THE SCIENTIFIC STUDY ASSESSMENT OF NATURA 2000 HABITATS AND SPECIES TO SUBSTANTIATION ECOLOGICAL RECONSTRUCTION IN THE LESPEZI QUARRY

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Table of contents

Abstract.................................................................................................................................2
Introduction.............................................................................................................................2
1.1. Objectives ..................................................................................................................2
1.2. General information about the physical-geographical characterization of the researched territory.................................................................3
1.3. Flora, fauna, vegetation and Natura 2000 habitat research methods.................................3
1.4. Results................................................................................................................................3
1.4.1. Research on the flora, fauna, vegetation and Natura 2000 habitats in Lespezi Quarry and neighboring areas..............................................................3
1.4.2. Considerations about the vegetation of Lespezi Quarry and neighboring areas ..................4
1.4.3. Natura 2000 habitats found in Lespezi Quarry and the surroundings.................................5
1.4.4. Ecological reconstruction proposals in Lespezi Quarry...................................................7
1.5. Discussions....................................................................................................................10
Conclusions..........................................................................................................................10
Annexes.................................................................................................................................11
ABSTRACT

"The only possibility to protect endangered species from extinction is preserving the biological communities and the ecosystems they are part of" (N. Boscaiu, 1985)." The consequences of the forest, shrubs, pastures and hay-fields areas reduction are multiples and they influence the whole planet: climate changes, exploitation mining, floods, the clogging of the inferior river basins, soils erosion, landslips, etc. All of these have negative effects over either the species or the landscape balance. In the area of the Lespezi Quarry part of the site ROSCI0013 - Bucgei, meet important Natura 2000 species and habitats. The diversity of flora and fauna in the Quarry Lespezi is very rich and very interesting. Conserving biological diversity in the Quarry Lespezi includes protecting habitats and protecting the wild animals and plants. Also this means and sustainable use. For preserving biological diversity is required to ensure a strategy based on the premise that the protection and use of biodiversity should always be considered from both an ecological, economic and social viewpoint. In this project we plan evaluation this species and habitats, as well as anthropogenic effects resulting from the exploitation mining in the area of the Quarry Lespezi. It is necessary to establish reference values of favourable conservation status of species and habitats Natura 2000. It is important to give a special attention to the most affected habitat. We carry out inventory and evaluate Natura 2000 species. Monitoring the state of preservation of habitats and species it is very important in this area.

Considering the importance and prevalence of the fauna and vegetation in this area it is necessary to identify the species of flora and fauna and the vegetation in the Quarry Lespezi;

- to identify the species of flora and fauna and the vegetation in the Quarry Lespezi;
- to identify and to stop the main causes which lead to the degradation of the vegetation content;
- to identify the brittle forest, grassland screes ecosystems which are affected by the mining exploitation;
- to identify the conservation measures and possibilities to comply with the conditions of the protected fauna and vegetation in this area;
- to elaborate the plans for promotion, careful management, control, preservation and durable development of the habitats Natura 2000 species. Monitoring the state of preservation of habitats and species it is very important in this area.

INTRODUCTION

Mining exploitation has been known and applied worldwide since ancient times. Throughout the world major actions are carried out for ecological reconstruction in areas where biodiversity was disturbed following the anthropic impact. These ecological reconstruction actions are significant objectives not only for the major scientific research facilities and universities, but also for the world’s leading industrial companies, which contribute more or less to the restitution of the ecological balance, through thorough and fundamental long-term researches on the ecosystems, aiming at better managing the patrimony of natural resources.

Reintegration in the landscape, as well as restitution of the ecosystem status for a mine area are phenomena of major importance in biodiversity conservation.

1.1. OBJECTIVES

Considering the importance and prevalence of the fauna and vegetation in this area it is necessary:

- to identify the species of flora and fauna and the vegetation in the Quarry Lespezi;
- to identify the habitats Natura 2000 in the Quarry Lespezi;
- to identify and to stop the main causes which lead to the degradation of the vegetation content;
- to identify the brittle forest, grassland screes ecosystems which are affected by the mining exploitation;
- to identify the conservation measures and possibilities to comply with the conditions of the protected fauna and vegetation in this area;
- to elaborate the plans for promotion, careful management, control, preservation and durable development of the habitats in quarry Lespezi;
- ecological rehabilitation at the grassland level;
- rehabilitation of screes;
- ecological rehabilitation at the level of the forest vegetation;
- to ensure forest regeneration by the ecological reconstruction of areas affected by mining exploitation.

Elaboration of measures to halt the decline of species and habitats through ecological reconstruction. Eological reconstruction in this area can be achieved through the regeneration of the forest fund. The diversity of flora and fauna in the Quarry Lespezi is very rich and very interesting. Conserving biological diversity in the Quarry Lespezi includes protecting habitats and protecting the wild animals and plants. Also this means and sustainable use. For preserving biological diversity is required to ensure a strategy based on the premise that the protection and use of biodiversity should always be considered from both an ecological, economic and social viewpoint. In this project we plan evaluation this species and habitats, as well as anthropogenic effects resulting from the exploitation mining in the area of the Quarry Lespezi. It is necessary to establish reference values of favourable conservation status of species and habitats Natura 2000. It is important to give a special attention to the most affected habitat. We carry out inventory and evaluate Natura 2000 species. Monitoring the state of preservation of habitats and species it is very important in this area.

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- to identify the brittle forest, grassland screes ecosystems which are affected by the mining exploitation;
- to identify the conservation measures and possibilities to comply with the conditions of the protected fauna and vegetation in this area;
- to elaborate the plans for promotion, careful management, control, preservation and durable development of the habitats in quarry Lespezi;
- ecological rehabilitation at the grassland level;
- rehabilitation of screes;
ecological rehabilitation at the level of the forest vegetation;
- to ensure forest regeneration by the ecological reconstruction of areas affected by mining exploitation.

Elaboration of measures to halt the decline of species and habitats through ecological reconstruction.

Eological reconstruction in this area can be achieved through the regeneration of the forest fund identified the species that can install best in these environmental conditions.

In order to avoid erosion of soil and reduction of pollution of air in the area of the Lespezi we consider most species indicated are the forest and shrubs species, but without disturbing the balance of habitats.

1.2. GENERAL INFORMATION ABOUT THE PHYSICAL-GEOGRAPHICAL CHARACTERIZATION OF THE RESEARCHED TERRITORY

Lespezi Quarry, an integral part of Bucegi National Park site ROSCI0013 – Bucegi, is located within the administrative scope of Dâmboviţa County, near the locality of Fieni (Annex 1, fig. 1, 2). From a geomorphological point of view, the territory of this quarry belongs to Carstic Plateau from Mount Lespezi. From a hydrographical point of view, the researched territory is found on Valea Brăteului, an affluent of Ialomiţa River. From the point of view of the climate, the researched territory has a mountainous climate, mountainous-forestry floor, comprised between 800 and 1,800 m altitude.

1.3. FLORA, FAUNA, VEGETATION AND NATURA 2000 HABITAT RESEARCH METHODS

The conspectus of the flora, fauna and habitats in the Lespezi Quarry has been elaborated on the basis of personal researches undertaken since April-September 2012, as well as the little bibliographical information regarding this field. In order to identify the flora species and the inter-taxa, we looked into: *Romanian Flora*, vol. I-XII (1952-1976); *Flora Europaea*, vol. I-V (1964-1980); *Flora Italic*, vol. I-II, by P. Zangheri (1976); *The Romania illustrated Flora – Pteridophyta et Spermatophyta*, by V. Ciocărlan (2000); Alpin *Flora*, VoI, II, III by D. Aeschimann et al. (2004). Regarding the nomenclature, we chose the nomenclature solutions which are considered correct, in accordance with The International Code of the Botanic Nomenclature (*Code de Vienna*, 2000).

In order to identify the fauna species, we looked into: *Atlas of birds brooding in Romania* by D. Munteanu & al. (2002); *Catalogul Lepidopterelor României* (Verzeichnis der Schmetterlinge Rumaniens) by L. Rakosy, M. Goia & Z. Kovacs (2003); *Romania Hunting* by V. Cotta, M. Bodea and I. Micu (2003).

For the study of the vegetation carpet in the Lespezi Quarry, we have used methods of phyto-sociologic research characteristic to the Central European phyto-sociologic School, which was based on the principles and methods elaborated by J. Braun-Blanquet (1926) and adapted by A. Borza (1934) to the particularities of our country’s vegetation. The associations were identified and distinguished according to the characteristic, edifying, dominant and differential species. The name of the vegetal association was given taking into account the regulations stated by the *Phytosociologic Nomenclature Code* (2000). The size of the sample areas was established according to the type of vegetation: 25-100 m² for meadows, 1-4 m² for rocky regions, 25-100 m² for underwoods, 400 m² -1000 m² for forests. The quantitative assessment of the participation of every species to the vegetal association was performed with the help of the abundance-dominance index, according to the Braun-Blanquet scale. We have noted also the constancy of the species (K). The vegetal associations were analyzed and characterized from the chorologic, ecologic point of view and according to the aspect of the floristic composition and physiognomy, syndinamically. In order to identify the habitats, we looked into: *NATURA 2000 IN ROMANIA HABITAT FACT SHEETS* (2008); *Habitats from Romania* by Doniţă N. & al. (2005); *MANUAL interpretation of NATURA 2000 HABITATS in ROMANIA* by D. Gafta & O. Mountford- coord. (2008).

