

## 1. Contestant profile

▪ Contestant name:	<b>Elena Buhaciuc-Ionita</b>
▪ Contestant occupation:	Researcher
▪ University / Organisation	S.C.E.C.B. NATURA-Z
▪ Number of people in your team:	<b>4</b>

## 2. Project overview

Title:	Quarry ecosystems sustainability. Key species identification and local conservation status increase
Contest: (Research/Community)	Research
Quarry name:	Baita-Craciunesti

## Abstract

Although a quarry is represented by industrial activities, being itself an ecosystem with specific environmental factors values, it is not separated by the surrounding ecosystems. As the species know no borders, between the quarry and the surroundings exists connective "green channels". These channels are used by key species for supply and energy exchange between the quarry and the surroundings. In order to be sustainable a quarry management needs to maintain these connections at optimal levels. Therefore, there are three steps to follow: 1. An inventory of the key species present at the quarry level and in the surroundings. 2. The conservation status assessment of the key species. 3. Adopting a set of measures in order to increase the conservation status of the identified key species. Following these three steps will bring a real visibility over the quarry ecosystem functioning in connection with natural habitats. Therefore we have identified 71 mushroom species, 3 lichens species, 3 moss species, 3 fern species, 77 superior plant species, 24 day butterfly species, 32 night butterfly species, 72 other invertebrate species, 7 amphibian species, 5 reptile species, 29 bird species (6 day raptors, 2 night raptors, 20 other species), 9 large mammal species, 4 small insectivore mammal species, 7 small rodent mammal species, 9 bat species. Thus, we have identified a total of 354 species within the quarry site and in the vicinity, from which, 281 were identified as key species for a sustainable quarry site. The local conservation status assessment revealed the next repartition of the species: rare species – 3 plant species, 2 day butterfly species, 3 other insect species, 3 amphibian species, 2 reptile species, 7 bird species, 2 large mammal species, 3 small mammals species, 7 bat species; decline species: 4 day butterfly species, 5 other insect species, 5 amphibian species, 3 reptile species, 9 bat species; thriving species: All the other species that were not listed in the above categories, summing 252 species. All the key species are contributing to the exchange of energy between the quarry and the natural habitats being producer or consumers. During our work in the studied area we found three major threats that are directly or indirectly affecting biodiversity and especially key species conservation: habitat loss, poaching and timber theft, household garbage pollution. Studying these three main vulnerabilities of the quarry and surrounding area we developed the next necessary measures in order to increase the key species local conservation status and ensure a sustainable management of the quarry. Reducing pollutants that degrade quality of ecosystems; Reducing poaching and timber theft; Preserving caves as habitats of particular importance for biodiversity conservation; Habitat restoration; Reducing overgrazing activities; Maintaining grasslands and meadows at optimal productive levels, including green channels inside the quarry; Maintaining the quality of water bodies inside and in the vicinity of the quarry. By applying the best conservation methods for the needing species will then be easier to apply and to long-term maintain environmental rehabilitation. By highlighting the connections between the quarry ecosystem and surrounding habitats through the key species we ensure public awareness of the habitat complexity of a quarry.

### 1. Introduction

The subjected project goal is to highlight the importance of key species in the process of quarry sustainability management and to increase their conservation status. Surrounded by natural habitats, some of them included in natural protected areas such as: ROSCI0110 Măgurile Băiței and ROSPA0132 Munții Metaliferi, the Baita-Craciunesti quarry is an important hot-spot for biodiversity conservation measures implementation. In order to achieve the desired goal, we emphasized that the quarry is a functional ecosystem, with specific environmental factors values. Therefore we have monitor the environmental factors such as: temperature, humidity, and due point, inside the quarry and in the nearby natural habitats, for a better understand of the quarry environmental conditions. The key species are very important for the well-functioning of an ecosystem, being the link between the food chain steps. They are represented by plant species, invertebrates, amphibians and reptiles, birds and mammals.

**The project specific work was spread over three major objectives:**

1. Inventory of the key species present at the quarry level and in the surroundings. This objective required the study of flora and fauna from the perspective of mutual benefit and inter specific relations. The aim of this objective was to show the diversity and abundance of key species at the quarry level compared with the surroundings. In previous projects applied to this quarry site a taxonomic conspectus of rare, vulnerable and endemic flora and a short list of fauna species were provided. However the data could not be used as it was only a short list of categories and species, unrelated to our objective.

