

RESTORATION AND PROTECTION OF THE POPULATION OF RARE AND PROTECTED PLANT SPECIES IN VITOSHA NATURE PARK

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Abstract: The populations of rare and endangered plant species in Vitosha have been supported in accordance with the conservation program stipulated in the Management Plan of Vitosha Nature Park. *Taxus baccata* L., *Clematis alpina* (L.) Mill, *Acer heldreichii* Orph., *Menyanthes trifoliata* L. and *Drosera rotundifolia* L. are species with conservation importance. *Clematis alpina* and *Menyanthes trifoliata* are considered extinct from the territory of Vitosha due to non-confirmation of their localities for several decades. As a result of changes in the water regime of the peatlands in Vitosha mountains the population of *Drosera rotundifolia* is significantly reduced. *Acer heldreichii* and *Taxus baccata* are poorly presented in the park and with limited regenerative abilities of the individuals.

The present work studies the existing experience in plant reproduction. Collected propagating materials (seeds and cuttings) have been used in an *in vivo* experiment. The appropriate methods and techniques have been selected to ensure the greatest possible success in reproduction.

New individuals of the five species have been produced and planted in their natural habitats in Vitosha. Varying degree of survival of the new individuals has been found by subsequent monitoring.

INTRODUCTION

Among the large diversity of plant species occurring in the territory of Vitosha Nature Park (1489 species, vascular plants) there are some which are rare, vulnerable or with low populations. These species are of special concern under the management actions carried out by the Vitosha Nature Park Directorate through implementing programs for their reintroduction (Management Plan of Vitosha Nature Park, 2005-2014).

The Common Yew (*Taxus baccata*) is an endangered species, according to the Bulgarian Red Data Book (Evstatieva, 2015) and is included in Annex 3 of the Bulgarian Biodiversity Act. The only location of *Taxus baccata* in Vitosha Mountain is above the Boyana district, under the Boyana Waterfalls. It was studied by Arnaudov (1920) and Penev (1940). Information about it is found also in the study of Jordanov (1977), which was confirmed by our observations – many adult trees in bad state and lack of seedlings. Due to the limited distribution and weak regeneration potential of the species, the Vitosha Nature Park Directorate implemented actions for reintroduction and created new localities of the Common Yew in the Northern (under the peak Kopitito) and in the Southern (Zhivata voda locality) part of the mountains (Project for restoration of *Taxus baccata* L. in the territory of Vitosha Nature Park, 2001) in the period 2001-2003. The experience gained motivated the team to continue these actions in the next years. It should be noted that there are attempts to protect the populations of this endangered species through reintroduction carried out by other park administrations – these of Nature Park “Rilski Manastir” and “Strandzha” (Project Life08 NAT/BG/000281).

The Alpine Clematis (*Clematis alpina*) is included in Annex 3 of the Bulgarian Biodiversity Act, as well as in the Red List of Bulgarian vascular plants, classified as „vulnerable“ (Petrova and Vladimirov, 2009). In Vitosha Mountain it is reported in the rocky sites of Reznyovete and Kominite localities (Kitanov and Penev, 1963). Recent studies carried out by the Vitosha Nature Park Directorate do not confirm the presence of the species in these localities, so measures for the restoration of its localities in the territory of the Park are required. Recent attempts to produce individuals of Alpine Clematis, carried out in the period 2005-2007 ended without success (Project for restoration of the locality of *Clematis alpina* (L.) Mill. in the territory of Vitosha Nature Park, 2005). The continuation of the activities for the reintroduction of the species is therefore required.

The Mountain Maple (*Acer heldreichii*) is one of the rare species in the flora of the Vitosha Mountains, listed as vulnerable in the Red Data Book of Bulgaria (Dimitrova, 2015) and protected by the Bulgarian Biodiversity Act (Annex 3). A study carried out in the territory of the Park by Dountchev (2005) confirmed six locations of Mountain Maple in Vitosha – Belcheva Skala peak, “Bistrishko branishte” Reserve, Zeleni del locality, Balabana locality, Chernata skala peak and Vladayski Cherni vrah peak. Cavkov carried out an inventory and detailed analysis of these localities in 2011. The weak, mostly coppice natural regeneration of the Mountain Maple and its modest, isolated locations in Vitosha were identified as prominent problems in both reports. The conservation of the species in the territory of the Park should therefore be considered a priority, raising the question of sustaining its populations.