1.4. RESULTS

1.4.1. RESEARCH ON THE FLORA, FAUNA, VEGETATION AND NATURA 2000 HABITATS IN LESPEZI QUARRY AND NEIGHBORING AREAS

The flora found in the perimeter of Lespezi Quarry, an integral part of Bucegi Mountains, is particularly rich and interesting. A series of endemic, rare, vulnerable and endangered species were found, of vegetal as well as animal origin. Such a rich flora is due first of all to the relief, climate, altitude, lithological and geological structure conditions and, not in the last place, the position of the researched territory which is part of the Alpine Bio-Geographical Region.

Some species of lichens, bryophytes and macromycetes from the Thalophyta group were identified in Lespezi Quarry and the surrounding forests. The bryophyte species were identified in spruce forests and in forests where there is a mix of beech and coniferous trees, which occupy quite large areas of this territory.

Out of the macromycetes, although 2012 was an extremely dry year and field trips were not sufficient, we found 18 species in the structure of the forest habitats within the quarry perimeter and its surroundings (List of species - Annex 2).

Out of the cormophytes, orchid species hold the supremacy in Lespezi Quarry, thanks to the limited antropic impact here. Quite many species are found here on a quite limited area, and especially in an active mining quarry, which is particularly impressive. Some of these species are found on the red lists and should be given careful consideration as regards their preservation. Thus, in the perimeter of Lespezi Quarry, we identified...
12 orchid species (List of species - Annex 2). All these orchid species are rare, endemic species and most of them are found on Natura 2000 list of species.

Within the researched territory, there are many rare, vulnerable, endangered or endemic species of cormophytes, a large part of which are included on the Natura 2000 list of cormophyte species. These species are found in Lespezi Quarry, as well as the neighboring areas (List of species – Annex 2).

The fauna found in Lespezi Quarry and its immediate vicinity is well represented and, during the study conducted this summer, we haven’t identified any particular disturbing issues resulting from the activities carried out here. Thus, we identified (although the time was very short) invertebrate as well as vertebrate species. Some of these species are frequently found in Lespezi Quarry and the surroundings. A number of vertebrate or invertebrate species are rare, endangered species, found on the Red Lists or part of the Natura 2000 species. (List of species – Annex 3). Out of the protected species of mammals found in the perimeter of Lespezi Quarry and its surroundings, 2 priority Natura 2000 species were identified - 1354* Ursus arctos (Linnaeus, 1758) (a frequently found species) and 1352* Canis lupus (Linnaeus, 1758). The amphibian and reptiles fauna in the perimeter of Lespezi Quarry is represented by a smaller number of species, but there are surely other species found in the quarry and neighboring areas. According to the bibliographical data, as well as the field observations, we can enumerate 27 species of birds in the area of Lespezi Quarry (Annex 3).

In the perimeter of Lespezi Quarry and its neighboring areas, several time of birds are found, but the time allocated to these studies during the competition was not sufficient for a proper identification hereof. However, we can say that the most frequent species are Parus, Picus, Turdus, Anthus, Prunella, and of course Corvus corax L.

1.4.2. Considerations about the vegetation of Lespezi Quarry and neighboring areas

The ground cover in Lespezi Quarry is a reflection of the very diverse stationary conditions, adding to a certain extent to the influence of the anthropo-zoogenic factors. However, following the field research, we were pleasantly surprised to find that the anthropic impact here is quite low compared to other mining quarries we worked on, for instance Arnata.

The woody vegetation is represented by forests and scrubs characteristic especially to the higher mountainous understory and to a smaller extent to the subalpine level. The main forestry vegetal associations found here are: Phyllitidi-Aceretum (Vida 1959) 1963 (Syn: Phyllitidi-Aceretum, Acereto-Fagetum auct. roman.), Hieracio rotundati-Fagetum (Vida 1963), Palmonario rubrae-Fagetum (Soó 1964) Tauber 1987, Sorbo-Betuletum pendulae Dihoru 1975, Populo-Betuletum pendulae Coldea 1972 (Syn. Junipereto-Betuletum albae Soó ex Borza et Boşcaiu 1965), Hieracio rotundati-Piceetum Pawl. et Br.-Bl. 1939, the latter one being also the widest spread (Annex 4).

Heath vegetation

Nut-groves classified under Coryletum avellanae Soó 1927 association are found in the area of Lespezi Quarry and neighboring areas – Brâteiuilui Basin, growing at the margin of beech woods. Mountain alders classified under Saliceto silesiaca-Alnetum alnobetulae Colic et al. 1962 (Syn. Alnetum viridis auct roman) association grow along the shady valleys, on steep slopes and rocky places, on slopes with an inclination between 10˚-35˚, being mainly found in neighboring areas.

Well outlined plant communities of Rubetum idaei Gams 1927 association grow especially at the forest margin.

Pinus mugo form dense scrubs difficult to go through, in the neighboring areas of Lespezi Quarry, while in the quarry they grow only as isolated individuals on the limestone ledges. The scrubs part of the plant communities dominated by juniper shrubs, classified under Campanulo abietinae – Juniperetum alpinae (Buia et al 1962) Boșcaiu 1971 (Syn. Juniperetum nanae Soó 1928, Juniperetum sibiricae Rațiu 1965) association, are frequently found at the higher limit of Lespezi Quarry, in the areas called Cliaia de Pitră and În Senin.

Dwarf scrubs of Ericaceae are also well represented at the higher limit of Lespezi Quarry and occupy quite large areas in the surroundings, the widest spread association being Campanulo abietinae-Vaccinietum myrtilli (Buia et al 1962) Boșcaiu 1971.

Herbaceous vegetation is represented by grasslands, ruderal vegetation and saxicolous and ledge vegetation, montane tall shrubs and less ruderal vegetation (growing around buildings, shelters, warehouses, on the side of the roads and footways or the soil areas of the quarry).

Grasslands are a wide-spread vegetal formation; the broadest areas are covered with secondary grasslands of Festucetum nigrescens, F. airoides și Potentilla ternata ssp. cryoseraspica, Agrostis capillaris, Nardus stricta. From a physiognomic point of view, these grasslands are characterized by the presence of endemic species and rare floristic species characteristic to the Southern Carpathians.

At the Northern limit of Lespezi Quarry, major grasslands classified under Seslerio haynaldianae-Caricetum sempervirenitis Pușcaru et al.1956 (syn.: Seslerietum haynaldianae sempervirenitis Pușcaru et al. (1950)1956, Seslerietum rigidae retezaticum Csúrös et al. 1956 p.p., Seslerietum rigidae biharicum Csúrös 1963), Festucetum saxatilis Domin (Syn. Festucetum saxatilis subalpinum auct. roman; Caricetum

Nardus grasslands, spreads in Lespezi area, define Violo declinatae-Nardetum strictae Simon 1966 association.

* Saxicolous vegetation * is well represented, taking into account the richness in rocky formations of Lespezi Quarry. On shady rocks, plant formations of Poa nemoralis and Asplenium trichomanes are found. In crevices of rocks with large inclination, plant formations of Hymenopterum capreiforme and Polygodium vulgare grow. On calcareous rocks, especially plant formations grow that were not classified under associations: Asplenio-Cystopteridietum fragilis Oberd. (1936) 1949 (Annex 1) and Asplenietum trichomano-rutiae murariae Tx. 1937, the plant formations of these associations growing in the crevices of the calcareous rocks.

The vegetation characteristic to ledges is dominated by the following species: Sesleria haynaldiana, Carex sempervirens, Festuca amethystina.

* Rock debris and blocks * which are widely spread in the researched territory are mainly occupied by the characteristic association - Acino alpini-Galietum anisophylli Beldie 1967 (Annex 6), spread at the higher limit of Lespezi Quarry. This category of vegetal communities in the researched territory also includes Thymo comosi-Galietum albi Sanda and Popescu 1999 (Syn. Thymetum comosi Pop et Hodisan 1963) and Teucrietum montani Csuros 1958.

The vegetation of montane tall weeds is quite well represented in the quarry, the calcareous underlayer having a particular role in the development of the plant communities. In some shadier areas of the quarry luxuriant weeds grow. One of the tall weed association is Senecio sylvatici-Chamaenerietum (Epilobieta angustifolii) (Hueck 1931) Tx. 1950 spread in the perimeter of the quarry, but especially in the neighboring areas, where deforestation activities were carried out.


