus minor* Mill., *Acer tataricu* L. and *Carpinus betulus* L.) were recorded together with lianas (*Periploca graeca* L., *Smilax excelsa* L., *Clematis vitalba* L., *Hedera helix* L.) and grass species (*Ruscus aculeatus*, *Iris pseudacorus* L., *Ranunculus ficaria* L., *Lysimachia nummularia* L., *Geum urbanum* L., *Tamus communis* L., *Parietaria officinalis* L.). On the bank of Ropotamo River is situated the economically significant locality of the valuable medicinal plant *Leucojum aestivum*, protected in BDA and included in RL and RB

with category Vulnerable. The population of this species occupied terrains periodically flooded by the river and its projective coverage was >50% (GUSSEV et al. 2003). The fresh and damp terrains located next to the dense forests are occupied by a forest with the participation of the following medicinal plants: trees - *Quercus frainetto*, *Acer tataricum*, *A. platanoides* L., bushes - *Cornus mas* L., *Crataegus monogyna* Jacq. and *Salix caprea* L., and grass species - *Primula acaulis* subsp. *rubra*, *Arum maculatum* L., *Anthriscus cerefolium* (L.) Hoffm., *Chaerophyllum temulentum* L., *Hedera helix*, *Aristolochia clematitis* L., *Tamus communis* L., *Equisetum sylvaticum* L., *E. telmateia* Ehrh., *Geranium robertianum* L., *Parietaria officinalis* L. and *Chelidonium majus* L.

The vegetation of the Arkutino marsh refers to the habitat EUNIS C3.2 *Water-fringing reedbeds and tall heleophytes other than cans* and includes the populations of two rare medicinal plants, which cover a high percentage of its surface: *Nymphaea alba* L. and *Nuphar lutea* (L.) Sm. The both species are included in the BDA and in RL and RB with the IUCN category Endangered. The results of the study show that the development of competitive species in a short period may lead to a change in the percentages of the both species. This requires periodic monitoring with urgent measures in case of changes. In the same habitat we found also the medicinal plants *Alisma plantago-aquatica* L., *Lythrum salicaria* L., *Lycopus europaeus* L. and *Typha angustifolia* L.

Habitat EUNIS E1.4344 *Helleno-Balkan andropogonoid grass steppes* represents secondary grasslands occurring on the site of destroyed forests. In this habitat the following medicinal plants were found: *Carlina vulgaris* L., *Eryngium campestre* L., *Filipendula vulgaris* Lam., *Origanum vulgare* L., *Hypericum perforatum* L., *Sanguisorba minor* Scop. and *Thymus* spp. *Anacamptis pyramidalis* (L.) Rich. and *Orchis papilionaceae* L., both from BDA and from RL and RB with category Vulnerable, were assessed as protected species represented with single plants.

Habitat EUNIS B1.4B11 *Southwestern Pontic fixed dunes* occupies large areas in the Reserve. The fixed gray dunes are colonized by various cenosis, with the predominance of perennial grasses. These dunes are spread all over the Black Sea coast, but mostly to the south of the Kamchiya River mouth. There occur the following medicinal plants: *Artemisia campestris* L., *A. absinthium* L., *Teucrium polium* L., *T. chamaedrys* L., *Centaurea cyanus* L., *Marrubium peregrinum* L., *Cotinus coggygria* Scop., *Paliurus spina-christi*, *Tribulus terrestris* L.

The largest population of the valuable species *Artemisia santonicum* L. (MPA) in Bulgaria is located in Ropotamo Reserve in the Protected Site Morski Pelin, where it occupies an area of 10 ha. After the designation of the site it was surrounded by a fence, which preserves the population.

Habitat EUNIS B1.313 *Pontic embryonic dunes* was also found in the Ropotamo Reserve. These are coastal formations which represent the first stages of the dune formation and include medicinal plants from the group of obligate psammophytes. Among them were *Eryngium maritimum* L. (included in the RL and RB with the category Endangered) and *Euphorbia peplis* L. (with the category Vulnerable in the RL), both included in BDA. In the same habitat we found small groups of the protected by MPA species *Glaucium flavum* Grantz. The research proved that the localities of *Eryngium maritimum*, *Euphorbia peplis* and *Glaucium flavum* often fall into the beach area actively used for recreation. The passing of large groups of people through the embryonic dunes negatively affects the development of the plants.

Another habitat of European significance in the Reserve is EUNIS F5.51A4 *Eastern [Phillyrea] thickets*, which occupies the exposed dry slopes in the place Luvska Glava. In this area *P. latifolia* is involved in a community with shrubs, semi-shrubs and grasses belonging to the Mediterranean, Submediterranean and Pontic-Central Asian floral elements. In these communities, we found *Primula acaulis* L. (valuable species included in RL with category Vulnerable and in MPA) among the large number of medicinal plants.

## Discussion

The floral complex in Ropotamo Reserve has a pronounced transient – Mediterranean character, which is characteristic of the local flora in the southern parts of Bulgaria, including also the southern Black Sea coast. The insignificant number of adventitious elements in the reserve defines its flora as natural and typical. In the same time, the significant number of ruderal elements is in accordance with the increased anthropogenic impact. The diversity of habitats in the reserve leads to the great floristic diversity with a high number of medicinal plants: 199 species, 22 of which were protected. Five species have a high conservation status in the RB with the Endangered category, 13 species are from the RL, 16 species are from the BDA, one species is from the Bern Convention, four species are from CITES and 7 species are protected by MPA. Many medicinal plants are rare for the country and some of them are distributed only along the Black Sea coast

and in Strandja Mountain (e.g. *Eryngium maritimum*, *Euphorbia peplis*, *Hypericum androsaemum*, *Cyclamen coum*, *Glaucium flavum*). The habitats of European significance documented on the territory of the reserve also require strict nature conservation measures. According to a number of international documents the rarity of endangered plants, animals, and natural habitats is considered as an element of threat. This requires constant monitoring and strict measures for protection of the flora complex in the Ropotamo Reserve. The results of the present study show that the medicinal plants are negatively affected by the active anthropogenic pressure due to the tourist flow and an important road from Bourgas to Malko Turnovo, passing through reserve territory. This is evidenced by the reduced number of representatives of some species like *Eryngium maritimum*, *Euphorbia peplis* and *Glaucium flavum*, growing on the beach used for recreation. Pollution of dense forests with waste has led to changes in their composition. Population of *Ruscus aculeatus* in the reserve dries, which is supposed to be caused by a viral or fungal disease, probably spread out by tourists. The results from this study allow to claim that the group of medicinal plants in the reserve has a medium to high degree of vulnerability to anthropogenic factors and to natural processes, occurring in the populations and some of the medicinal plants were of medium to high rarity for the country.

## Conclusion

The results from the present study showed that the conservation status of the Ropotamo Reserve territory favors the protection of the flora complex. However, the medicinal plants were negatively influenced by the active anthropogenic pressure due to the recreation of large groups of people in the protected area. The rich and unique flora of the reserve, the great variety of the plants including the medicinal plants, as well as the significant percentage of rare and protected species have to be preserved as national treasures. Therefore, the monitoring of the flora and mapping of the populations of protected species and their habitats are necessary. The data collected in this study on the diversity of medicinal plants and their populations, organized as a database, offer a valuable scientific prerequisite for the implementation of an effective conservation policy by the Administration of the Reserve.

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