2. Key species conservation status assessment at local level. The aim of this objective is to assess the wellbeing of species, more exactly their elimination risk within the quarry. This assessment represents a valuable resource for biodiversity conservation measures and quarry sustainability management, as it highlights the needs of key species from the flora and/or fauna which inhabit or trespass the quarry for biological or ecological reasons.

3. Adopting a set of measures in order to increase the conservation status of the identified key species. After the completion of the second objective and analysis of obtained results we propose a set of conservative measures for maintaining or increasing the local conservation status of existing key species at the quarry level. This measures were focused on ecosystems well-functioning, habitat quality maintaining or restoring and species specific protection measures.

Completion of these three objectives delivered an overview of species richness and quality reflected in the quarry ecosystems functioning linked to the surrounding natural habitats.

## 2. Methods.

The three main objectives presents different working methods for completion. The first objective, regarding key species inventory needed method differentiation function of studied group.

1. Flora key species: We have performed active search monitoring within the quarry and its vicinity with emphasis on the connections of flora species with the present fauna and with the landscape.

2. Invertebrates key species: we have use different methods, due to the complexity of this group: active search monitoring during the day, Barber pit fall traps all the study period and light traps during the night, using UV light as attraction.

3. Amphibian key species: for identifying amphibian key species we have performed an active search and investigation of suitable aquatic habitats within and in the vicinity of the quarry. Also, we have conducted night surveys with emphasis on amphibian sounds, some species being active during the night.

4. Reptile key species: we have identified them using linear transects and active search within the quarry and in the vicinity.

5. Birds key species: we used three methods: Vantage point, for a better view all over the quarry and the surroundings, linear transects and active search.

6. Mammal key species: we performed active search monitoring, trace identification and tracking and sound recording. Small mammals were identified using bones from raptor pellets and caves research and bat species identification using ultrasound recordings using Echo Meter Touch Bat Detector, Recorder and Analyzer. We used camera trap for large mammal's identification.

We have focused our attention on observing inter specific relations between the identified species. During every study trip we have conducted linear transects and research stations using 62s Garmin GPS. Species identification was made in situ and where necessary from photography using Nikon D7100, 200-500 Tamron lens, 18-104 Nikorr lens and specific identification guides. In order to identify any differences between the quarries' invertebrate's fauna and the surroundings, the surveys were taken separately inside the quarry and outside, and statistically compared the resulted data.

We used EL USB data loggers for environmental conditions registering and EASYLOG USB soft for interpretation. In total we have used 4 data loggers as follows: one data logger was planted in the center of the quarry and another one outside the quarry in a grassland habitat at the edge of the forest, at the beginning of the study and were recovered at the end of it. Another two data were used during our work being attached to our backpack. The data loggers were set to take data every 2 minutes.

The second objective: Key species conservation status assessment at local level. Defining which key species are rare, declining or thriving is decisive for targeting the conservation of species or habitats in need. In order to reach the results of this objective we have used the three factor category proposed by Nature Serve: rarity, trends and threats. Dealing with local biodiversity conservation measures we did not need to use all the factors within the above mentioned categories, we used only: area of occupancy, population health (depending on species), number of occurrence, area percentage with ecological integrity, environmental specificity, and the long or short term trend depending on the case.

The third objective: Proposing a set of conservation measures for the quarries management, in order to increase the conservation status of the identified key species. After the completion of the second objective and analysis of obtained results we have conducted a set of conservative measures for maintaining and increasing the local conservation status of existing key species at the quarry level. This measures are focused on ecosystems Well-functioning, habitat quality maintaining and restoring and species specific protection measures

## 3. Results.

### Key species inventory:

Flora and vegetation key species were chosen after studying their connection with the other flora and fauna species, as they act as hosts for invertebrates or maintain ground cover, they provide shelter or food for the fauna species, etc. Day butterflies key species were chosen after studying their connection with the other flora and fauna species, as they act as pollinators, consumers and food for other fauna species. The inventory of all amphibians and reptiles species from the quarry area and from the vicinity showed a great diversity. Although, as

we expected, only few of them could be considered as key species, amphibians being linked to the aquatic ecosystems. The key species below were chosen after studying their importance in the quarry's ecosystems good functioning. The birds' key species are represented by breeding, wintering or resident species. Those birds' species which have been observed only in passage during spring migration were not included in this list as they don't contribute in the energy exchange system. The same variable was applied for mammals key species identification, those mammals' species which did not use the quarry and the surroundings in the energy exchange system were not included into the key species list. We present the selected key species:

