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RESTORATION AND PROTECTION OF THE POPULATION OF *SALIX PENTANDRA L.* AND *GALANTHUS ELWESII* HOOK IN VITOSHA NATURE PARK

DESSISLAVA GYUROVA[1*], SLAVCHO SAVEV[2]

1 – Vitosha Nature Park Directorate, 1303 Sofia, 17 Antim I Str, Bulgaria
2 – Department of Silviculture, Faculty of Forestry, University of Forestry, Sofia
**Corresponding author: dessybg2001@yahoo.com*

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Abstract: One of the objectives of the Management Plan of Vitosha Nature Park is to protect the natural conditions and restore populations of species of conservation significance. Bay Willow (*Salix pentandra* L.) and Giant Snowdrop (*Galanthus elwesii* Hook.) are included in Annex 3 of the Bulgarian Biodiversity Act and are enlisted in the Bulgarian Red Data Book as Critically Endangered (CR) and Endangered (EN) species respectively. Bay Willow in Bulgaria occurs only in the territory of Vitosha Nature Park with limited numbers and Giant Snowdrop is considered extinct from the park territory. Methods of vegetative propagation, suitable substrates and period of collection of vegetative propagules are established through an *in vivo* experiment. New individuals of the two species have been produced and they have been planted in their natural habitats in Vitosha. High degree of survival of new individuals has been found through subsequent monitoring.

INTRODUCTION

One thousand four hundred eighty nine higher plant species are described in the territory of the Vitosha Nature Park. Some of them are under the protection of the environmental legislation in Bulgaria (Management Plan of Vitosha Nature Park, 2005-2014). *Salix pentandra* and *Galanthus elwesii* are protected by the Bulgarian Biodiversity Act (Annex 3) and included in the Bulgarian Red Data Book as critically endangered (Apostolova, 2015) and endangered species (Evstatieva, 2015) respectively. The Management Plan of Vitosha Nature Park prioritized the conservation of the most important plant species by developing

and implementing programs that support their habitats and through reintroduction activities.

Bay Willow (*Salix pentandra*) is a glacial relict and in Bulgaria it only occurs in Vitosha and the Choklyovo swamp (where it is considered extinct). There are some non-published data about attempts for reintroduction of the species along the swamp, carried out in the period 2001-2004. Two specific localities occur in the territory of Vitosha and there are some chorological data about that – the woodlands around the art house of Artists and the peatlands in the area of Ofeliite. The species has weak reproductive potential and it is sensitive to climate changes, forest fires, drainage of habitats etc. (Apostolova, 2015). The inventory carried out by experts of the Vitosha Nature Park Directorate did not confirm the presence of the species in the Ofeliite locality, which encouraged activities for the reintroduction of the species back. These activities carried out in 2001-2003 resulted in the restoration of *Salix pentandra* in this area (Project of restoration of the localities of Bay Willow in Vitosha Nature Park, 2001) and the subsequent introduction of the species along the information alley "Forest peat bogs" (Fig. 1).

Fig. 1. *Salix pentandra* L. in Ofeliite locality, 2013

The reduction of the localities of *Salix pentandra* is also due to ecological succession and habitat changes. The species is a part of habitat type 91D0 Bog Woodland, subtype 44.A412 Spruce and Spruce-pine forests on peat substrates with the participation of *Moneses uniflora* and *Sphagnum girgensohnii* in enlightened areas (Directive 92/43/EEC). The seed propagation of the species is really difficult because of the strong fragmentation of this forest subtype. The

reasons for this fragmentation are mainly anthropogenic. Because of that the reintroduction of vegetatively produced seedlings of the species is needed.

Giant Snowdrop (*Galanthus elwesii*) is rare throughout most of the country, not reported from the Black Sea coast, Belasitsa and Strandzha Mts (Evstatieva, 2015). According to old herbarium materials, the species occurred in Vitosha in the area of Boyana village, on Boyana River and in the area of the Boyana Waterfall. The last chorological data are from 1961 (Sidjimova, 2008), but nowadays this species has nor been confirmed in this area. There are reports for damaging the population of Giant Snowdrop (Stoyanov, 1937) and for collecting it as a decorative and medicinal plant in the past (Urumov, 1930; Jordanov, 1977). Considering this, we can certainly think that *Galanthus elwesii* has gone extinct from the territory of Vitosha.

This article presents the results from the restoration and protection of the population of *Salix pentandra* and *Galanthus elwesii* in the Vitosha Nature Park.

MATERIALS AND METHODS

The natural habitat of *Salix pentandra* in Vitosha occurs around the art house of Artists on the South-western part of the mountain at an altitude of 1470 m and it represents a swamp forest in the community of *Picea abies* L. Reproductive materials were collected from individuals, which grow in this area (Figure 2) - vegetative annual shoots with a length of 30-50 cm (Figure 3). They were collected in two consecutive years – in April 2013 and 2014 before beginning of the vegetation. A total of thirty branches were picked each year. Wet towels were used to retain the moisture during the transport to the nursery. The reproduction of vegetative materials was carried out in the "Gorski dar" nursery in Studena village. The greenhouse was used for this purpose.