In some shadier areas of the quarry, but especially in the neighboring areas, which are classified under the following *vegetal associations*: Adenostylo alliiariae-Doronicetum austriacum Horv. 1956 (Syn. Adenostylo alliaariae auct. roman. Cirsio waldsteinii-Heracleetum palmati Pawl. et Walas 1940 (Syn. Cardueto-Heracleetum palmati Beldie 1967; Heracleetum palmati auct. roman.) and Telekio speciosae- Petasitetum hybridi (Morarui 1967 n.n.) Resmeriţă and Raţiu. The plant communities of these associations are usually spread on colluvium alluvial soils.

As regards ruderal vegetation, plant communities of Urtica dioica, Tussilago farfara etc. are frequently found.

*1.4.3. Natura 2000 habitats found in Lespezi Quarry and the surroundings*

The main habitats of the researched area are typical to the alpine biogeographical area. Knowledge of the different types of habitats, as well as their distribution and area is particularly important for biodiversity conservation in Lespezi Quarry. This requires the identification and mapping of not only the species, but also Natura 2000 habitats, as well as the establishment of conservation measures. In Lespezi Quarry and the surroundings, Natura 2000 habitats fall under the following categories: forests, rock and debris, grasslands, tall grass along the springs, shrubs.

A. Forest habitats

1. The most important forest habitat present in the perimeter of Lespezi Quarry is Habitat 9410 - Acidophilus spruce forests (Picea) of the montane to the alpine levels (Vaccinio-Piceetum); CLAS. PAL.: 42.21 to 42.23, 42.25-Eastern Carpathian arrolla forests; EUNIS cod - G3.1B62 -Eastern Carpathian subalpine spruce forest; RO habitat type code: R4203, R4205, R4206, R4207, R4208, R4209.

They include spruce forests, grouping the following associations: Soldanello majoris-Piceetum Coldea et Wagner 1998; Hieracio rotundati-Piceetum Pawl. et Br.-Bl. 1939 (syn.: Luzulo sylvaticae-Piceetum Wraber 1953); Hieracio rotundati-Abietetum (Borhidi 1974) Coldea 1991; Leucanthemio waldsteinii-Piceetum Krajina 1933.

Carpathian spruce forests represent the higher woody vegetation characteristic to the higher montane level, growing on slopes with different inclinations and layouts, on lands with districambiosol. Characteristic and dominant species for habitat 9410: Picea abies, Abies alba, Vaccinium myrtillus, V. vitis-idea, Monesys uniflora, Orthilia secunda, Pyrola minor, P. rotundifolia, Hieracium rotundatum, Monotropa hypopitys, Hyperzia sellago, Lycoperdon annotinum, Sorbus aucuparia, Lonicera coerulea, Deschampsia flexuosa, Oxalis acetosella, Soldanella hungarica ssp. major, Homogyne alpina, Luzula luzuloides, Saxifraga cuneifolia, Oxalis acetosella, Dryopteris dilatata, Hylcomium splendens, Pleurozium schreberi, Sphagnum girgensohni.

2. The second type of important habitat found in this area is habitat 91V0 - Dacian beech forests (Symphyto-Fagion) CLAS. PAL.: 41.1D2; RO habitat type code R4101, R4103, R4104, R4108, R4109, R4116. This type of habitat groups: spruce (Picea abies), beech (Fagus sylvatica) and fir (Abies alba) forests with Pulmonaria rubra; spruce (Picea abies), beech and fir (Abies alba) forests with Leucanthemum waldsteinii;

3. In neighboring areas there is also habitat 9110 – *Laureola-Fagetum* beech forests; CLAS. PAL.: 41.11; RO habitat type code: R4102, R4105-4107, R4110. It comprises the following forest vegetal associations: *Festuco drymeiae-Fagetum* Moraru et al. 1968; *Hieracio rotundati-Fagetum* (Vida 1963) – Táuber 1987 (syn.: *Deschampsiio flexuosae-Fagetum* Sóó 1962).

**B. Rock and screes habitats**

The most important debris habitat in Lespezi Quarry is habitat 8120 – Calcareous and calcashist screes of the montane to alpine levels (*Thlaspietea rotundifolii*): CLAS. PAL.: 6.1.2; RO habitat type code: R6106, R6107, R6108, R6109, R6110, R6111, R6112, R6113 (Annex 7). This habitat is found on the calcareous screes in Lespezi Quarry and neighboring areas. Although it is poorly spread in general, this habitat is well developed in Lespezi Quarry, covering quite large areas at the higher limit of the quarry and in the areas called Claia de Piatră and În Senin. This habitat is highly significant for Lespezi Quarry as it presents an essential role in early falling and application of mobile calcareous screes. Thus, we have to take this habitat into account in our ecological rehabilitation plan as it has all the chances to get installed with our help in the area where mining operations ended. In general, the characteristic and dominant species in this habitat are specific and adapted to fixed, semi-fixed or mobile screes, with soilification process or not: *Acinos alpinus*, *Cardaminopsis neglecta*, *Cerasitum arvense* ssp. *calcicolum*, *Cerastium lerchenfeldianum*, *Cerastium transsilvanicum*, *Doronicum carpaticum*, *Galium album*, *Galium anisophyllum*, *Papaver coronopus* sancia-stephani, *Rumex scutatus*, *Saxifraga aizoides*, *Saxifraga moschuta*, *Saxifraga paniculata*, *Thymus comosus*, *T. pulcherrimus*, *Teucrium montanum*, *Alyssum repens*, *Poa molinerii*, *Parietaria officinalis*, *Geranium macrorrhizum*, *Galium lucidum*.

In Lespezi Quarry, the most important vegetal community of this habitat is *Acino alpinii-Galietum anisophylli* Beldie 1967 (Syn: *Calamintha baumgarteni-Galium anisophyllum* Beldie 1967), spread at the higher limit of Lespezi Quarry, characterized by the following physiognomy and floristic composition (Annex 6). In the rock habitats of Lespezi Quarry and neighboring areas, habitat 8210 is found - Calcareous rocky slopes with chasmophytic vegetation; CLAS. PAL.: 62.1; RO habitat type code: R6202, R6204, R6206, R6207, R6208, R6209, R6211 p.p., R6212, R6213, R6214, R6216, R6217, R6218, R6222, R6223. This habitat is characteristic to rocky, steep and shady walls, calcareous rocks, growing on superficial rendzinic soils. Out of the vegetal communities characteristic to the habitat in Lespezi Quarry the most frequently found are the following: *Asplenio-Cystopteridetum fragilis* Oberd. (1936) 1949; *Thymo pulcherrimio-Poëtum rehmanii* Coldea (1986) 1990; *Asplenietum trichomanato-ratae-murariae* Kuhn 1937, Tx. 1937 (Syn: *Tortulos-Asplenietum* Tx. 1937); *Asplenio quadrivalentii-Poëtum nemoralis* S. et ex Gergely et al. 1966.

**C. Grassland habitats**

The most important grassland habitat is 6170 - Alpine and subalpine calcareous grasslands; CLAS. PAL.: 36.1.2, 36.41 până la 36.43, 36.37, 36.38; RO habitat type code: R3601, R3605-3607, R3611, R3612, R3613, R3616, R3618, R3619. The most important vegetal community in this habitat is: *Seslerio haynaldianae-Caricetum sempervirentis* Puşcaru et al. 1956; (syn.: *Seslerietum haynaldianae* sempervirentis Puşcaru et al. (1950)1956, *Seslerietum rigidae retetaticum* Csûrös et al. 1956 p.p., *Seslerietum rigidae biharicum* Csûrös 1963) and is highly significant for Lespezi Quarry as regards the ecological rehabilitation at the level of the higher bench of the quarry where the exploitation operations ended. This vegetal community is found at the higher limit of the quarry and in the neighboring area in the Northern part, in În Senin and Claia de Piatră points. Another important grassland habitat is habitat 6150 - Siliceous alpine and boreal grasslands; CLAS. PAL.: 36.11, 36.32, 36.34; RO habitat type code: R3602-3604, R3615, R6301, R6302, R6303, R6304, R6305, R6306 (Annex 5). The most important vegetal community in this habitat is *Potentillo chrysocraspedae-Festucetum airodii* Boșcaiu 1971. Another important vegetal community in this habitat is priority habitat 6230* - Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and sub-mountain areas, in Continental Europe); CLAS. PAL.: 35.1, 36.31; RO habitat type code: R3608, R3609. It is quite spread in Lespezi area and can be highly significant for the ecological rehabilitation here. The most important vegetal communities of the habitat are: *Scorzoneroroeseae-Festucetum nigricanae* (Puşcaru et al. 1956) Coldea 1978 (Syn.: *Festucetum rubrae fallax* Puşcaru et al. 1956, *Festucetum rubrae montanum* Csûros et Resmeriţă 1960); *Violo declinatae-Nardetum* Simon 1966(Syn.
This category includes habitat **6430** - Hydrophilous tall-herb fringe communities of plains and of the montane to alpine levels; CLAS. PAL.: 37.7 și 37.8; RO habitat type code: R3701, 3702, 3703, 3706, 3707, 3708, R3714. Hydrophilous plants in this habitat grow in shady places with high humidity of the montane level on colluvium alluvial soils. This habitat is particularly found in the neighboring areas of Lespezi Quarry. The widest spread vegetal communities in this area are: *Adenostylo-Doronicetum austriaci* Horvat 1956; *Cirsio waldsteinii-Heracleetum transsilvanici* Pavl. ex Walas 1949; *Scirpetum sylvatici* Ralski 1931 em. Schwich 1944.