1. **Thalophyta:** *Cladonia pyxidata*, *Leucobryum glaucum*, *Climacium dendroides*, *Tortula muralis*, *Asplenium ruta –muraria*, *Asplenium trichomanes*, *Asplenium ceterach*.
2. **Spermatophyta:** *Acer platanoides*, *Populus tremula*, *Carpinus betulus*, *Fraxinus excelsior*, *Cornus sanguinea*, *Pyrus pyrastrer*, *Quercus sp.*, *Corylus avellana*, *Crataegus monogyna*, *Agrimonia eupatoria*, *Allium flavum*, *Alyssum alyssoides*, *Ajuga reptans*, *Anthemis tinctoria*, *Aposeris foetida*, *Astragalus monspessulanus*, *Botriochloa ischaemum*, *Carex distans*, *Campanula persicifolia*, *Centaurea atropurpurea*, *Cephalantera longifolia*, *Chamaecytisus hirsutus*, *Cynoglossum officinalis*, *Dactyloriza incarnata*, *Dianthus carthusianorum*, *Dictamnus albus*, *Euphorbia cyparissias*, *Erysimum virgatum*, *Fragaria vesca*, *Gagea lutea*, *Genistella sagittalis*, *Geranium phaeum*, *Heleborus purpurascens*, *Hieracium pilosella*, *Iris aphylla ssp. hungarica*, *Iris pseudacorus*, *Jurinea mollis*, *Lotus corniculatus*, *Lychnis flos-cuculi*, *Festuca gigantea*, *Melampyrum bihariense*, *Rhinanthus minor*, *Melampyrum arvense*, *Minuartia setacea*, *Neottia nidus-avis*, *Origanum vulgare*, *Orlaya grandiflora*, *Plantago media*, *Poa pratensis*, *Potentilla erecta*, *Polygonatum odoratum*, *Primula sp.*, *Rosa sp.*, *Rubus caesius*, *Salvia sp.*, *Sedum sp.*, *Teucrium chamaedrys*, *Thymus sp.*, *Tillia sp.*, *Tusilago farfara*, *Urtica dioica*.
3. **Lepidoptera:** *Calophrys rubi*, *Melitea cinxia*, *Scolitantides orion*, *Plebeius idas*, *Coenonympha pamphylus*, *Melitea phoebe*, *Coenonympha arcania*, *Neptis rivularis*, *Hamearis lucina*, *Maculinea arion*, *Parnasius mnemosyne distincta*, *Zygaena filipendulae*, *Melitea ornata kovacsi*, *Polyommatus amandus*, *Lycaena alciphron*, *Argynnis pandora*, *Colias erate*, *Iphiclides podalirius*, *Thecla betulae*, *Zerynthia polyxena*, *Pontia edusa*, *Mellicta aurelia*, *Coenonympha glicerion*, *Hipparchia fagi*.
4. **Lepidoptera:** *Rhodostrophia vibicaria*, *Eilema sororcula*, *Scopula floslactata*, *Mesoleuca albicillata*, *Trisateles emortualis*, *Scopula immutata*, *Arctia villica*, *Chlorissa viridata*, *Pentopthera morio*, *Cyclophora linearia*, *Semiothisa clathrata*, *Heliomata glarearia*, *Laspeyria flexula*, *Spilosoma lutea*, *Ligdia adustata*, *Cossus cossus*, *Scopula decorata*, *Siona lineata*, *Macrothylacia rubi*, *Scopula marginepunctata*, *Spilosoma lubricipeda*, *Herminia tarsicrinalis*, *Scopula immorata*, *Agapeta hamana*, *Pterophorus pentadactylus*, *Emmelia trabealis*, *Hyphantria cunea*, *Cyclophora annularia*, *Horisme vitalbata*, *Pyrrhia umbra*, *Axylia putris*, *Pseudopanthera macularia*
5. **Other invertebrates:** *Helix pomatia*, *Ectobius sylvestris*, *Centrotus cornutus*, *Cicadetta montana*, *Agapanthia villosoviridescens*, *Cicindela campestris*, *Agriotes pilosellus*, *Agriotes ustulatus*, *Agrypnus murinus*, *Cantharis fusca*, *Dorcadion pedestre*, *Eusomus ovulum*, *Chrysomela vigintipunctata*, *Pyrochroa serraticornis*, *Melolontha melolontha*, *Rhizotrogus aestivus*, *Phyllobius pomaceus*, *Pyrochroa coccinea*, *Pholidoptera transsylvanica*, *Gryllus campestris*, *Euthystira brachyptera*, *Tetrix depressa*, *Gomphocerippus rufus*, *Arcyptera fusca*, *Calliptamus italicus*, *Chorthippus dorsatus*, *Chorthippus parallelus*, *Decticus verrucivorus*, *Apis mellifera*, *Vespa germanica*, *Bombus hortorum*, *Bombylius ater*, *Bombylius major*, *Xylocopa violacea*, *Camponotus vagus*, *Netelia testaceus*, *Aulacus striatus*, *Megalodontes cephalotes*, *Myrmica rubra*, *Formica rufa*, *Xanthogramma citrofasciata*, *Nephrotoma appendiculata*, *Volucella zonaria*, *Eupeodes corollae*, *Ectophasia crassipennis*, *Dexiosoma caninum*, *Panorpa meridionalis*, *Sympetrum sanguineum*, *Libellula depressa*, *Calopteryx splendens*, *Calopteryx virgo*, *Orthetrum brunneum*, *Valgus hemipterus*, *Cercopis sanguinolenta*, *Acanthosoma haemorrhoidale*, *Adelphocoris vandalicus*, *Alydus calcaratus*, *Calocoris affinis*, *Corizus hyoscyami*, *Dolycoris baccarum*, *Graphosoma lineatum*, *Pisaura mirabilis*, *Pardosa pullata*, *Philaeus chrysops*, *Runcinia grammica*, *Synema globosum*, *Xysticus cristatus*, *Hogna radiata*, *Cheiracanthium erraticum*, *Misumena tricuspidatus*, *Pardosa amentata*.
6. **Amphibians:** *Salamndra salamandra*, *Triturus cristatus*, *Bombina variegata*, *Bufo bufo*, *Rana dalmatina*.
7. **Reptiles:** *Vipera ammodytes ammodytes*, *Zamenis longissimus*, *Natrix natrix*, *Lacerta viridis*, *Podarcis muralis*.
8. **Birds:** *Buteo vulpinus*, *Buteo buteo*, *Buteo rufinus*, *Pernis apivorus*, *Falco tinnunculus*, *Falco peregrinus*, *Asio otus*, *Strix aluco*, *Corvus corax*, *Pica pica*, *Garrulus glandarius*, *Sylvia communis*, *Ptyonoprogne rupestris*, *Hirundo rustica*, *Motacilla cinerea*, *Motacilla alba*, *Lanius collurio*, *Sturnus vulgaris*, *Parus major*, *Poecile palustris*, *Aegithalos caudatus*, *Picus canus*, *Dendrocopos major*, *Carduelis cannabina*, *Carduelis carduelis*, *Apus melba*, *Phoenicurus ochruros*, *Oenanthe oenanthe*, *Ciconia ciconia*.
9. **Large mammals:** *Canis lupus*, *Lynx lynx*, *Martes martes*, *Cervus elaphus*, *Capreolus capreolus*, *Vulpes vulpes*, *Martes foina*, *Meles meles*, *Sus scrofa*.



