

## CONSERVATION IN THE UNIVERSITY BOTANIC GARDEN LJUBLJANA

Jože BAVCON

University Botanic Garden Ljubljana, Department of Biology, Biotechnical Faculty,  
Ižanska cesta 15, 1000 Ljubljana, Slovenia  
e-mail: joze.bavcon@guest.arnes.si

### SUMMARY

The University Botanic Garden Ljubljana has a long tradition of conserving endangered species. *Pastinaca sativa* var. *fleischmanni*, growing on the Ljubljana Castle premises, where it was discovered in 1819, disappeared from its natural habitat in the following twenty years. It has only been conserved in the nearby Ljubljana Botanic Garden.

*Daphne blagayana*, first correctly determined on the territory of present-day Slovenia and celebrating the 170th anniversary of its discovery in May 2007, was one of the first species which King Frederick Augustus II of Saxony suggested putting under protection already in 1838, which was implemented in Slovenia in 1898.

The Botanic Garden, situated on the margins of the one-time southernmost high moorland, plays a very important role in conserving the remaining moorland plants since the human intervention initiated more than 200 years ago has made the moorland disappear. Some of the species, now hard to find in isolated locations, have been multiplied in the Botanic Garden wherefrom they will be re-introduced into their original habitat, should this prove necessary.

The Botanic Garden actively protects certain plants *in situ*. In a dry meadow in the vicinity of Ljubljana, that we have had on lease for the last seven years, plants are monitored and protected *in situ*. The meadow is an isolated area in the midst of an intensively cultivated flatland.

Some of our endemites and endangered species have been monitored in their natural habitats.

The Botanic Garden activities aim at contributing to the *ex* and *in situ* protection of plants in the Slovenian territory and, most particularly, at counselling.

**Key words:** conservation, *ex situ*, *in situ*, monitoring, dry summer, dry meadow, botanic garden.

### INTRODUCTION

Slovenia lies at the crossroads of the Alps in the north, the Dinarids in the south, the Pannonian Plain in the east and the Mediterranean in the southeast. All of this is reflected in its division between four phyto-geographic regions: Alpine, Dinaric, Subpannonian and Submediterranean, along with a pre-Alpine and a pre-Dinaric transition. As a result of such diversity, the relatively small superficies of Slovenia amounting to 20 256 km<sup>2</sup> is home to more than 3 452 species, 3 119 of which are autochthonous or naturalized, the rest of them introduced (Martinčič et al 2007). 66 among them are endemic (Mayer 1960, Wraber 1996), some of them present only in Slovenia or spreading also into the neighbouring countries, namely Italy, Austria and Croatia.

The University Botanic Garden Ljubljana has a long tradition of conserving endangered species. *P. sativa* var. *fleischmanni*, growing on the Ljubljana Castle premises (Fleischmann 1844), where it was discovered by Andrej Fleischmann in 1819, was then immediately brought to the Botanic Garden. (Hegi 1906–1992). Franc Hladnik later described it and named it after its finder. By 1837 it had already disappeared from the castle area. Since 1819 it has been growing in culture in the Botanic Garden, where it has been preserved in *ex situ* habitat.

In the seventies the Garden was engaged in cultivation of an extremely rare species, namely, *Degenia velebitica*, an endemite of neighbouring Croatia, re-introduced from here to its natural habitat on Velebit (Strgar 1979).

In the last ten years the Ljubljana Botanic Garden, in addition to cultivating and protecting endangered species, has also been involved in *in situ* monitoring of certain endangered species in nature, for which purpose it hired a dry meadow on the outskirts of Ljubljana and has had it on lease for the last seven years (Bavcon, Marinček 2004).

## MATERIALS AND METHODS

Plants are collected from their natural growing sites. Strict care is taken to avoid removing them from areas with decreasing population density. Where plants are rare, their growing spots are marked, just a small number of seeds are removed and from these new plants are grown. Plants are collected primarily during spring and autumn and much less during summer, because in spite of proper watering and shading the survival of plants transferred from a natural habitat to the Garden is then much lower. The only exceptions are summers with moderately high temperatures and sufficient precipitation.

The collected plants are first potted and placed on to cultivation beds for easier shading and watering. Breeding new plants from mother plants is not always immediately successful. More delicate plants are therefore planted in at least two to three different spots in the Garden where the conditions are similar to those in nature; afterwards they are closely observed to find where they thrive best.