**E. Heath habitats**

This category includes, in the neighboring areas of Lespezi Quarry (in the immediate vicinity hereof) the following two types of habitats:

- Habitat **4060** - Alpine and Boreal heaths CLAS. PAL.31.4; RO habitat type code: R3101, R3104, R3107-3109, R3111, R3115, R3617. It includes dwarf, sometimes crawling heaths, characteristic to the higher montane levels, mainly dominated by *Ericaceae* species.

- Habitat **4070** Bushes with *Pinus mugo* and *Rhododendron hirsutum* (*Mugo-Rhododendretum hirsutiii*); CLAS. PAL.31.5; RO habitat type code: R3105. This habitat includes mountain pine formations (*Pinus mugo*).

### 1.4.4. ECOLOGICAL RECONSTRUCTION PROPOSALS IN LESPEZI QUARRY

Ecological reconstruction requires the restoration of phytocenoses and, implicitly zoocenoses, but not in the last place pedogenesis. Ecological reconstruction following mining exploitations is achieved through technical and biological methods which can ensure ecogenesis. In addition to the climate, geomorphological, biotic and anthropic factors, the edaphic conditions and place type are key points for the reinstallation of vegetal species in the area of Lespezi Quarry (Annex 7).

In Lespezi Quarry, like in any other mining quarry, we must first take into account the restoration of the biotope factors through mechanic works, organic fertilization with green fertilizer, farmyard manure from the neighboring stables and only if necessary through chemical fertilization. The soil where herbaceous and forest species are installed must meet the requirements, very important being the humus and soil properties. Major importance must be given to the improvement of the hydric and hydrological regime of the soil, a fundamental condition for vegetation blossom, development and maintenance.

The second stage will target the phytocenosis reconstruction, by colonization, seeding or cultivation of the species (as the case may be) and stabilization of the interspecific relations favorable to the productivity and biocenotic balance of the new ecosystem. After the installation of the plant communities, the focus will be placed on monitoring the species dynamics, combating the pests and invasive species, controlling erosion and the action of climate factors.

Concretely, we believe ecological rehabilitation in Lespezi Quarry must be achieved at the level of the forest vegetation and at the level of grasslands and screes. In Lespezi Quarry (where the exploitation is made in benches) the focus is placed on the ecological rehabilitation of the higher bench, where the exploitation ended, but on smaller portions also in other quarry areas, where possible. In order to achieve a proper rehabilitation at the level of the higher bench, it must be achieved on three levels or terraces.

**Ecological rehabilitation at the grassland level** is achieved with native species from the quarry or its surroundings, without disturbing or fragmenting the existing habitats here. Thus, the grassland vegetation recommended for ecological rehabilitation in Lespezi Quarry falls under 5 associations (as mentioned under habitat description): *Seslerio haynaldianae-Caricetum sempervirentis* Puşcaru et al.1956, *Potentillo chrysocraspedae-Festucetum airodis* Boşcaiu 1971, *Scorzonero roseae-Festucetum nigricans* (Puşcaru et al. 1956) Coldea 1978 and *Violo declinatae-Nardetum* Simion 1966.

At the higher limit of the bench where the exploitation ended, namely on terrace III, rehabilitation is recommended with species falling under the first two grassland plant communities *Seslerio haynaldianae-Caricetum sempervirentis* Puşcaru et al.1956 and *Potentillo chrysocraspedae-Festucetum airodis* Boşcaiu 1971 (Syn. *Festucetum supinae* Domin 1933), as this part of the quarry is in direct contact with an area where such grassland vegetates spontaneously. The first stage in vegetation installation (after bench leveling) is to restore the soil in optimum time using a layer of at least 20 cm of soil of the respective terrace. The soil must be spodosols or humicosillicatic soils, little deep to shallow, very acid or little acid with pH=4.1-4.5) rich in humus,
and can be brought from the immediate vicinity, not elsewhere, thus favoring the development of the species which are to be installed. It is recommended for grassed lands to be brought with the soil, thus favoring proper installment and natural development of this type of grassland. Plots (of 50-100 m²) will be naturally seeded using mowed grass that reached maturity (not green) from this type of grassland in the neighboring areas of Lespezi Quarry. However, in order to speed up the phytocenosis process and have spectacular results as regards the installation of this grassland, we can also use a smaller or higher quantity of seed belonging to the edifying species, from which the seed can be reaped to a certain extent. No fertilizations are necessary, but if they are made nonetheless, they should be made with farmyard manure from the neighboring stables.

The species making up the floristic composition of this grassland and which must be introduced are indicated in Annex 5.

The next terrace (recommended to be larger than the previous terrace) is meant to be rehabilitated with the other two grassland associations: Scorzonero roseae-Festucetum nigricantis (Puşcaru et al. 1956) Coldea 1978 and Violo declinatae-Nardetum Simon 1966. The same methods will be applied, only the floristic compositions will be different. However, we can mention that for Scorzonero roseae-Festucetum nigricantis (Puşcaru et al. 1956) Coldea 1978 association, the soil must be districambiosols, with short profile and saturated in alkalis (20-25%) and pH=4-4.5 and can also be brought from such grasslands in the immediate vicinity together with grassed lands which will facilitate the installation of this type of vegetation. Mowed grass that reached full maturity can be used also in this case, as well as a minimum quantity of the seed of the edifying species Festuca nigrescens and Scorzonera rosea and of the fundamental species belonging to Potentillio-Nardion association and Nardetalia order: Viola declinata, Poa media, Geum montanum, Phleum alpinum coming especially from mowed and dried grass, which is subsequently disseminated over the area subject to rehabilitation.

In the case of Nardus planting (which are widely spread in the surrounding areas, on spodosols with short profile, poor in alkalis (5-10%), poorly aerated and acid, pH = 3.6 -4.5) together with grassed lands and mature mowed grass, the seed to be used as rehabilitation aid, will also consist of the two edifying species Nardus stricta and Viola declinata and the fundamental species of the vegetal community: Ligusticum matellina, Geum montanum, Phleum alpinum, Centaurea nervosa, Antennaria dioica, Pseudorchis albida, Carex ovalis, Campanula serrata, Hypochoeris uniflora, resulting from mowed and dried grass, which can be disseminated in the respective areas. From our point of view Nardus are not particularly significant from an economic point of view (poorly productive grasslands), although they are scientifically important, we propose that the ecological rehabilitation is made on small areas and give priority to Festuca nigrescens and Scorzonera rosea grasslands, which are of inestimable value. In conclusion, we believe the best method for grassland rehabilitation is to use grassed lands, in addition to mowed grass and seed.

As regards the ecological rehabilitation of scree, we can take into account the vegetal association Acino alpini-Galietum anisophylli Beldie 1967, found at the higher limit of the quarry and in the surrounding areas. It is an endemic association, particularly important from a scientific viewpoint as well as due to the role it has in scree application. Vegetation planting on these lands is toilsome and requires special procedures, which implicate bringing the fertile soil from the immediate vicinity of the quarry, from areas populated with this association. In this situation, we should first achieve a stabilization of the scree (when the deposits are not very thick-over 0.5 m) using fences or dry masonry benches. In the case of thick deposits consisting of boulders, rocks, lacking fine material, floors of up to 1.50 m in diameter will be created and filled with fertile soil, after layers of bryophytes and vegetal debris (leaves, mowed grass, sprouts) are previously placed at the bottom to prevent soil washing and flowing through the scree boulders or rocks. The areas which require rehabilitation based on this community can only be rehabilitated through grassed lands, seed from edifying and fundamental species being extremely difficult to obtain. The edifying and fundamental species: Acinos alpinus ssp. alpinus, Galium anisophyllum, Cerastium arvense ssp. calcicolum, Euphrasia salisburgensis, Myosotis alpestris, Thesium alpinum, Scabiosa lucida, Thymbus pulcherimus, Saxifraga paniculata brought with these lands have great power of blossom. In this case, it is difficult to use mowed species, as small species are found in the floristic composition.