The Buckbean (*Menyanthes trifoliata*) and the Round-leaved Sundew (*Drosera rotundifolia*) are protected by the Bulgarian Biodiversity Act (Annex 3). *Menyanthes trifoliata* is listed in the Red Data Book of Bulgaria as endangered

species (Evstatieva, 2015) and *Drosera rotundifolia* is included in the Red List of Bulgarian vascular plants, classified as „vulnerable“ (Petrova and Vladimirov, 2009). In the past *Menyanthes trifoliata* occurred in the peat areas around the springs near Boeritsa Chalet under the Black Rock Peak and possibly at other locations in Vitosha (Kitanov and Penev, 1963). As the habitats of the Buckbean in Vitosha have not been confirmed for the last decades, the species has been considered extinct from Vitosha. There is a number of data on the prevalence of *Drosera rotundifolia* in Vitosha. More recent studies of Hajek et al. (2005) and Natcheva et al. (2016) of the subalpine peatland in Vitosha Mountain, confirm its limited distribution in the mountains. The Buckbean and the Round-leaved Sundew have specific environmental requirements, and are extremely sensitive to disruption of their natural habitat, namely 7140 Transition mires and quaking bogs (Directive 92/43/EEC). The threats to their existence were associated with tendencies towards reduction of these habitats as a result of climatic and anthropogenic factors - changes in the hydrologic regime, diversion of water for drinking purposes, overgrowth of grasses and so on, and with regards to the Buckbean - collection as a medicinal plant as well. For all these reasons, the two species are also subject to reintroduction carried out by the Vitosha Nature Park Directorate.

The current article presents the results from the attempts to restore the populations of Alpine Clematis and Buckbean, and protect the populations of the Common Yew, Mountain Maple and Round-leaved Sundew in the territory of Vitosha Nature Park.

MATERIAL AND METHODS

In September 2009 two hundred and fifty mature stem cuttings and thirty seeds of adults *Taxus baccata* individuals were collected from the maternal field in the vicinity of the Boyana Waterfalls. The cuttings were selected from both male and female specimens. Reproducing material from Common Yew, as well as other target species mentioned in this article was multiplied using the „Green Spring“ nursery in the village of Negovan. The cuttings collected from *Taxus baccata* were set on a substrate of sand and peat and the rooting of the cuttings took about eight months. Vegetative production of seedlings was preferred as the process of seed germination takes too long (15 months). Rooted cuttings were removed from the greenhouse and planted in a soil mixture in one-liter plastic containers (Figure 1). After a year of growing, they were planted in stages in their natural environment. The necessary sex ratio was observed during the planting process.



Fig. 1. Potted plants of *Taxus baccata*

The location of *Clematis alpina*, used for production of reproductive material is situated along the river Yadenitsa, the Western Rhodopes. The species there develops on steep and rocky terrain beneath the forest canopy of spruce forests. About 200 mature seeds were collected in October 2009 from that location and were immediately planted in a suitable substrate (a mixture of peat and sand) and allowed for natural winter stratification outdoors. We established a high percentage of germination in the spring of 2010 and a relatively fast development of the seedlings (Figure 2). The young plants were planted in one-liter pots (Figure 3).



Fig. 2. *Clematis alpina* seedlings



Fig. 3. Potted plants of *Clematis alpina*

Reproducing material of *Acer heldreichii* was collected from the best preserved and numerous population in Vitosha, in the Balabana locality. It is situated at an altitude of 1700 m, on a Northern slope in mixed forest with dominated by *Fagus sylvatica* and *Picea abies* (L.) Karst. According to Dountchev (2005) and Tsavkov (2015) good fruiting is observed in this location. Despite that, fruit production was not found during a visit to collect seeds carried out in October 2009. Because of that, four hundred and seventy pieces of Mountain Maple soft cuttings were obtained in June 2010 and June 2011, which were set in a plastic greenhouse with the installation of an artificial fog. A mixture of sand and peat was used as substrate. Rooting cuttings started in about 40-60 days. For the purpose of acclimatization and successful hibernation, rooted cuttings were periodically removed from the greenhouse and placed in a cold conservatory. They were potted in containers of one liter in a mixture of peat, soil and manure (Figure 4).