Plants are grown from seeds, some are multiplied by using cuttings. Seeds are sown already in autumn or still during winter to facilitate natural stratification. We normally reserve some seeds for the seed bank or for later sowing in the event the seedlings die.

The percentage of the germination capacity for *Pastinaca sativa* var. *fleischmanni* was determined in natural conditions. One hundred seeds per pot were sown into four identical clay pots filled with a mixture of soil and sand. The pots were left exposed to natural conditions – natural stratification all through winter. Seed germination was examined next spring.

Plants growing in the wild are followed up through periodic monitoring. Plants are also actively protected *in situ*. This is the reason behind the hiring, in 2000, of a dry meadow on the outskirts of Ljubljana, mown just once late in the year, when most of the plants are already seeding.

## RESULTS AND DISCUSSION

The University Botanic Garden Ljubljana has a long tradition of conserving endangered species. *P. sativa* var. *fleischmanni* has been growing in the garden ever since its being discovered in 1819. Thanks to conscientious gardeners who continue to select this variety from among all other intermediate forms, the mutant has survived to this day. According to our observations to date the percentage of atypical specimens ranges between 3 and 5%. In the nineties of

the previous century the reduced number of gardeners and the financial difficulties of the Garden resulted in a decrease of the number of plants of the said mutant to no more than five live specimens.

The population of the plant became endangered even in the Garden. However, due to the systematic work during the last ten years, it has been revived and revitalized. The experiments led us to conclude that the seeds of the said mutant, on the average, have a significantly lower germination capacity (50%) than those of common wild parsnip (80%). Long years' cultivation of the plants in the Garden conditions reveals poor competitive capacity of the mutant, that would certainly not survive for long without substantial help from the gardeners. It has never been found to germinate near the compost heap, which is quite frequent with other umbelliferous plants (Bavcon 2002). In spite of the increase in the plant's population during the last decade we are currently witnessing a new decrease in the population due to the curtailed space for cultivation beds resulting from urgent maintenance work which, however, is progressing much too slowly because of inadequate and incoherent financing of the Garden. The mutant in question is particularly affected by such adverse conditions. Another possible reason could be sought in the mild winters of the last two years and the early spring drought reducing the number of germinating plants.

In Slovenia the tradition of protecting single plant species goes well back to nineteenth century. The idea was pioneered by King Frederick Augustus II of Saxony on the occasion of his visit to a habitat of Blagay's daphne, when he noticed some torn twigs of the plant lying on the path. The actual protection of *Daphne blagayana* was implemented in 1898 and extended also to edelweis (*Leontopodium alpinum*). (Zakon 1898) In Slovenia Blagay's daphne continues to surprise with new growing sites. In 2004 Slabe A. & A. Vončina from the environs of Idrija reported finding a rich and also very large new locality of this plant (Praprotnik 2004). In Slovenia such finding places and ravines are numerous. Nowadays, the plant is put in not only by people but also by game, above all deer and roebucks nibbling away the evergreen shoots.

However, not only human but also environmental circumstances are responsible for the decrease in plant populations. A fine example how dry summers may affect the number of plants is our endemic monotypic genus *Hladnikia pastinacifolia*. Due to the dry summer of 2003 the plants hardly formed seeds at all. As a biennial plant is concerned, the small quantity of

seeds from before and the very few new seeds meant that the population would take several years to renew itself. In 2005 flowering plants were still very few, seeds still quite rare, but there was a sufficient number of young plants, which in 2006 produced an abundant quantity of seeds. For these biennial plants more frequent variations between dry and hot Junes and Julies result in a fairly rapid decrease in the number of populations. The good side of this situation is that the plant, thriving best in dry habitats, still has other more shady and moist habitats so that even in very hot summers some plants at least succeed in blooming and bearing seeds. This was confirmed in the very dry summer of 2003. Some seed umbels were found only in more shady and moist habitats. Regular seed collecting can also involve fine monitoring of plant populations.

In Slovenia the population of *Cerastium dinaricum*, a typical Balkan species, is very small (Wraber 1995). The plant grows solely in a very small population with some ten patches in sinkhole in Mt. Snežnik. It can easily become endangered due to overgrowing. The surrounding plants can in time grow over it, taking away its living space. Some years ago, the Botanic Garden managed to breed some plants from the seeds of this population. The cultivation of the plant from the mentioned population creates a possibility of re-introducing it-into its natural habitats.