If we want quick rehabilitation of the grasslands, we can use another type of grassland (practically used at wide scale at the level of our country and not only) but in this case the natural vegetation cannot be restored, and the habitats are fragmented. It’s about Festucetum rubrae-Agrostietum capillaris Cstürös-Káptalan 1964 (Syn. Festucetum rubrae-Agrostietum capillaris Horv. 1951) grasslands. Thus, the leveled land will be divided into plots subject to re-cultivation by seeding a mix of 8 plants used in the following percentage shares: Festuca rubra 30, Agrostis capillaris 20, Anthoxanthum odoratum 15, Phleum pratense 15, Trifolium pratense 15, Lotus corniculatus 3 and Achillea millefolium 2. Although it is extremely easy to install such grassland, and the seed can be very easily acquired, I personally do not recommend this.

As regards the ecological rehabilitation at the level of the forest vegetation, the most important thing, just like in the case of the rehabilitation of the grassland and screes vegetation, is to avoid their fragmentation and take into account the reconstruction of the natural fundamental type of vegetation.
Brush regeneration on anthropic-modified lands is achieved in this case artificially, through plantations, as well as naturally. As part of the ecological management measures for Lespezi Quarry, we will aim at achieving ecological rehabilitation first of all by promoting natural regeneration with native species, which will also be used as regards the rehabilitation of the forest vegetation, avoiding the substitution of native species with "quickly growing" species.

Taking into account the stationary conditions in this area, natural regeneration is toilsome. Hence, we will try to artificially rehabilitate the forest vegetation (brushes), taking into account their particular protection role, but the native species will be maintained, i.e. the species from natural regenerations, including pioneer species. There are two rehabilitation possibilities: through plantations or direct seeding. Of course, the second method by direct seeding is much easier to apply, less costly and very similar to natural regeneration. However, taking into account the stationary conditions in Lespezi Quarry, as well as the importance of brush restoration in an area as important from the point of view of biodiversity, I recommend the first method.

Thus, taking into account the type of vegetation and forest habitats existing in the area, as well as the type of fundamental vegetation, the fundamental species should preferably be the spruce—*Picea abies* (L.) Karsten (Syn. *P. excelsa* Link).

Spruce was chosen based on the following considerations:
- it is found in a favorability area, with the optimum stationary planting conditions;
- very suitable climate and altitude conditions;
- slope layout;
- De Martone aridity index is favorable to spruce planting.

The main stages for the ecological rehabilitation of the forest vegetation in Lespezi Quarry are:
- land preparation and modeling, and, if necessary, temporary land consolidation works will be carried out until the forest vegetation develops and takes over this function;
- soil preparation for setting a layer of fertile soil (to be brought from the neighboring forests if it was not deposited and kept in the immediate vicinity of the uncovered area), of 20-35 cm thick. Taking into account that the underlayer in the area of Lespezi Quarry is calcareous, the soil must be brown-yellowish, shallow, but rich in humus, well-structured and mellow (brought from the neighboring spruce forests, under no circumstance can it be brought from a different type of forest, as it must observe the acid pH first of all).
- forestations;
- maintenance works carried out in the first 5-6 years – cutting of the herbs in the planting floors, as well as monitoring and combating biotic and abiotic pests.

Starting from the fundamental species—*Picea abies* (L.) Karsten (Syn. *P. excelsa* Link) we propose the following two formulations:


We chose the spruce as fundamental species for the rehabilitation of the forest vegetation because, despite its rootedness, it has anti-eroding qualities, can be relatively easily planted in Lespezi area where, in its natural habitat, its vegetal biomass will contribute to the balance of the discharge, to the stopping of surface erosion, it can also fulfill (secondarily) the hydrological function and can contribute to air purification from dust. Forestation will be achieved at the level of the higher bench of the quarry, especially on its sides. The soil will be brought from the neighboring spruce forests together with moss layer lands and characteristic species. The culture density is 5000 -6000 saplings/ha, and the planting distance will be 1.5 x 1 m. In order to have good results, I believe the spruce saplings should be grown in polyethylene bags, be aged 4, non-transplant and healthy. They will be planted in floors of 40/60 cm.

2. Ecological rehabilitation of the forest vegetation through mixed plantations of *Picea abies* (Mo) și *Larix decidua* ssp. *carpatica* (Domin) Šiman (Syn. *Larix decidua* var. *polonica* (Recid.) Ostfen et Syrach-Larsen) (La);

Together with spruces, in order to have an even better result, *Larix deciduas* can also be introduced in this area. This species is found in its natural habitat, with favorable stationary conditions for installation (even though we did not find it in the quarry but its surroundings) and grows rapidly. Moreover, it has strong rootedness, which confers it great stability, being recommended to be installed with spruces, so as to prevent blow-downs.

In this case the forestation composition and planting scheme is as follows:
60Mo and 40La – forestation is made in pure alternate bands, of 10-15 m wide, perpendicular on the direction of damaging winds (as per the Romanian Technical Regulation). Planting will be made in the spring. The culture density is 5000 saplings/ha, of which 3500 saplings of *Picea abies* (Mo) and 1500 saplings of *Larix decidua* (La). For spruces, the planting distance will be 1.5 x 1 m, and for larches 2 x 1.5 m. Spruce saplings must also be aged 4, non-transplant and planted in floors of 40/60 cm. Maintenance works will be required: hoeing and weeding, 2 in the first year and one in the next 2 years.
As mentioned above, spruce and larch installation can also be achieved by direct seeding, on very well prepared soil, but in this case more and careful attendance works will be necessary, even though this method is very similar to natural regeneration. It can, however, be achieved on limited areas, but lands with a slope of over $20^\circ$ must be avoided or at the base of the slope, where scree accumulation usually occurs.

On small areas of Lespezi Quarry, which require quick rehabilitation, the pioneer and colonizing species of *Betula pendula* Roth. (Syn. *B. verrucosa* Ehrh.) can also be used (Annex 8). It is installed very easily, being a first forestation species. The possible rehabilitation method is simple and little expensive, and can even be applied by the quarry workers.

Thus, the method consists of direct seeding with good results, achieved through the direct spread of mature seeds on the snow. This procedure can be applied in March, April when there is still snow in the quarry and the temperature is increasing. The snow ensures optimum moisture for the germination of birch seeds. Seeds can be collected from the quarry specimens in July-August. This species is characterized by high ecological plasticity and can be used especially in the case of screees. The recommended seed quantity is 20g/m

1.5. Discussions

Biodiversity conservation in Lespezi Quarry is indispensable, taking into account it is an integral part of Bucegi Mountains and the National Park of the same name. The most important paper about the flora and vegetation in the whole area of Bucegi Mountains was written by Alexandru Beldie in 1967, but the flora and vegetation here suffered certain changes. As regards the fauna, a number of specialists studied in Bucegi Mountains, such as Predoiu George, Dan Munteanu etc. We did not find any complex flora, vegetation and fauna studies, to strictly refer to Lespezi area, Beldie cites only some species of cormophytes here. Thus, our results regarding especially the flora, vegetation and habitats are the fruit of our own research this summer. However, this research can only be considered a start point, taking into account the short period of time and the fact that we went through one single season of vegetation, as well as the complexity of the biodiversity here and the phenomena occurring.

The ecological rehabilitation of Lespezi Quarry presents also a major social and economic impact. The reinstalled vegetation, herbaceous as well as forest vegetation, can be an inestimable source of berries, macromycetes, medicinal plants, honey and, not in the last place, wood. Moreover, the vegetation reinstalled on the lands exposed to the mining exploitations has a significant role in improving and protecting the environment, as well as from an aesthetic, sanitary and touristic viewpoint.

As regards the achievement of the seeding or planting works, in order to avoid additional costs, these could be achieved with the help of the quarry employees. Moreover, taking into account the noble goal as regards biodiversity conservation in this area, cleaning actions can be carried out inviting students from the faculties with agricultural and forestry specializations, as well as volunteer environmentalists.

**TECHNICAL SOLUTIONS**

From a technical point of view, we make the following recommendation. At the level of the bench on which the exploitation is currently carried out, a mobile crusher could be used, that is continued with a vertical pipe along the slope in order to avoid the rolling of the extracted material. The rolling of this material affects the vegetation and flora on the slope, produces scree at the bottom of the slope and dust in the quarry. On this slope, on one and the other side of the pipe where the extracted material can go through, pioneer vegetation can easily be naturally installed, as shown in the pictures in Annex 9. In other situations, non-stationary vertical carriers can also be used. These could periodically move in the working fronts. They have speeds of 2-5-6 m/s, and the length is limited by the length of the working front. Things are definitely much more complex at the level of Lespezi Quarry, but this requires much more time, much more field trips and a much more complex analysis.

