

ECOLOGICAL RESTORATION ACTIVITIES FOR LONG-TERM PRESERVATION OF THE ALPINE AND SUB-ALPINE HABITATS IN THE RETEZAT NATIONAL PARK

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Abstract: This paper is focusing on the mountain pines (*Pinus mugo*), the juniper (*Juniperus communis*) and the rhododendron (*Rhododendron kotschyi*) common habitats, the establishing the methods of maintaining or protecting of non-degraded populations, and the restoration methods of degraded populations, within the alpine habitats conservative management belonging to the Retezat National Park. Between the natural and artificial regeneration methods applicable to restore the degraded mountain pines populations, the regeneration by plantation seems to be the only reasonable method, having in view that the natural regeneration is difficult and require long period of time. This study begins with presentation of the preservation plans of the unique natural landscape, named Retezat National Park, located in Meridional Carpathians (Romanian Southern Carpathians) and continues with the description of the natural distribution of the mountain pines (*Pinus mugo*) populations and their associated herbaceous and woody species in the Retezat National Park. The renaturation with mountain pines seedlings, within the case study regarding an ecological restoration in Retezat National Park, methods, remarks and predictable results are presented. Also, the study offers details concerning the ecological principles of the destroyed habitat's artificial regeneration, such as: the planted area, seedlings, seedling production and their transportation to the planting area and effective plantation.

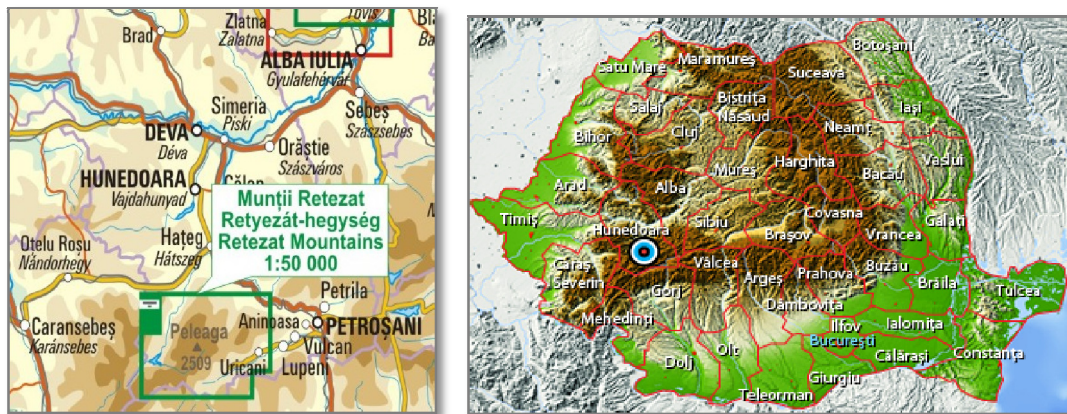
Introduction

The Retezat National Park, located in Meridional Carpathians (Romanian Southern Carpathians), encompasses Romania's highest mountain ranges and one of Europe's last remaining pristine forests. Established since 1935, the Retezat National Park Reservation protects an exceptional floral diversity for high mountainous area with steep slopes, raised from ancient forests. The existence of more than a third of the Romanian flora in this area, sheltering around 1190 superior plants species of the 3450 species known in Romania, is one of the reasons for which it was declared a National Park (REPORT 2008, 2009, 2012, 2013).

The Retezat Mountains is one of the most species-rich areas dedicated to nature protection in Romania and has great significance for the conservation of Europe's natural heritage. The Retezat National Park has a great diversity of forms, which makes the landscape peculiarly spectacular. The protected area occupies the center of the mountain. The first area with full protection has a scientific character (11466 ha), being prohibited any exploitation (mining, grazing, hunting, fishing, gathering fruit, hiking, and camping). In this area, the access is allowed only with authorization from the Natural Monuments Preservation Commission, on certain routes and territories. The second area has a less rigorous protection, grazing being allowed two months per year. With a wide variety of endangered and endemic plants and spectacular wildlife, the Retezat National Park is included in the UNESCO network of biosphere reserves.