10. **Small mammals (other than bats):** *Sciurus vulgaris*, *Talpa europea*, *Sorex araneus*, *Neomys fodiens*, *Crocidura leucodon*, *Glis glis*, *Muscardinus avellanarius*, *Apodemus sp.*, *Mus musculus*, *Sciurus vulgaris*.

11. **Small mammals (bats):** *Rhinolophus ferrumequinum*, *Rhinolophus hipposideros*, *Barbastella barbastellus*, *Myotis myotis*, *Myotis blythii*, *Myotis bechsteini*, *Miniopterus schreibersi*, *Nyctalus noctula*, *Pipistrellus pipistrellus*.

**Key species local conservation status:**

Dealing with local biodiversity conservation measures we did not need to use all the factors within the above mentioned categories, we have used only: area of occupancy, population health (depending on species), number of occurrence, area percentage with ecological integrity, environmental specificity, and the long or short term trend depending on the case. Thus, we present the local conservation status for the key species:

**Flora and vegetation**

Rare species: O.U.G. 57/2007 with 2011 additions: ANNEX 5 A - *Cladonia pyxidata*, *Leucobryum Glaucum*; ANNEX 3 - *Iris aphylla ssp. hungarica* also in ANNEX II TO COUNCIL DIRECTIVE 92/43/CEE ANEX 2-9150 Cephalanthero - Fagion Medio - european forests; Annex 1 of Habitat Directive 92/43/EEC - 91EO \* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior*.