**CONCLUSIONS**

In conclusion, the biodiversity of Lespezi Quarry presents a particular interest through its richness, diversity and the presence of many rare, endangered, vulnerable, endemic or Natura 2000 species. Natura 2000 habitats are some of the most diverse, with forest habitats and brushes, grasslands and rocky areas, tall-herbs and even ruderal habitats found here. Taking into account the scientific, landscape, economic and social significance of this area, we believe its rehabilitation, conservation is imperative. In order to have chances of success, the ecological rehabilitation in Lespezi Quarry must follow the best restoration methods for the vegetal communities and, implicitly, the animal communities, as well as landscape reintegration, highly significant phenomena in biodiversity conservation. All these actions must be carried out at the level of herbaceous as well as forest habitats. The natural habitats here must under no circumstance be fragmented, even though their restoration takes time. We must not forget one important thing, which is keeping the uncovered soil nearby the respective area, so as to be restored and repopulated after the end of the exploitation. This is the best soil, and the natural vegetation will be much quicker reinstalled.
Fig. 1. Quarry Lespezi - The woody vegetation

Fig. 2. Lespezi Quarry - the level of exploitation
Fig. 3. Forest with *Fagus sylvatica* in Quarry Lespezi

Fig. 4. Vegetation of screes in the Lespezi Quarry
Fig. 5. *Asplenio-Cystopteridiedum fragilis* Oberd. (1936) 1949 plant community

Fig. 6. *Calamagrostio arundinaceae-Digitalietum grandiflorae* (Silling. 1933) Oberd. 1957 plant community
Annex 2

LIST OF SPECIES OF FLORA IN LESPEZI QUARRY AND NEIGHBORING AREAS

ASCOMYCOTA

Verrucaria bucegiensis Servít.
Parmelia sulcata Taylor
Polyblastia butschetschensis Zschacke
Microgaena butschetschensis Zschacke ex Bachm.
Thelidium bucegiensis Servít.
Lecanora verrucosa (Arch.) Laurer. var. bucegica

MACROMYCETES

Amanita muscaria (L. ex Fr.) Hooker.
Armillaria mellea (Vahl.) Quélet Tr.
Boletus badius Schaeffer
B. satanas Lenz. (fig. 1)
Cantharellus cibarius Fr. (fig. 2)
Lactarius piperatus (Scop.) S.F.Gray
L. pergamenus (Swartz. ex Fr.) Fr.
Mycena galericulata (Scop. Ex Fr.) S. F. Gray.
M. pura (Pers. ex Fr.) Kumm.
Phellinus igniarius (L. ex Fr.) Quél.
Pitoporus betulinus (Bull. ex. Fr.) Karst.
Pseudotrometes gibbo (Pers.) Bond. et Sing.
Russula cyanoxantha (Seff. ex Schw.) Fr.
R. virescens (Schff. Ex Zant.) Fr.
Stereum hirsutum (Willd: ex.Fr) S.F. Gray
Trametes hirsuta (Wulf.ex. Fr.) Pil (Syn. Coriolus hirsutus) (Wulf ex.Fr.) Quél.
T. versicolor (L.ex.Fr.) Fr.(Syn Coryolus versicolor (L. ex Fr.) Quél.
Xylaria polymorpha (Scop.) Grev.

BRYOPHYTA

Polytrichum juniperinum Hedw.
Hylocomium splendens (Hedw.) W.P. Schimp.
Pleurozium schreiberi (Brid) Mitt.

SPERMATOPHYTA

Abies alba Mill.
Acinos alpinus (L.) Moench (Calamynthia alpina (L.) Lam.)
Aconitum toxicum Rchb.
A. tauricum Wulf.
Allium montanum Schmidt. (Syn. A. senescens L.)
Alnus alnabetula (Ehrh.) Hartig (Alnus viridis (Chaix) DC.)
Alyssum alyssoides (L.) Nath. (A. calycinum L.)
A. repens Baumg.
Asperula liliifolia (L.) A. DC.
Angelica archangelica L.
Adenostyles aliiariae (Gouan) Kern.
A. vulgaris L. ssp. nigricans (Baumg.) Jav. (A. nigricans Baumg., A. haenkeana auct. transs.)
Asperula capitata W. et K
Athamantha turbith (L.) Brot. ssp. hungarica (Borbas) Tutin.
Betula pendula Roth (B. verrucosa Ehrh.) specie pionieră în Cariera Lespezi
Campanula carpatica Jacq. (fig. 3)
C. serrata (Kit) Hendrych.
C. sibirica L. ssp. divergens (Willd.) Neir. (Syn. C. divergens Willd.)
C. patula ssp. abientina (Gris.) Simonkai
C. rotundifolia L. var. saxatilis Hruby.
C. polymorpha Witas.
C. serrata (Kit) Hendrych.
C. trachelium L. (fig. 3)
Cardaminopsis arenosa (L.) Hayek
Clematis alpina (L.) Miller (Artagene alpina L.) (fig. 4)
Cnidium sialifolium (Jacq.) Simk. (C. apioides Spreng.)
Carduus divergens (Willd.) Neilr. (Syn. C. divergens Willd.)
Carduus kernerii Simk.
Cerastium arvense L. ssp. calcicolum (Schur) Borza (fig. 5)
C. transsilvanicum Schur.
Delphinium elatum L. (D. intermedium Sol., D. elatum ssp. intermedium (Sol.) Fleisch’h et Lindm)
Dianthus spiculifolius Schur. (fig. 6)
Doronicum carpaticum (Griseb. & Schenk) Nyman.
Draba dornei Heuffel.
Epilobium angustifolium (L.) Scop. (Syn. Chamaenerion angustifolium (L.) Scop.)
Galium anisophyllum Vill.
Gentiana acaulis L. (Gentiana kochiana Perr. et Song.)
G. austriaca (A. et J. Kerner) (Syn. G. praecox A. et J. Kerner)
G. asclepiadea L.
G. nivalis L.
G. verna L.
G. lutea L.
G. punctata L.
Geum rivale L.
Heracleum palmatum Baumg.
H. sphondylium L.
Hepatica transsilvanica Fuss.,
Hesperis matronalis L. ssp. moniliformis (Schur.) Borza (Syn. H. moniliformis Schur.)
Hieracium transsylvanicum Heuff. (Syn. Hieracium rotundatum Kit.)
Hypochoeris uniflora Vill.
Iris aphylla L. ssp. hungarica Waldst. et KIt. (fig. 7)
Juniperus communis L. ssp. alpina (Suter) Eelak (Juniperus sibirica Burgsd.)
Koeleria macrantha ssp. transsilvanica Nyárády
Larix decidua Miller ssp. carpathica (Dom.) Siman (var. polonica auct. rom.)
Leontopodium alpinum Cass. – Natural Monument (fig. 8)
Leucanthemum waldsteinii (Schultz Bip.) Pouzar
Libanotis montana Cr. (Seseli libanotis (L.) Koch.)
Ligusticum mutellina (L.)
Lingularia sibirica L.
Minuartia verna (L.) Hiern.
Myosotis alpestris F.W. Schmidt.
Pedicularis verticillata L. (fig. 9)
Picea abies (L.) Karsten (Picea excelsa Lam., Pinus abies L.)
Pinus mugo Turra.
P. aurea L. ssp. chrysocraspeda (Lehm.) Nyman (Potentilla ternata C. Koch)
Salix caprea L.
S. cinerea L.
S. silesiaca Willd.
Saxifraga adscendens L.
Saxifraga demissa Schott et Kotschy
S. corymbosa Boiss. (fig. 10)
S. cuneifolia L.
S. tridactylites L.
Sesleria bielzii Schur.
S. rigida ssp. haynaldiana Schur.
Scabiosa lucida ssp. barbata Nyaradi
Sempervivum maemoreum Griseb. (Syn. S. schlehanii Schott.; S. blandum Schott.)
S. heuffelian Schott. (Jovibarba heuffelian Schot)
Silene nutans subsp. dubia (Herbich) Zapal
Soldanella hungarica Simk. ssp. major (Nielr.) S. Pawl.
Scabiosa lucida ssp. barbata Nyaradi
Symphymy cordatum W. Et K.
Ranunculus carpasicus Herbich
Rhododendron myrtifolium Schott et Kotschy (R. kotschyi Simonkai)
Thevium alpinum L.
The. kernerianum Simonkai
Thlaspi dacicum Heuffel
Thymus bihoriensis Lalas (Syn. Thymus marginatus A. Kerner non Sm)
Th. balcanus Borbas (Syn. T. praecox Opiz ssp. skorplii (Velen.) Jalas)
Th. comosus Heuff. (Syn. Th. nummularius Auct., non M. B.)
Th. pulcherimus Schur (Syn. Th. carpaticus Cel.)
Vaccinium gaultherioides Bigelow.
V. myrtillus L.
V. vitis-idaea L.
V. uliginosum L.
Valeriana montana L.
V. officinalis L.
V. sambucifolia Pohl.
Viola biflora L.
V. declinata Waldst. et Kit.
V. reichenbachiana Jord. (V. sylvestris Lam.)