Fig. 2. Motherhood locality of *Salix pentandra*

Fig. 3. Vegetative annual shoots from *Salix pentandra*

On the day of the collection, the shoots were cut into cuttings, 7-10 cm long. After that, they were potted in 20 cm deep containers at 50 % of their length. The substrate used was a mixture of sand and perlite at a ratio of 4:1. The water regime was maintained by double-watering through a fogging system which provided a relative humidity of above 80 %. Callus formation began in the third-fourth week after potting. Rooting in the sterile substrate finished in the twelfth-thirteenth week.

The rooted cuttings were potted on the fifteenth week in two-liter containers with peatland soil substrate. Their adaptation lasted for six weeks in the same conditions as in the greenhouse. Their placement occurred in May and September 2014.

The natural habitat of *Galanthus elwesii*, which we used for the collection of reproductive materials, is located on the riverside of Iskar River in the Lozen Mountains, Kokalyane village, under the fortress of Urvich, at an altitude of 650 m (Sidjimova, 2008). The species there is developing in a forest, dominated by *Alnus glutinosa* (L.) Gaertn. on alluvial soils (AlluviiFluvisoils). Bulbs from Giant Snowdrop were collected as reproductive materials. Thirty bulbs were collected in March 2013 (Fig. 4). The transport and reproduction took place under the mentioned conditions and in mixture of sand, perlite and alkaline peat at a ratio of 2:1:4 were used (Fig. 5). The length of the bulbs picked was about 1,5 times their original length.

Fig. 4. Bulbs of *Galanthus elwesii*

Fig. 5. Placing the bulbs of *Galanthus elwesii* in a suitable substrate

The formation of daughter bulbs started in the fourth-fifth week after the death of vegetative leaves and ended after the fortieth week. The reproduction materials were planted in 0,9 liter containers right after the formation of daughter bulbs. The individuals were adapted for eight weeks. The new individuals were planted in their new place in April 2014 after the generative organs of the plants wither away.

The new individuals were planted in preliminary chosen places. The ecological conditions of the source population were taken under consideration for the right selection of sites. The afforestation activities were organized by the team of the Nature Park Vitosha Directorate and were supported by many volunteers.

RESULTS AND DISCUSSION

The new individuals from both species were ready to be introduced in their natural habitat in the spring of 2014. Two hundred saplings of *Salix pentandra* (Figure 6) and two hundred new plants of *Galanthus elwesii* were produced (Figure 7).

Fig. 6. Saplings of *Salix pentandra*

Fig. 7. New plants of *Galanthus elwesii*

Waterlogged pitches, marshy places, forest woodlands or peatlands in beech and coniferous belt are suitable for the introduction of saplings of Bay Willow. These specific types exist in several places in Vitosha and they are presented in the mentioned habitat 91D0 Bog Woodlands, subtype 44.A412 Spruce forests on peat substrates. The saplings were planted in the spring and autumn of 2014. They were divided in two halves. The first one (100) were planted in the area near the original locality of Bay Willow on waterlogged soils, at an altitude of

1500 m. Plantation took place on three different sites with different lighting. The other half (100) was planted at an altitude of 170 m, in forest peatlands near the "Zvezditsa" hut (Figure 8). The saplings there were divided equally in two adjacent peatlands, all planted in open ground. The subsequent monitoring in the autumn of 2015 showed that there was a greater percentage of interception (90%) on the peatlands in open ground as compared to under the canopy of the bog woodland (30%).

Fig. 8. Newly planted saplings of *Salix pentandra*

We studied some areas around riverside forests on rich alluvial soils, which are close to the original locality in Lozenska Mts for the right place to plant *Galanthus elwesii*. Such places exist along the rivers of Struma and Kladnishka and they are a part of the natural habitat 91E0 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Directive 92/43/CEO). They are characterized by rich alluvial soils, inundated by the river periodically. One hundred individuals of Giant Snowdrop were planted on Kladnishka River, the other sixty plants were planted along the Struma River. One small part of snowdrops (forty) were planted on Boyana River, around the Boyana Village because this site is mentioned as historic locality in the literature. All of the three populations created are at an altitude between 950 m and 1000 m. The conditions along the Boyana River are different from the two other sites, yet this was the place where the saplings had the highest percentage of interception (100%) – on rocky steep terrains in the zone of beech forests (habitat type 9110 *Luzulo-Fagetum* beech forests) - Fig. 9.

Fig. 9. *Galathus elwesii* on Boyana Rive

The success in the other two sites is as follows: we found 60 % interception along the Struma River, and the lowest number of plants was counted along the Kladnishka River – 20 %.

CONCLUSION

Our experience with reintroducing *Salix pentandra* showed that young saplings successfully grew in sparse forest communities, forming the natural habitat 91D0 Bog Woodland, subtype 44. A412 Spruce forests on peatland substrates. The young saplings are extremely photophilic and do not develop normally under forest canopy. The limiting factors are clay soils. The young individuals prefer soil with good aeration and good humidity and the peatlands provide such conditions.

The reintroduction of *Galanthus elwesii* individuals along three Vitosha rivers showed a different rate of success. The young individuals develop the best on steep, rocky along-river terrains, forming habitat type 9110 *Luzulo-Fagetum* beech forests. The illumination of the terrain, the richness and mechanical ingredients of the soil substrate do not matter much for their development. The most important condition is the better aeration of the soil. Waterlogged terrains are bad for them. Because of this reason the interception of snowdrops is smallest on heavy and waterlogged soils along Kladsnishka River.

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