Since the 90s, the grazing activity has increased considerably, and damages brought to nature in Retezat National Park have increased worryingly. Every summer, sheep were climbing to alpine meadows, endangering the flora and fauna of the area (as a result, the chamois number is decreasing every year). Because of this, in the last decade of the past century, the pasture area in Retezat decreased considerably, and for years, at the end of each summer remained eroded lands and much stevia (*Rumex*), as a result of sheep grazing. Due to overgrazing, the characteristic species of natural grasslands have been completely degraded or

gradually replaced by species that eliminate the other cohabiting plants (HODOR 2008, REPORT 2012, 2013). Retezat National Park is the only national park in Romania that has a management plan, which is fully approved by the central public authority for environment (REPORT 2012, 2013, KISS és ALEXA 2014a, 2014b). However, information is lacking on the distribution of habitats and species in the park and management is not always adequate – some habitats are threatened by overgrowth following abandonment of traditional pastoral activities and by the invasion of alien species. At the same time, tourism in the area leads to deliberate destruction of valuable mountain pine (*Pinus mugo*) habitats and the scattering of waste throughout the area.



1. ábra A Retezát Nemzeti Park (Hunyad megye, Románia)
Figure 1. The Retezat National Park Reservation (Hunedoara County, Romania)

Following a study on grasslands in Retezat Mountains (Retezát-hegység), the Retezat National Park Administration concluded that their area has decreased drastically due to overgrazing (REPORT 2012, 2013). The alpine habitats in Retezat National Park are abused by overgrazing, an example in this respect being Drăgșanu Ridge (Dréksán-nyereg), where the biodiversity is very low, being correlated with the abandonment of former grazing areas, which requires careful management measures.



2. ábra Dréksán-nyereg a Retezát-hegységben
Figure 2. The Retezat Mountains view on the Drăgșanu Ridge (Dréksán-nyereg)

The preservation of the unique natural landscape, undisturbed is a priority activity which brings benefits both in terms of biodiversity and tourism attractiveness. During 2008, it has been developed a monitoring protocol for the priority habitat of the creeping mountain pine and juniper shrubs in Retezat Mountains, aimed at the maintenance of natural processes deployment and elimination, or at least reduction of the factors hindering the deployment of these processes (REPORT 2012, 2013). So, certain direct actions have been supported for

stopping the destructive processes, within a conservative management of the alpine habitats belonging to Retezat National Park (HODOR 2008, REPORT 2012, 2013). The main objective was to improve the conservation management of the alpine habitats in the Retezat Mountains. Onsite activities to halt habitat destruction would be implemented along with a campaign promoting conservation, especially the long-term preservation of the alpine habitats.

The socio-economic changes in Romania apply an increasing pressure over the natural habitats, and urgent measures for the long-term preservation of these values are needed. The complexity of the issues concerning the protected areas and the diversity of approaching the priority habits subject, are essential factors that emphasize the need of implementing restoration activities, in the years to come.

The biodiversity and specific habitats in the Retezat Mountains

The mountain pines (*Pinus mugo*) are dominant in the Retezat Mountains, spread over the entire subalpine floor, from the upper limit of the spruce forest (*Picea abies*), found at about 1500–1600 meters, up to an altitude of 2300 meters (CANDREA BOZGA 2009, RADU 2004, HODOR 2008). The large hedges covering the subalpine slopes, the mountain pine habitat, are mostly composed of creeping mountain pine (*Pinus mugo*), which grows either alone or associated with other arborescent woody plant species (especially spruce – *Picea abies*) or juniper shrubs (*Juniperus*). Species of the genus rhododendron are widely distributed and are considered alpine native plants. *Rhododendron kotschyi* (*R. myrtifolium*) is found in the Carpathian in forest floor, pine scrub to open moorland on acid and limestone. It can form large stands in the alpine heaths growing along with *Juniperus communis*. Of the numerous species of Rhododendron, this (i.e. *Rhododendron kotschyi*) is the only growing in Retezat Mountains, in alpine and sub-alpine areas, gaps in the mountains or on hillsides.