CORMOPHYTES SPECIES IN ANNEX II TO COUNCIL DIRECTIVE 92/43/CEE
4068 Adenophora liliifolia (L.) A. DC.
1758 Ligularia sibirica L.
2113 Draba dorneri Heuffel
4070 Campanula serrata (Kit) Hendrych.
4116 Tozzia alpina L. ssp. carpatica (Woloszczak) Hayec.
4097 Iris aphylla L. ssp. hungarica Waldst. et Kit.
Fig. 1. *Boletus satanas* Lenz.

Fig. 2. *Cantharellus cibarius* Fr.
Fig. 3. *Campanula trachelium* L.

Fig. 4. *Clematis alpina* (L.) Miller (*Artagene alpina* L.)
Fig. 5. *Cerastium arvense* L. ssp. *calcicolum* (Schur) Borza

Fig. 6. *Dianthus spiculifolius* Schur.
Fig. 7. *Iris aphylla* L. ssp. *hungarica* Waldst. et Kit.

Fig. 8. *Leontopodium alpinum* Cass.
Fig. 9. *Pedicularis verticillata* L.

Fig. 10. *Saxifraga corymbosa* Boiss.


ORCHID SPECIES IN LESPEZI QUARRY

*Cephalanthera rubra* L.
*Dactylorhiza incarnata* (L.) Sóó (fig. 11)
*D. maculata* (L.) Sóó (fig. 12)
*Epipactis atropurpurea* Rafin.
*Gymnadenia conopsea* (L.) R.Br. (fig. 13)
*Listera ovata* (L.) R. Br. (fig. 14)
*Neottia nidus-avis* (L.) L. C. M. Rich. (fig. 15)
*Orchis mascula* L. ssp. *signifera* (Vest) Soó (*Orchis speciosa* Host.)
*O. militaris* L. (fig. 16)
*O. ustulata* L.
*Platanthera bifolia* (L.) Rich. (fig. 17)
*Pseudorchis albida* (L.) A. Et E. Löve. (Syn. *Leuorchis albida* (L.) E. Mey. (*Gymnadenia albida* (L.) Rich.))

Fig. 11. *Dactylorhiza incarnata* (L.) Sóó
Fig. 12. *Dactylorhiza maculata* (L.) Sóo

Fig. 13. *Gymnadenia conopsea* (L.) R.Br.
Fig. 14. *Listera ovata* (L.) R. Br.

Fig. 15. *Neottia nidus-avis* (L.) L. C. M. Rich.
Fig. 16. *Orchis militaris* L.

Fig. 17. *Platanthera bifolia* (L.) Rich.
Annex 3

THE LIST OF ANIMAL SPECIES IN LESPEZI QUARRY AND NEIGHBORING AREAS

REPRESENTATIVE SPECIES OF INVERTEBRATES IDENTIFIED WITHIN THE LESPEZI QUARRY:

**COLEOPTERA AND ORTHOPTERA**

1087* Rosalia alpina (Linnaeus, 1758) (fig. 1)
1089 Morimus funereus (Mulsant, 1863)
4014 Carabus variolosus (Fabricius, 1787)
4052 Odontopodisma rubipes (Ramme, 1931)
4054 Pholidoptera transsylvania (Fischer, 1853) (Carpathian Bush-cricket) (fig. 2)

**LEPIDOPTERA**

Argynnis adippe (Linnaeus, 1761) (fig. 3)
Boloria dia (Linnaeus, 1761)
1065 Euphydryas aurinia (Rottemburg, 1775)
Erebia montanus (Prunner, 1798)
Erynnis tages (Linnaeus 1758)
Melanargia galathea (Linnaeus 1758)
Melitaea cinxia (Linnaeus 1758)
Polyommatus icarus (Rottemburg, 1775)
Pseudophilotes baton (Bergsträsser, 1779)

**THE LIST OF MAMMALS IN LESPEZI QUARRY AND NEIGHBORING AREAS**

1352* Canis lupus (Linnaeus, 1758)
Capreolus capreolus (Linnaeus, 1758)
Cervus elaphus (Linnaeus, 1758)
1361 Lynx lynx (Linnaeus, 1758)
Rupicapra rupicapra (Linnaeus, 1758) (specie frecvent întâlnită)
Sus scrofa (Linnaeus, 1758)
1354* Ursus arctos (Linnaeus, 1758) (specie frecvent întâlnită)
Vulpes vulpes L. (Linnaeus, 1758)

Fauna of amphibians and reptiles from the perimeter of the Lespezi Quarry is represented by the following species, according to the observations in the field:

Cod 1193 Bombina variegata (Linnaeus, 1758)
Salamandra salamandra (Linnaeus, 1758) (în făgetele din carieră) (fig. 4)
Lacerta vivipara (Von Jacquin, 1787; Syn. Zootoca vivipara (Von Jacquin, 1787)
L. agilis (Linnaus, 1758) (fig. 4)
L. muralis (Laurenti, 1768)(specie comună, frecvent întâlnită în Cariera Lespezi)(fig. 6)
Vipera berus (Linnaeus, 1758)
Cu siguranță în zonele limitrofe se întâlnesc și alte specii de reptile.

**THE LIST OF COMMON OR RARE BIRDS IN LESPEZI QUARRY AND IN THE SURROUNDING AREAS:**

Apus melba (L.)
Anthus spinoletta (L.)
A. trivialis (L.)
Buteo buteo (L.)
Corvus corax (L.)
Cuculus canorus (L.)
Dryocopus martius (L.)
Emberiza citrinella (L.)
Falco tinnunculus (L.)
Fringilla coelebs (L.)
Loxia curvirostra (L.)
Motacilla cinerea (Tunst)
Nucifraga caryocatactes (L.)
Parus ater (L.)
P. major (L.)
Paser montanus (L.)
Phoenicurus ochruros gibraltariensis (Gm.)
Picoides tridactylus (L.)
Picus canus (Gmelin.),
Picus viridis (L.)
Prunella collaris (Scop.),
P. modularis (L.)
Pyrrhula pyrrhula (L.).
Turdus torquatus alpestris (Ch.L. Brehm) (fig.7)
T. merula (L.)
T. philomelos (Brahm.)
T. pilaris (L.)

Fig. 1. Rosalia alpina Linnaeus, 1758
Fig. 2. *Pholidoptera transsylvanica* (Fischer, 1853)

Fig. 3. *Argynnis adippe* (Linnaeus, 1761)
Fig. 4. *Salamandra salamandra* (Linnaeus, 1758)

Fig. 5. *Lacerta agilis* (Linnaeus, 1758)
Fig. 6. *Lacerta muralis* (Laurenti, 1768)

Fig. 7. *Turdus torquatus alpestris* (Ch.L. Brehm)
### Annex 4

**Ass. Hieracio rotundati-Piceetum** Pawl. et Br.-Bl. 1939

**Table no. 1**

<table>
<thead>
<tr>
<th>No. of relevée</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altitude m.o.s. (x 10 m)</td>
<td>135</td>
<td>140</td>
<td>135</td>
<td>140</td>
<td>140</td>
<td></td>
</tr>
<tr>
<td>Exposure</td>
<td>S</td>
<td>S</td>
<td>SE</td>
<td>SE</td>
<td>SE</td>
<td>SV</td>
</tr>
<tr>
<td>Inclination (in grades)</td>
<td>10</td>
<td>10</td>
<td>20</td>
<td>10</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Canopy (%)</td>
<td>0,7</td>
<td>0,7</td>
<td>0,7</td>
<td>0,8</td>
<td>0,8</td>
<td></td>
</tr>
<tr>
<td>Coverage of herbaceuous layer (%)</td>
<td>20</td>
<td>25</td>
<td>30</td>
<td>25</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Area (m²)</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td></td>
</tr>
</tbody>
</table>

#### Char. ass.

- **Picea abies**: 4 4 4 4-5 4-5 V
- **Hieracium rotundatum**: + + + + V

#### Vaccinio-Piceion

- **Homogyne alpina**: + + + + 1 V
- **Soldanella hungarica ssp. major**: - + + + + IV
- **Dryopteris dilatata**: + + + + + V
- **Gymnocarpium dryopteris**: + - + - IV

#### Vaccinio-Piceetalia

- **Vaccinium myrtillus**: + 1 + 1 + V
- **Vaccinium vitis-idaea**: - - - + + II
- **Huperzia selago**: + + - - - II
- **Lycopodium anotinum**: - - + + - II
- **Deschampsia flexuosa**: + + + + + V

#### Symphyto – Fagion

- **Symphytum cordatum**: - + - - - I
- **Pulmonaria ruhra**: - - - + + II
- **Dentaria glandulosa**: - - - + - I