Decline species: None of the key species mentioned before are in decline.  
Thriving species: All the selected key species are in a good state of preservation.

The rare species are located along the N-NE, E and S-SE rocky walls of the quarry. The priority habitat is located at the base of the N-NE and E rocky wall of the quarry. The local conservation status for the selected flora key species in present is favorable. In long term, only if the environmental reports suggestions will be followed and the local communities will benefit of ecological education.

**Invertebrates**

Rare species: O.U.G. 57/2007 with 2011 additions, ANEXA 4 A - *Zerynthia polyxena*, *Pholidoptera transsylvanica*, Annex 5A – *Helix pomatia*

IUCN RED LIST - *Maculinea arion*, *Parnasius mnemosyne distincta*, *Hipparchia fagi*.

Decline species (at European level according to IUCN): *Scolitantides orion*, *Neptis rivularis*, *Hamearis lucina*, *Maculinea arion*, *Parnasius mnemosyne distincta*, *Lycaena alciphron*, *Zerynthia polyxena*, *Hipparchia fagi*, *Gomphocerippus rufus*, *Arcyptera fusca*, *Calliptamus italicus*, *Chorthippus dorsatus*, *Decticus verrucivorus*.

Thriving species: All the species that were not listed in the other categories. Even if some species are in decline at European level, the local conservation status is favorable.

**Amphibians and reptiles:**

Rare species: O.U.G.57/2007 with 2011 additions: Annex 4B–*Salamandra salamandra*, *Bufo bufo*, Annex 3 and 4A–*Triturus cristatus*, *Bombina variegata*, Annex 4A–*Rana dalmatina*, *Vipera ammodytes ammodytes*, *Zamenis longissimus*, *Podarcis muralis*, *Lacerta viridis*.

Decline species (at European level according to IUCN)–*Salamandra salamandra*, *Triturus cristatus*, *Bombina variegata*, *Rana dalmatina*, *Vipera ammodytes ammodytes*, *Zamenis longissimus*, *Natrix natrix*.  
Thriving species: *Bufo bufo*, *Podarcis muralis*, *Lacerta viridis*.

The decline species at European level are also threaten at national and local level. For amphibians, the ecological trait that linked them to the aquatic environment and for reptile especially the wrong local people education and lack of ecological education which most of the time leads to their death on purpose, even if they represent actually useful species for agriculture and zootechnics keeping at optimum level the harmful species. The amphibians represents also bio indicator species for the health of the environment, therefore where the amphibian populations are in decline the ecosystem is damaged.

**Birds:**

Rare species: O.U.G. 57/2007 with 2011 additions: Annex 3–*Buteo rufinus*, *Pernis apivorus*, *Falco peregrinus*, *Picus canus*, *Ciconia ciconia*; Annex 4B–*Falco tinnunculus*, *Corvus corax*, *Motacilla sp.*, *Aegithalos caudatus*, *Carduelis sp.*, *Phoenicurus ochruros*, Annex 5C–*Pica pica*, *Garrulus glandarius*, *Sturnus vulgaris*.

Decline species (at European level according to IUCN)–*Pernis apivorus*, *Falco tinnunculus*, *Hirundo rustica*, *Sturnus vulgaris*, *Carduelis cannabina*.

Thriving species: *Buteo buteo*, *B. rufinus*, *Buteo b. vulpinus*, *Falco peregrinus*, *Asio otus*, *Strix aluco*, *Corvus corax*, *Pica pica*, *Garrulus glandarius*, *Sylvia communis*, *Ptyonoprogne rupestris*, *Motacilla sp.*, *Parus major*, *Poecile palustris*, *Aegithalos caudatus*, *Dendrocopos major*, *Crduelis carduelis*, *Phoenicurus ochruros*, *Apus melba*, *Oenanthe oenanthe*, *Ciconia ciconia*.

From the rare species only *F.tinnunculus* and *P. apivorus* are listed as in decline species at European level and also at the studied area level. *Hirundo rustica* and *Carduelis cannabina* are listed as in decline at European level, but at the quarry level they are actually thriving. The species listed as rare species, are found in

great abundance at the quarry level excepting *F.tinnunculus* and *F.peregrinus* presenting a population density survival limit. Their local conservation status is stable, even increasing for most of the species but fragile.