3. ábra A kúszó törpefenyő (*Pinus mugo*), a boróka (*Juniperus nana*) és a rododendron (*Rhododendron kotschyi*) közös élőhelye a Retezát-hegységben

Figure 3. The mountain pines (*Pinus mugo*), juniper (*Juniperus communis*) and rhododendron (*Rhododendron kotschyi*) common habitat in the Retezat Mountains

Dominant species is the creeping mountain pine, forming very dense shrubberies, with flexible branches, hard to peppered, with or without rhododendron or juniper associations. The mountain pines are found from the upper limit of the spruce forest, up to the contact with the alpine meadows, physio-gnomically characterizing the sub-alpine floor (CANDREA BOZGA 2009, DONIȚĂ et al. 2005, UNTARU et al. 2012). The mountain pines scrubs are becoming compact with increasing altitude, the boundary spruce forests thinning gradually. The clumps of stunted mountain pines and juniper bushes can be found at altitudes far beyond the limit of the compact mountain pines trees, on alpine meadows and rocks. With increasing altitude, the

mountain pines compact thickets are crumbling, making way increasingly for undergrowth's of 30–50 cm height, such as rhododendron (*Rhododendron*). As this is a natural habitat to the upper limit of their forests, they are not required special management measures. In fact, that this type of habitat is very rare, it is recommended to protect themselves.



4. ábra Bozótos kúszó törpefenyő (*Pinus mugo*) és rododendron (*Rhododendron*) társulások a Retezat-hegységben

Figure 4. The mountain pines (*Pinus mugo*) scrubs with rhododendron (*Rhododendron kotschyi*) associations in the Retezat Mountains



5. ábra Boróka (*Juniperus communis*) és rododendron (*Rhododendron*) társulások a Retezat-hegységben
Figure 5. The juniper (*Juniperus sibirica*) scrubs with rhododendron (*Rhododendron kotschyi*) associations in the Retezat Mountains

The mountain pines tree subfloor (between 1700 and 2300 m) is, undoubtedly, interesting in terms of vegetation and landscape in Retezat National Park, consisting of juniper and creeping mountain pine trees, found in clumps or spreading carpets. Clumps can be seen on the northern slopes below 1700 m, as modest shrubs can withstand the climate at altitudes over 2300 m. The largest carpets of mountain pine are spreading between 1700 and 2100 m, as is the case of Drăgșanu Valley's forests and thickets.

The two indigenous species of juniper berries that grow in Romania, are shrubs of small or medium (2 to 3 meters, in the case of *Juniperus communis*, and 0,3 m to 0,5 m, in the case of *Juniperus sibirica*) with dense clump. These species appears often in sub-alpine floor alpine and Carpathian area, especially in Retezat mountains, where they form true dwarfs forests. Species vegetates well even under the most adverse environmental conditions, meeting even on forested cliffs, standing exposed to the wind and bad weather.

Ecological restoration actions in the Retezat Mountains

Accelerated degradation of natural capital in Romania under the pressure economic development, in particular under the conditions present crisis economic-financial creates countless environmental problems in most protected areas. National and natural parks, nature and scientific reserves and other categories of protected natural areas — and by default

protected species and their habitats — are subject to pressures of all kinds, which result in the reduction and fragmentation of habitats, invasive species, and the threat of species with extinction.

Degraded land imposes such execution of any specific actions for upgrading, consolidation and preparation of the land with a view to planting, as well as the use of certain special procedures for afforestation of hills and going downhill's. Thus, the terraces may be planting seedlings of forest species specific conditions appropriate to the environment of habitat. Forest types of crops which have submitted a good production and have a high efficiency in stopping the excessive erosion of surfaces are the priority habitats of the creeping mountain pine and juniper shrubs.