#### Fagetalia

- **Fagus sylvatica**: - + - - - I
- **Daphne mezereum**: - - + - - I
- **Actaea spicata**: + + - + - III
- **Luzula luzuloides**: + + + + + V
- **Polystichum setiferum**: - - + - + II
- **Rubus hirtus**: - - + + + II

#### Querco - Fagetea

- **Athryrium filix-femina**: - - + - + II
- **Galium scultesii**: - - + - + II
- **Poa nemoralis**: - + - + + III
- **Viola reichenbachiana**: - + + + - III

#### Varae Syntaxa

- **Polypodium vulgare**: - + - + - II
- **Geranium robertianum**: - - + - + II
- **Mycelis muralis**: - + + + + IV
- **Oxalis acetosella**: + + + + + V
- **Campanula patula ssp. abietina**: + + + + + V
- **Gentiana asclepiadea**: - + - - - I
- **Rubus idaeus**: + - - + - II

---

Place and data of the relevés: 12.VI.2012, Lespezi Quarry
Fig. 1. Ass. *Hieracio rotundati-Piceetum* Pawl. et Br.-Bl. 1939 in Lespezy Quarry

Fig. 2. Restoration of the *Hieracio rotundati-Piceetum* Pawl. et Br.-Bl. 1939 plant community
Annex 5

**Ass. Potentillo chrysocraspedae-Festucetum airoidis** Boșcaiu 1971

| Table no. 2 |
|------------------------|--------|--------|--------|--------|--------|
| No. of relevée         | 1     | 2      | 3      | 4      | 5      | K      |
| Altitude m.o.s. (x 10 m) | 165   | 165    | 167    | 167    | 167    |
| Exposure               | SV    | S-V    | S      | SE     | V      |
| Inclination (in grades)| 10    | 7      | 5      | 5      | 7      |
| Coverage of herbaceaeous layer (%) | 95    | 85     | 90     | 95     | 90     |
| Area (m²)              | 25    | 25     | 25     | 25     | 25     |

**Char. ass.**

Potentilla aurea ssp. chrysocraspeda 1 + + 1 + V
Festuca airoidis 4 4 4 4 4 V

**Potentillo-Nardion**

Phleum alpinum - + - + - II
Ligusticum mutelina + - - + + III
Geum montanum + - - + - II
Viola declinata - - + + - III
Campanula patula ssp. abietina + + + - - III
Thymus balcanus + + - - - II

**Nardetalia et Nardo-Callunetea**

Nardus stricta - + + + - III
Festuca nigrescens + - - + + III
Anthenaria dioica - - - + + II

**Variæ Syntaxa**

Ranunculus polyanthemos + - - - - I
Cerastium fontanum - - - + - I
Vaccinium myrtillus + + + - - III
Carex sempervirens + + - - + III
Luzula luzuloides - - + + - II
Homogyne alpina + - - + - II
Descampsia flexuosa + - + + + IV
Vaccinium vitis-idaea - + - - + + III
Agrostis capillaris + + + - + IV

*Place and data of the relevés: 12.VI.2012, Lespezi Quarry – Claia Mică*

**Fig. 1. Potentillo chrysocraspedae-Festucetum airoidis** Boșcaiu 1971- plant community
Fig. 2. Here it is necessary ecological rehabilitation at the grassland level
Annex 6

**Ass. Acino alpini-Galium anisophylli** Beldie 1967

### Table 3

<table>
<thead>
<tr>
<th>No. of relevée</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>K</th>
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<td>145</td>
<td>155</td>
<td>155</td>
<td>160</td>
<td>160</td>
<td></td>
</tr>
<tr>
<td>Exposure</td>
<td>SE</td>
<td>SV</td>
<td>SV</td>
<td>SE</td>
<td>S</td>
<td></td>
</tr>
<tr>
<td>Inclination (in grades)</td>
<td>20</td>
<td>20</td>
<td>10</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Coverage of herbaceous layer (%)</td>
<td>60</td>
<td>40</td>
<td>60</td>
<td>60</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Area (m²)</td>
<td>4</td>
<td>10</td>
<td>20</td>
<td>10</td>
<td>10</td>
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<table>
<thead>
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<th>Char. ass.</th>
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<tbody>
<tr>
<td><strong>Galium anisophyllum</strong></td>
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<tr>
<td><strong>Acinos alpinus ssp. alpinus</strong></td>
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</tr>
<tr>
<td><strong>Thlaspietalia rotundifolii</strong></td>
<td></td>
</tr>
<tr>
<td>Senecio rupestris</td>
<td>+</td>
</tr>
<tr>
<td>Thymus pulcherrimus</td>
<td>+</td>
</tr>
<tr>
<td><strong>Androsacetalia alpinae s.l.</strong></td>
<td></td>
</tr>
<tr>
<td>Saxifraga adscendens</td>
<td>-</td>
</tr>
<tr>
<td>Luzula spicata</td>
<td>-</td>
</tr>
<tr>
<td><strong>Potentillietalia caulescentis s.l.</strong></td>
<td></td>
</tr>
<tr>
<td>Cystopteris fragilis</td>
<td>+</td>
</tr>
<tr>
<td>Aspemium ruta-muraria</td>
<td>+</td>
</tr>
<tr>
<td><strong>Seslerietalia</strong></td>
<td></td>
</tr>
<tr>
<td>Myosotis alpestris</td>
<td>-</td>
</tr>
<tr>
<td>Scabiosa lucida</td>
<td>+</td>
</tr>
<tr>
<td>Carex sempervirens</td>
<td>-</td>
</tr>
<tr>
<td>Cerastium arvense ssp. calcicolum</td>
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</tr>
<tr>
<td>Thesium alpinum</td>
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</tr>
<tr>
<td><strong>Variae Syntaxa</strong></td>
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<tr>
<td>Thymus balcanus</td>
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<tr>
<td>Asplenium trichomanes</td>
<td>+</td>
</tr>
<tr>
<td>Galium album</td>
<td>-</td>
</tr>
<tr>
<td>Festuca airoides</td>
<td>-</td>
</tr>
<tr>
<td>Minuartia verna</td>
<td>+</td>
</tr>
<tr>
<td>Potentilla aurea ssp. chrysocraspaeda</td>
<td>-</td>
</tr>
<tr>
<td>Luzula luzuloides</td>
<td>-</td>
</tr>
<tr>
<td>Alchemilla conivens</td>
<td>+</td>
</tr>
<tr>
<td>Poa media</td>
<td>+</td>
</tr>
</tbody>
</table>

*Place and data of the relevés: 12.VI.2012, Lespezi Quarry – Claia Mică*
Fig. 1. *Acino alpini-Galium anisophylli* Beldie 1967 plant community

Fig. 2. Here there are very good ecological conditions for the Ecological rehabilitation with screes vegetation
Fig. 3. Installation of scree vegetation
Fig. 1. Continuation the rehabilitation with *Picea abies* (L.) Karsten (Syn. *P. excelsa* Link)

Fig. 2. Here it is necessary to restore the forest of *Picea abies* (L.) Karsten
Fig. 3. Here there are very good ecological conditions for the restoration of the forest of spruce.

Fig. 4. Here can be installed the forest with *Picea abies* (Mo) și *Larix decidua* ssp. *carpatica* (Domin) Šiman.
Fig. 1. *Betula pendula* Roth. installed in Quarry Lespezi
Fig. 2. Here can be installed easily *Betula pendula* Roth.

Fig. 3. The same thing

Fig. 4. Here it is necessary ecological rehabilitation for starters with the pioneer and colonizing species *Betula pendula* Roth.
Annex 9

Fig. 1. Here it is necessary to install a vertical pipe along the slope

Fig. 2. At the level of the bench on which the exploitation is currently carried out, a mobile crusher could be used, that is continued with a vertical pipe along the slope in order to avoid the rolling of the extracted materia
On this slope, on one and the other side of the pipe where the extracted material can go through, pioneer vegetation can easily be naturally installed, as shown in the pictures—fig. 1, 2, 3.

**Fig. 3.**

In this situation, non-stationary vertical carriers can also be used.

**Fig. 4.**
REFERENCES

10. MALSCHI, D. – 2010, Planificarea și reconstrucția mediului -tehnologii de bioremediere și reconstrucția ecologică a terenurilor degradate și poluate antropic -Note de curs, Universitatea „Babeș-Bolyai” Cluj-Napoca, Facultatea de Știința Mediului
16. PREDOIU, G.- 2002. Cercetări privind monitorizarea, managementul si conservarea populației de râs (Lynx lynx) din Romania. ICAS București
24. ***-. 2005 , Code of Botanical Nomenclature, Vienna
25. ***, 1979 - Directiva Pasari (79/409/CEE), Directiva Consiliului Europei privind conservarea pasarilor salbatice