**Mammals (other than bats):**

Rare species: O.U.G. 57/2007 with 2011 additions: Annex 3 and 4A– *Canis lupus*, *Lynx lynx*; Annex 5A– *Martes martes*; Annex 5B– *Cervus elaphus*, *Capreolus capreolus*, *Vulpes vulpes*, *Martes foina*, *Meles meles*, *Sciurus vulgaris*, *Sus scrofa*.

Decline species (at European level according to IUCN) – *Lynx lynx*, *Martes foina*.  
Thriving species: *Canis lupus*, *Capreolus capreolus*, *Vulpes vulpes*, *Sus scrofa*, *Talpa europea*, *Sorex araneus*, *Neomys fodiens*, *Crocidura leucodon*, *Glis glis*, *Muscardinus avellanarius*, *Apodemus sp.*, *Mus musculus*, *Sciurus vulgaris*.

The decline species at European level are also threaten at national and local level, especially due to habitat loss and trophy hunting. *Lynx lynx* is represented in this area by a single individual who has his principal shelter in one cave from the SE wall of the quarry. Their local conservation status is stable but fragile, due to poaching activities that we also encounter during our field trips. According to Romanian legislation only one of the small mammals selected key species are in need for conservation measures, and as we can see, all of them are thriving even according to IUCN European Red List. 3.80 % of key species determination were made using the bones found in the caves, using measurement method. The number of bones is impressive, exceeding few dozen of individuals (skulls) which were taken into the laboratory for species identification (app. 10% of the total of found skulls), meaning that the population size of this small mammals is quite impressive at local level.

**Bats:**

Rare species: O.U.G. 57/2007 with 2011 additions: Annex 3– *Rhinolophus ferrumequinum*, *Rhinolophus hipposideros*, *Barbastella barbastellus*, *Myotis myotis*, *Myotis blythii*, *Myotis bechsteini*, *Miniopterus schreibersi*.  
Decline species (at European level according to IUCN) – *Rhinolophus ferrumequinum*, *Rhinolophus hipposideros*, *Barbastella barbastellus*, *Myotis blythii*, *Myotis bechsteini*.

Thriving species: *Myotis myotis*, *Nyctalus noctula*, *Pipistrellus pipistrellus*, *Miniopterus schreibersi*.  
The decline species at European level are also threaten at national and local level, especially due to habitat loss, this species being linked to cavernicole habitats such as: caves, caverns, old hollowed trees. The caves located in the NE, E, S, SE part of the quarry wall are used by the bats key species for hibernation and maternity, being therefore extremely important for their conservation, especially the cave “Zidul de Sus”. All the species are using the quarry as a feeding ground, due to its characteristics of open space, which helps the bat species in their hunting activities

**4. Discussion.**

**Environmental conditions assessment:** Data regarding temperature, due point an humidity was recorded in different habitats and two models were created for presenting the environmental conditions during winter and late spring seasons in the studied area. This data shows great differences between the quarry site and the natural surrounding habitats in all three variables, which are to be expected as the majority of the quarry's area is represented by uncovered rocky habitats – higher temperatures and lower humidity than the natural surrounding habitats, which means that the species need to bear and adapt to this conditions when using the quarry's area for different activities. Some of the species find this type of habitat favorable such as: numerous insects, small birds (especially *Oenanthe oenanthe* who is using the rocky habitat of the quarry as a nesting ground), foxes for warming during the winter, etc. The ecological implications of this differences are minimal as the quarry area is not large enough to influence a population of a certain species to adapt to this new environmental conditions, none of the identified species being affected.

**Species diversity assessment in analogy:** We conducted a comprehensive analogy regarding the species diversity between the quarry site and the natural habitats from the vicinity, with a range of 2 km around the quarry. The differences are statistically significant, with a general lower range in the quarry in relation to the natural habitats around it. However, this differences are based only on the data gathered for this study, and a suitable and realistic conclusion could be made only after few years with mark recapture methods. The differences are not significant from an ecological point of view, due to their even distribution between the quarry and the surroundings. In terms of abundance we can say that this variable is linked to the habitat diversity, the quarry site being an active one, has a limited number of habitats: grasslands, wooden patches and rocky areas, therefore the abundance of individual's form each identified species is lower than the one form the natural habitats. All the bat species which are inhabiting the caves from the quarry wall and other caves near the quarry site where found during night time in feeding activity above the quarry site. The open space characteristic of the quarry being a advantage for the bats facilitating their hunting activities, acting as a “fast food”. This conclusions must be taken

as preliminary due to the mobility of fauna species. The fact that this species coexist with a long term industrial activity is what we believe to be an important finding. Even elusive species as the *Lynx lynx* or *Canis lupus* have been observed in and around the quarry site, observations based on tracking. Most of the identified species (birds, mammals, reptiles, invertebrates) are using the quarry site for different purposes such as: nesting for small birds (*Oenanthe oenanthe*), feeding ground for raptor, feeding ground and shelter for bats and other small mammals.