Research within the research institutes highlights the particularly important role exerted by the forest crops installed on damaged land in the environment protection. As a result of the exercise of the protection of the soil (anti-erosional), these crops constitute a real shield to protect against erosion and substantially reduce the land movements (REPORT 1995, COMIN 2010, CONSTANDACHE et al. 2010).

Stabilization processes of degradation of lands, the progressive restorations, in the meantime, of the land that may have been damaged and the restoring (renaturation) of the forest vegetation effects can be considered to be more important functional exercised forest protection actions. All of these have a resulting that improve and protect the natural environment, and, gradually, under direct effect of forest crop protection, it is the gradual restoration of the ecological balance of areas. Forest vegetation installed on the degraded lands has, therefore, an important role in silencing variations in flow and, by default, to provide for permanent leaks and balanced by increasing the amount of precipitation in the form of snow and the delay in its melting (JORDAN et al. 2003, KISS és ALEXA 2014a).

Research made for the study of the leakage area and soil erosion, in experimental boundaries located in different slope conditions, vegetation and degree of erosion, have implemented submits that, to the excessively eroded afforested land, after the age of 15–20 years of crops, it is carried out a reduction in leakage surface of more than 4 times, as compared with the land erosion active, practically free of vegetation. Forest vegetation makes soil erosion to be much reduced as compared with those of the plots of land which are discovered, in particular in the case torrential floods. Thus, the nearing forms a crucial importance, especially in the case of the downpour floods accompanied by high winds, specifics in the alpine areas. Also, the water retained on the hills and stored in the soil ensures adequate supplies of crops, especially during the drought periods (UNTARU et al. 2008).

The positive effects of the protection forest crop to improve the conditions of vegetation, and implicitly of the soil, have led, particularly in the case of land for the moderate to strongly eroded soils, when the naturally installing of a habitat being friendly environmentally reconstructed. Thus, current concerns and projections for the future by the reconstruction environmental afforestation of degraded land should be intensified, by new ecological activities. Special attention should be given to choice of the afforestation species, taking into account the consistency between specific requirements of the mountain habitat and the environmental conditions.

Two ecological restoration actions have been proposed — the ecological reconstruction of eroded slopes and reforestation of some degraded ecosystems — destroyed areas located within the creeping mountain pine and juniper habitat. The reforestation action has been cancelled, because it was seen the natural regeneration of juniper in the affected areas, while the ecological restoration was made in Drăgșanu Ridge area, on a highly eroded torrent found in the juniper habitat, where a total of 1600 creeping mountain pine seedlings were planted, obtained from seeds collected from the Park, thus stopping the severe soil erosion phenomena over an area of approx. 1,5 ha (REPORT 2008, 2013, KISS és ALEXA 2014a).

The socio-economic changes in Romania apply an increasing pressure over the natural habitats, and urgent measures for the long-term preservation of these values are needed (REPORT 2010). The complexity of the issues concerning the protected areas and the diversity of approaching the priority habitats subject, are essential factors that emphasize the need of implementing restoration activities, in the years to come. Forest landscape restoration provides a complementary framework to sustainable forest management and the ecosystem approach in landscapes where forest loss has caused a decline in the quality of ecosystem services. It doesn't aim to re-establish pristine forest, even if this were possible; rather, it aims to strengthen the resilience of landscapes and thereby keep future management options open.

In the summer of 2007, it was started the destruction of stevia (*Rumex*), and in the subsequent have been started the ecological restoration projects (REPORT 2008, 2013). In the years that followed, direct actions have been taken to restore the valuable alpine habitats belonging to the Park, resulting in the development of pilot projects for ecological restoration of some mountain pine tree habitats. In this regard, for the rehabilitation of some degraded areas in the mountain habitat, a series of actions have been conducted to review the perimeter planted, in soil beds, with 2–3 years old seedlings of creeping mountain pine shrubs originated from natural populations (REPORT 2008, 2013, KISS és ALEXA 2014b).