Fig. 4. Potted plants of *Acer heldreichii*

50 small boxes with seeds from *Drosera rotundifolia* were collected in September 2012. To do so, a numerous population was selected in the peatland in the Konyarnika locality, at an altitude of 1800 m. The seeds were planted in pure peat moss at the end of January 2013, soaked with distilled water and were watered throughout the growing season. The sowing was carried out in two batches: one was merged into a common seed tray and the second was planted in a seed board with separate sockets. The seedlings were submerged in containers of distilled water and a soil-heating device was made and equipped with a phyto lamp working around the clock, in order to speed up the sprouting process. The seed germination process started after about 20 days and continued until about 40 days after sowing. Seeds showed high rates of germination. In addition to distilled water young seedlings require a large amount of sunlight and cool

temperature. The sprouting seeds of *Drosera rotundifolia* from the merged seed tray were later potted. It was found that the seedlings easily tolerated potting. The new plants grew relatively slow and the growth could not be accelerated through fertilization due to salt intolerance. Potted individuals of Round-leaved Sundew were prepared for planting in the field in September 2013 (Figure 5).

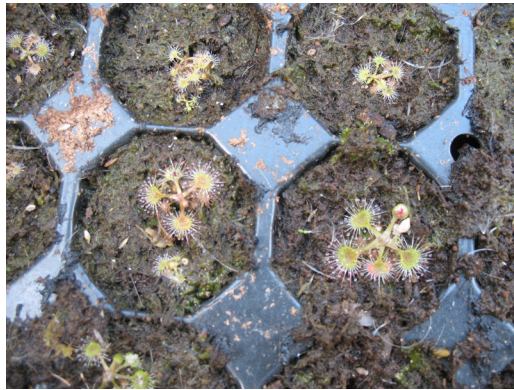


Fig. 5. Potted plants of *Drosera rotundifolia*

Vegetative propagation was applied for *Menyanthes trifoliata*. Rootage from 20 plants were collected in June 2013 from the Smolyan Lakes, Middle Rhodopi Mountains. The collected plants were divided into cuttings and planted directly in one-liter pots in clean sand with controlled release of „Osmocote“ fertilizer. The planted pots were completely immersed in water baths (Figure 6). Rooting plant cuttings took place relatively quickly. The young specimens of *Menyanthes trifoliata* were prepared for planting outdoor in September 2013.



Fig. 6. Potted plants of *Menyanthes trifoliata*

The new individuals from the five species were planted on preliminary chosen locations in the Vitosha Nature Park territory. Ecological conditions of the source population were taken into consideration when selecting the recipient sites. The planting activities were organized by the team of the Vitosha Nature Park Directorate and were supported by many volunteers.

RESULTS AND DISCUSSION

A total of 420 pieces of container seedlings of *Taxus baccata* were produced. Steep terrain (25°) in beech habitats (natural habitat type 9130 *Asperulo-Fagetum* beech forests), Northern exposition and an altitude of 1300-1400 m were the conditions selected for planting the seedlings, similar to the those of the source population. The saplings were planted in stages (July 2011, May and October 2012) in the Bai Krustylo locality in Northern Vitosha (270 individuals) and above the village of Chuypetlovo, in the Southern Vitosha (150 individuals). One hundred and fifty saplings were planted on a shady place as an undergrowth in the high canopy beech forest, and the remaining 150 saplings were planted in beech forest with lower canopy and participation of *Betula pendula* and *Populus tremula* L. We established a weak interception of *Taxus baccata* seedlings on both sites, but more the attempt in the better lighted area - 30% (Figure 7) was more successful as compared to the shady one (15%). The result is approximately the same above the village of Chuypetlovo, where barely barely 20% of saplings were intercepted.



Fig. 7. *Taxus baccata* sapling

The choice of location for planting *Clematis alpina* was based on literature data and in particular on those outside the reserve “Bistrishko Branishte”, namely the Kominite locality. The terrain is steep and stony, with a high percentage of rock cover, vegetation is wood-shrub with prevailing *Betula pendula* (L.) Roth, *Salix caprea* L., *Coryllus avellana* L., etc. The high air humidity in this stretch of the river valley, the Western exposition, and the rocky terrain, represent a combination of appropriate conditions for the development of *Clematis alpina*. There are 70% successfully adapted young individuals from all the one hundred and fifty planted in June 2011 (Figure 8).