**Sustainable conservation measures:** After the completion of the second objective and analysis of obtained results we can conduct a set of conservative measures for maintaining or increasing the local conservation status of existing key species at the quarry level. This measures will be focused on ecosystems well-functioning, habitat quality maintaining or restoring and species specific protection measures. Human activities are connected with biodiversity therefore is essential to maintain natural ecological processes. Biodiversity contributes to a multitude of products and ecosystem services that sustain human well-being, including water and air purification, wild resource production, provision of oxygen, medicine, spiritual and cultural benefits and play an important role in ecological processes such as pollination, seed dispersal and decomposition, as a source of food and clothing, for recreation, tourism, and cultural uses, and as esthetic and cultural icons in most areas of the world. Biodiversity resources are the heritable materials maintained within and among species that are of actual or potential economic, environmental, scientific or societal value. They are crucial to the adaptation and protection of our ecosystems, landscapes and production systems, yet are subject to increasing pressures and unsustainable use. During our work in the studied area we found three major threats that are directly or indirectly affecting biodiversity and especially key species conservation.

1. **Habitat loss** – considering the main activity of this area (surface mining) habitat loss is inevitable, but the surface lost during mining activities can be recovered by ecological restoration and green corridors preservation.
2. **Poaching and timber theft**- in Romania, this activities are omnipresent, and the Baita – Craciunesti area is also subjected to this type of illegal activities.
3. **Pollution** – considering the main activity of the studied area we should present pollution as a secondary result of this activity such as: air pollution (dust, exhaust gases), accidentally leaks, etc. but this is not the case. The main source of pollution in the quarry and the surrounding protected natural areas is represented by household waste. The local people who should protect their living are actually the first responsible of its degradation in terms of garbage disposal.

Studying this three main vulnerabilities of the quarry and surrounding area we developed the next necessary measures in order to increase the key species local conservation status and ensure a sustainable management of the quarry.

1. **Reducing pollutants that degrade quality of ecosystems** – this is a very important measure in a great need of implementation. The amount of household waste observed in the studied area is actively affecting species wellbeing and habitat quality, especially those located along the water courses from the N, N-E part of the studied area, on the Magurile Baitei Natural Reserve territory. In order to successfully reduce the amount of polluted areas, next measures are in great need to be applied.

- a. Greening affected areas – involving company employers and local people in this activity will bring a real visibility over the importance of ecosystems quality in human life. During this project we have conducted one greening sessions along with local people from which resulted 40 kg of household garbage. We strongly recommend the continuity of this program along with ecological education.

- b. Ecological education programs for local people and company employers – emphasizing on lifestyle improvements and mutual benefits between nature and people and the importance of maintaining ecosystems quality at optimal levels as a mutual benefit for nature, industry and people.

2. **Reducing poaching and timber theft activities and appropriate management of game and wood resources**

First, we must mention that the surveillance of this illegal activities is independent of the quarry's management, the only way to control this action is by strictly prohibiting them at the quarry level and in the vicinity. This can be done by ecological education programs for company employers with emphasis on wild resources importance for the quarry's sustainability. Natural resources (game and wood) represent a very important link between human activities and natural ecosystems wellbeing in order to maintain the quarry's sustainability. During our activities we have encounter different situations of poaching and timber theft inside the Natural Reserve Magurile Baitei in the vicinity of the quarry. We only could act for one case of timber theft by reporting it to the authorities.

### **3. Preserving caves as habitats of particular importance for biodiversity conservation especially for key species local conservation status increase**

The only manner in which caves habitats can be preserved is represented by the lack of exploitation in the area where cave habitats are present. At the Baita-Craciunesti quarry level few caves are present in the N, NE, E, SE, S part of the quarry's wall. These caves are acting as shelter for a large number of key species as: bats, large and small mammals, raptors, amphibians, reptiles, invertebrates. In order to preserve these caves, recognizing their importance, the quarry's management has decided to stop the exploitation in that area.