Study Case on Renaturation in Retezat National Park

Brief overview & Motivation

A shorter erosion stage is observed on the northern slope of the mountain, on Drăgșanu Ridge (approx. 1600–1800 m altitude). A land in Retezat Mountains, degraded by overgrazing, located at 1600 m altitude, was strengthened by planting creeping mountain pines and junipers supplied by the Retezat National Park Administration. Thus, a severely damaged forest area in Retezat National Park will be ecologically reconstructed (REPORT 2008, 2013).

Within the ecological restoration, five tons (1600 seedlings) of creeping mountain pine and juniper seedlings were transported in Retezat National Park by Retezat National Park Administration, for the renaturation of a degraded area. The objective of such ecological restoration is to restore the mountain pine natural habitat in Drăgșanu Ridge area, part of Retezat Mountains, belonging to Retezat National Park, located between 1600 m and 1950 m altitude, on the northern slope of Retezat. In this area, the priority habitat has been destroyed, and the habitat area reduction occurred in the past due to deforestation activities in favor of extending the grasslands, using mountain pine and juniper as firewood by shepherds and tourists, and the intense adjacent grazing (KISS és ALEXA 2014a, 2014b).



6. ábra Túllegeltetés miatt degradált talaj, Retezát-hegység (Dréksán völgy)
Figure 6. Degraded land by overgrazing in Retezat Mountains (Drăgșanu Valley)

Why was mountain pine and juniper required in Drăgșanu area? There, because of gullies dug by the sheep hooves, strong soil erosion occurred, phenomenon that favored the formation of a torrent. This has resulted in landslides and degradation of the area, and the slope was severely affected. The mountain pine remained only in proportion of about 30% of the area. Because of the tree vegetation disappearance and the steep slope, which in some sections even reached 45°, an avalanche corridor has been formed.

All these led to the need to restore the former natural habitats, recovery consisting of strengthening by planting creeping mountain pine and juniper (seedlings). In these conditions, some ecological terraces have been made, on which creeping mountain pine was planted, for strengthening the soil. The planting of creeping mountain pine seedlings was organized by camps at altitude, with volunteers, with the support of Retezat National Park Administration and the assistance of Deva Forestry Directorate. To be noted that this is only one of the actions conducted within the conservative management activities aiming the alpine habitats of Retezat Național Park. Restoration works would target around 130 ha of valuable alpine habitats, mountain pine (*Pinus mugo*) habitats and alpine wetlands, and soil erosion would be prevented on several locations.



7. ábra Helyreállítási tevékenységek/A csemeték ültetése
Figure 7. The restoration works/Planting of seedlings

In the last few years, similar actions for the degraded grassland restoration have been started, through the implementation of pilot projects for ecological restoration of some mountain pine habitats. In the Retezat National Park, the reconstruction actions will continue in the coming years, by planting mountain pine and juniper seedlings. Just like before, the planting will be made in compost pits, with 2–3 years old seedlings, supplied by Deva Forestry Directorate, a branch of National Forest Administration, from the nurseries of the Forest Research and Management Institute (ICAS).

Materials

The plant material consisted of creeping mountain pine and juniper seedlings. The habitat restoration was designed based on the principles of genetics, according to which the planting should be made using seedlings with local provenance. This principle could not be strictly observed in case of creeping mountain pine, as this species, although it's well represented in Retezat Mountains area, is very poor in the affected area (KISS és ALEXA 2014a, 2014b).



8. ábra Törpefenyő (*Pinus mugo*) és boróka (*Juniperus nana*) csemeték
 Figure 8. The mountain pine (*Pinus mugo*) and juniperus (*Juniperus communis*) seedlings

Therefore, the seedlings were grown in a nursery of the Forest Research and Management Institute, in Sinaia. The mountain pine seedlings of *Pinus mugo* were transported by truck from Sinaia, from the nursery of the Forest Research and Management Institute (ICAS), taken over by a helicopter, and brought in the affected area to be planted on Drăgșanu Ridge, in Retezat National Park.