Fig. 8. Planting the new individuals of *Clematis alpina*

Vegetative propagation is an atypical and unreliable method for *Acer heldreichii*, and our experience confirmed that - the low percentage of rooting cuttings produced only 10 pieces of saplings. They were planted in the Cvetna Polyana locality, at an altitude of 1500 m, in the medium forest vegetation belt. There is a rich, fresh spruce habitat, which is the most appropriate type according to Cavkov (2015). The area was affected by windthrow in 2001 and was subsequently afforested with Norway Spruce. All ten saplings successfully developed among the pioneer woods and shrubby vegetation with the participation of *Sorbus aucuparia* (L.) Crantz., *Coryllus avellana*, *Rubus idaeus* L., *Sambucus racemosa* L. etc., which was confirmed during the last inventory this year (Figure 9).

About 180 young specimens of *Drosera rotundifolia* were planted in September 2013 in Konyarnika locality and along the Boyana River, within the natural habitat type 7140 Transition mires and quaking bogs (Figure 10). When choosing a peatland we took into account that Round-leaved Sundew does not tolerate shading and competition on grasses and sedges herbs, so we put the new individuals in peat moss dominated mires. As a result, we recorded 50% interception of the individuals in the next year.



Fig. 9. *Acer heldreichii* sapling



Fig. 10. Newly planted individual of *Drosera rotundifolia*

A total of 70 young specimens of *Menyanthes trifoliata* were planted within the same habitat type in September 2013. A leading criterion in the choice of location was the availability of water level, remaining as long as possible during the growth season. *Sphagnum*-dominated mires around the Boyana River over the building “Kamennoto Zdanie”, at an altitude of 1800 m were identified as suitable and 20 new individuals of *Menyanthes trifoliata* were planted. A total of 80% of individuals survived. Other 30 of the young individuals were planted in the area of the Konyarnika locality in peatland along the stream with a constantly running water. This site showed highest interception of individuals - 90%, and flowering individuals were observed in the spring of 2015, which proves the successful adaptation of the species. The remaining 20 new plants from the Buckbean were planted in the peripheries and the shallows of bogs at the foot of the Cherny Vruh peak. The altitude here is bigger (2200 m) and the growing season is shorter, yet the plants adapted well and a high degree of interception was observed (70%) (Figure 11).



Fig. 11. Newly planted individuals of *Menyanthes trifoliata*

CONCLUSION

Taxus baccata has been successfully propagated from mature stem cuttings. The attempt for its reintroduction showed that the limiting factor for the young seedlings is sunlight. They are growing well in places with high air humidity, on moist and rich soils. Partially lighted places in the beech forest communities were found appropriate for their development (natural habitat type 9130 *Asperulo-Fagetum* beech forests).

The reintroduction of the seed generation of *Clematis alpina* along the Dragalevska River in the Kominite locality has been successful, in conditions of ample air humidity, Western exposition and rocky silicious terrain. The vegetative method for production of *Acer heldreichii* used because of lack of fruit production is atypical and unreliable. The few produced seedlings grew well in fresh and rich spruce habitats.

Suitable locations for the reintroduction of *Drosera rotundifolia* and *Menyanthes trifoliata* are waterlogged areas, representing the natural habitat type 7140 Transition mires and quaking bogs. The seedlings of Round-leaved Sundew are in good condition in areas with preserved hydrologic regime, dominated by peat mosses. They have high requirements of light and cannot tolerate the competition of tall grasses and hedge herbs.

The successful reintroduction and the restoration of extinct species in Vitosha Nature Park are the most valuable results. *Menyanthes trifoliata* has successfully propagated vegetatively. It should be noted that high water level during the active season of vegetation types in the bogs and peatlands is a necessary condition for the successful development of the plants. The presence of individuals with generative organs in the spring of 2015 is a confirmation for its successful adaptation in the Vitosha Mountains (Figure 12).



Fig. 12. *Menyanthes trifoliata* at the time of flowering

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