Certain populations have been decreasing from perfectly natural causes. Thus, in one of its classical habitats in Porezen the population of *Gentiana pannonica* (Scopoli 1772) has been found to be diminishing due to the overgrowing of the ground. Many years' absence of mowing and pasturing has thinned the plants so badly that in 2003 just about 50 groups with 3 to 5 plants were counted and only half of them actually also blossomed. The situation has been somewhat stabilized by renewed pasturing. However, in the area where the plants used to be most abundant, the population continues to be sparse. In spite of the promising beginnings due to pasturing, the situation in 2007 is not really better. As a result of the current enlargement of pasture and excessive concentration of animals at the very growing site, only nearly 120 plants were counted, and only two of these also blossomed. Our plan is to suggest excluding from pasturing the most exposed area preferred by animals due to its favourable position and to have it temporarily secluded from the rest of the place. We are not entirely sure whether such a measure is attainable.

The threat resulting from overgrowing and pasturing has been demonstrated in the case of *Eryngium alpinum* growing only a few hundred meters from the

mentioned classical habitat. Due to the overgrowing of the grounds the populations of the plant have been seriously decreased. The steep slopes that thirty years ago used to be entirely blue were a fifteen years ago a home to no more than isolated tufts of flowering plants. Small-cattle pasturing has proven to be damaging, since sheep will nibble away the savoury buds. It has been proposed to allow small cattle to graze there for a few years, otherwise the area will be overgrown by shrubbery, i.e. *Rubus idaeus* and *Alnus alnobetula*. Renewed late mowing would be most recommendable but not very likely. The measure of periodic pasturing over the last ten years has proven very good, which was corroborated also by other observers (Dakskobler 2004). In 2007 the situation is even better, the population has been restored to such an extent that the current state resembles that of thirty years ago, as described by Seljak (1974), and in the author's observations from that time. Thus, in 2007 the slope, thanks to *E. alpinum*, turned as blue as it used to be in the past.

The monitoring of plant populations often contributes to their protection. *Primula carniolica*, an endemic species of western Slovenia, has only three habitats in nature, situated in open mountain meadows. Originally, however, this is a plant of rocky areas growing in humid spots of bright forests. Those area, described by Bavcon 1987, have become seriously endangered. Now such grounds are private property and not state protected, so in the nineties one of these habitats was turned into a small cattle pasture. As these pastures are not at very high altitudes and small cattle begin grazing there already in early May, i.e. the period of the plant's blossoming, this could rapidly result in the disappearance of the plant. Due to our field work and monitoring of the population we managed to prevent such a development and suggested that the area be eliminated from regular pasturing which would be allowed only periodically but not during the plant's blossoming season. On the other hand, without being periodically mown or pastured, the area could be overgrown much too quickly.

The Botanic Garden, situated on the margins of the one-time southernmost high moorland, plays a very important role in conserving the remaining moorland plants. The plants of the former Ljubljana Moor were provided an *ex situ* habitat in the Botanic Garden. Some of them have been successfully propagated and could, if necessary, be re-introduced into their fragile original habitats. The largest populations are those of *Hottonia palustris* and *Calla palustris*, both of which have been bred from a very small number of specimens. *Calla palustris*, has ended up by occupying just

one very restricted natural habitat in the environs of Ljubljana. *Hottonia palustris* that used to be abundant in the ditches on the Ljubljana Moor can now be hardly found at all. The canals are cleared every few years as otherwise they would be completely overgrown, but this intervention keeps reducing the plant's habitat.

In a dry meadow in the vicinity of Ljubljana that we have taken on lease for the last seven years, plants are monitored and protected *in situ*. The meadow is an isolated area in the midst of an intensively cultivated flatland (Bavcon & Marinček 2004). The purpose of the lease was to protect plants *in situ*. Late July mowing facilitates natural seeding. We also keep annual records on the occurrence of single species in the meadow, which is a home to more than 120 species. It also allows us to determine the dependence of plants on precipitation. In the wet year of 2004 the place did not make a picture of a dry meadow at all. In normal years most of its plants are typical of a dry meadow.

The Botanic Garden would welcome more substantial support from the competent institutions and a more positive attitude to our suggestions which usually result from long-years' monitoring of populations in the wild or their *ex situ* habitat in the Botanic Garden. Last, but not least, all our efforts and endeavours are regularly presented to school groups, students and Garden visitors, thereby raising the awareness of the general public of the importance of protecting plant species.

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