Method of action/Remarks

The plantation at the end of summer in subalpine zones was preferable to the spring one, because the nursery, where the seedlings were produced, is located at about 680–700 m altitude, where the vegetation period usually starts in March. Depending on soil thaw, in the Retezat Mountains area the planting process cannot take place until the second decade of June. Until this time, the seedlings have already achieved a significant growth in nursery, and can be broken during transportation and handling. This is why we opted for planting them in late August.

We must note that the slope, associated with the felt formed by the perennial grass carpet roots and the limestone rock fragments, located at the surface or incorporated into the soil, created particularly difficult working conditions.

The habitat restoration with creeping mountain pine, within Drăgșanu Ridge area, depends on the success of this plantation, located in the subalpine zone on the northern slope of Retezat Mountains. Although the mountain pine seedlings may suffer transmutation stress, it is hoped, however, that at least 75–80% of the seedlings will adapt to the new conditions. In this regard, the creeping mountain pine seedlings are brought from the nursery with a sleeve of ground weighing more than 3 kilograms. Also, to prevent the drying during transmutation due to differences in humidity and temperature, the transportation had to last a period as short as possible. According to the inventory made taking into account the sample areas planted with creeping mountain pine, the median survival of the seedlings was even 90% in the previous years, but the survival rate varied from one area to another.

Predictable results

This paper proposes to establish a synthesis of research, protection measures and regeneration initiatives for mountain pine (a priority EU habitat type, bushes with *Pinus mugo* and *Rhododendron myrtifolium*) from inside the Retezat National Park, and also to depict the distribution of this vegetation in the area.

Underlining previous contributions related to structure, functions and regeneration possibilities we would like to argue the necessity to continue them and develop new ones from the perspective of principles and methods of monitoring and ecological management.

(KISS és ALEXA 2014a, 2014b) The current economic conditions and as a result of the actions to promote tourism it is very likely that the pressures due to tourism activity to increase, endangering one of the basic features of Retezat National Park, natural look that wild, as well as specific diversity, genetics and ecosystem.

The long-term predictable results of the ecological restoration with creeping mountain pine, performed for supporting some actions aiming the stoppage of the destructive processes, are:

- prevention of avalanches, floods and soil erosion as a result of solid and liquid precipitation retention by the woody vegetation;
- creating the required conditions for natural regeneration and/or restoration of the creeping mountain pine population;
- provision of food, by means of mountain pine seeds, of some mammals (bear and certain species of small rodents), as well as some birds living in the mountain area;
- organizing a campaign to promote the green conservative concepts, with a special focus on long-term preservation.

In the medium term, the expected outcomes are to create better conditions for the development of woody and herbaceous plants, along with the wild animals, followed by a normal development in the future. This goal is achieved by establishing a control over the factors that previously contributed to the degradation of the ecosystems consisting of plants and wild animals.

In the short term, the predictable results of this ecological restoration are:

- protection and preservation of flora and fauna;
- ecological restoration of creeping mountain pine and juniper habitats by planting in affected and degraded areas;
- creating normal conditions for natural regeneration of the mountain pine, which is going to spread bit by bit in the surrounding areas, so that the creeping mountain pine population will recover.

The research and studies carried out in this area are numerous; they have continuity and tradition, and concern fundamental aspects regarding the biodiversity. For this reason, the maintenance and proper management of this unique national park is a priority. The main objective was to improve the conservation management activities to halt the alpine habitats destruction in the Retezat Mountains would be implemented along with a campaign promoting conservation, especially the long-term preservation of the alpine habitats (KISS és ALEXA 2014a; 2014b).

Concluding remarks

In order to reconstruct and maintain a favorable conservation status of *Pinus mugo*, *Juniperus* and *Rhododendron* mountain habitats and in full compliance with the European legislation and existing national, with the results obtained in other projects which have as their object of study this type of habitats but also with environmental requirements, we proposed the ecological reconstruction by planting in ground beds with young trees, coming from natural populations (nursery).

By ecological restoration of these mountain habitats, it is expected that the surface erosion of the degraded woodlands, previously used for grazing, to be fully stopped in 5–15 years after the execution of afforestation works, in accordance with the afforestation species and the nature and intensity of degradation.

Through the direct effect of the protective afforestations with creeping mountain pines, applied for the ecological reconstruction of these mountain habitats, it is expected a

regeneration in 5–10 years' time of the moderately/highly eroded slopes, and in 8–15 years' time of the very strong/excessively eroded slopes.

Given the scale of action, it is therefore necessary to draw up programs for afforestation by stages and geographical areas, with the needs of seedlings, of labor, effort and financial resources, on the basis of an assessment of the forest surface necessary and the urgency of intervention. The future restoration actions shall consist of re-entry into the soil of specimens affected by winter phenomena, supplemented by compost of previous years' planting areas and planting in addition to young trees and seedlings. The action will be completed at the beginning of the summer months, when will it be maintained either vegetation around young trees planted and will be determined degree of success of planting.

In conclusion, the afforestation of land that may have been damaged, associated with installation of forest curtains, represents one of the most effective measures to protect the environment and ambient to mitigate climate change, through vital functions which the crops forestry exercising them, while at the same time providing resources of renewable materials. The anti-erosional measures, with renaturation character, must be based on wide studies to determine the damaged fields characteristics and to establish the proper species and appropriate technologies for the further afforestation actions.

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A HAVASI ÉS ALHAVASI ÉLŐHELYEK HOSSZŰ-TÁVŰ MEGÓVÁSA ÉRDEKÉBEN VÉGZETT
ÖKOLÓGIAI HELYREÁLLÍTÁSI TEVÉKENYSÉGEK A RETEZÁT NEMZETI PARKBAN

Kulcsszavak: Retezát hegység, havasi élőhelyek, törpefenyő (*Pinus mugo*), boróka (*Juniperus communis*), rododendron (*Rhododendron kotschy*), élőhely rekonstrukció, mesterséges regenerálódás

Összefoglalás: Jelen tanulmány a törpefenyő (*Pinus mugo*), a boróka (*Juniperus communis*) és a rododendron (*Rhododendron kotschy*) közös élőhelyeire fókuszál oly módon, hogy bemutatja a Retezát Nemzeti Park havasi és alhavasi, nem sérült populációinak fenntartási és megőrzési módszereit, valamint a már sérült populációk rekonstrukciós módszereit és konzerváló kezelését is. A természetes és mesterséges regenerációs módszerek közül a leromlott állapotú törpefenyő populációk helyreállítására a csemete ültetvényes regeneráció tűnik az egyetlen elfogadható módszernek, tekintettel arra, hogy a természetes regeneráció bonyolult folyamat és hosszú ideig tart. Az alkalmazandó módszerek helyes kiválasztása érdekében a tanulmány a Romániai Déli-Kárpátokban található Retezát Nemzeti Park egyedülálló természeti tájainak megőrzési terveit is bemutatja, majd a törpefenyő (*Pinus mugo*) és a társult lágú- és fásszárú növényfajok élőhelyeinek leírásával folytatódik. A Retezát Nemzeti Parkban végzett ökológiai helyreállítással kapcsolatos esettanulmány — a törpefenyő és a boróka csemete ültetvényes regeneráció — a módszerek és konkrét eredmények ismertetése mellett a várható eredményeket is előrevetíti, figyelembe véve az elpusztult élőhely mesterséges regenerációjának ökológiai elveit, mint például: beültetett terület, csemeték, csemetenevelés és az ültetés helyére történő szállításuk, valamint a tényleges ültetés.