### **4. Habitat restoration**

We set the foundation for restoring the affected area, in collaboration with the quarry's management we set the foundation for ecological rehabilitation of some parts of the quarry through revegetation. The first part of this work, represented by covering the sterile layer with 20 cm of vegetal soil, is in progress. We have the species list which are the most suitable for this operation. The actual plantation will take place next year, as the vegetal soil needs some time to settle.

### **5. Reducing overgrazing activities in the quarry area and in the natural reserve**

The flora species which are repopulating the affected quarry's area, are extremely vulnerable to anthropic influences as the natural balance of the ecosystem is not yet at optimal levels. Therefore grazing activities especially sheep's grazing in these areas will not allow the flora to naturally restore and recreate the lost habitats through the constant negative pressure created by overgrazing. Therefore, the prohibition of overgrazing at the quarry level is necessary. In the vicinity traditional grazing is allowed and sometimes even necessary for maintaining the meadows at optimal levels. Also ecological education amongst local people is needed.

### **6. Maintaining grasslands and meadows at optimal productive levels, including green channels inside the quarry.**

Grasslands and meadows represent the most suitable habitat for invertebrate's key species. To maintain these habitats at optimal levels periodic mowing is necessary. In collaboration with the quarry's management a periodic calendar for mowing the meadows and grasslands inside the quarry will be created. For the moment a natural grassland, acting as a green channel, was created inside the quarry which will act as a shelter for the biodiversity trespassing the quarry and also as a shelter for the quarry's workers during their break time.

This measure will help especially those key species which are using the quarry surface. This allows an exchange of individuals between populations, which may help prevent the negative effects of inbreeding and reduced genetic diversity (via genetic drift) that often occur within isolated populations. Corridors may also help facilitate the re-establishment of populations that have been reduced or eliminated due to the main activities of exploitation. Furthermore, this measure will help increase the local conservation status for those beneficial insects from the key species list which are attracted to native flowering plants.

### **7. Maintaining the quality of water bodies inside and in the vicinity of the quarry.**

The water bodies are very important being the main source of life in all ecosystems, as they act as drinking places for the reptiles, birds and mammal key species and reproduction and larval development habitat for amphibians and some of the invertebrate's species key species. The quality of the water bodies is linked to the habitat quality. Therefore, if all the measures mentioned before especially reducing pollution measure will be accordingly applied, the water bodies' quality will be maintained at optimal levels. Also, ecological education is needed.

### **Ecological restoration and habitat quality improvement:**

Ecological restoration is an important part of the assessment of habitat requirements. Therefore the identification of the most suitable areas for revegetation and a list of suitable plant species was necessary. During one of our field trips, we have met with the quarry representatives in order to decide on the best areas for ecological restoration. We found most of the best places for this type of activity in the north-north-east part of the quarry, areas where fertile soil is already deposited. We have made a list of native plant species which are the most suitable for ecological restoration. These species are: *Cornus mas*, *Cornus sanguinea*, *Corylus avellana*, *Crataegus monogyna*, *Rosa canina*. They are resistant plants with a high probability to root and stay healthy. These species are also used as a food provider by numerous animal species from invertebrates (Coleoptera, Lepidoptera, Heteroptera, Hymenoptera etc.) to vertebrates (squirrels, deer, frugiferous and omnivorous birds, badgers, martens, wild boars, etc.), sustaining, therefore, the food chains.

Furthermore, we can apply the natural ecological restoration steps in the S-E part of the quarry where the fertile soil from the covert is deposited. We have identified pioneer plant species for ecological restoration, which are characteristic for the native habitats around, that begun to evolve small populations. The measures for maintaining these populations are explained in the above chapter.



Due to the specificity of the area in which the quarry exists, a karst area, we need to better understand how this type of ecosystem works in parallel with the quarry activities. The first part of this stage was to determine the location of the caves, therefore we have created GIS maps for identifying where the most important caves for conservation are located in the quarry area. The second part represents the investigation of the caves from a conservative point of view. All the caves are important as hibernation and maternity caves for bats and cave number P04 is also important for big mammals conservation as it is used by a *Lynx lynx* individual as a shelter. Traces of his presence were found in this cave as we showed before. Next steps are linked to the manner in which the animals use the quarry area. We have monitor the bat species presence in the quarry during the feeding time and we have found several species that are using the quarry as a feeding ground.

We found an animal passage through the quarry and around it, which shows that the fauna is using the quarry area. We found wolf (*Canis lupus*), bobcat (*Lynx lynx*), red deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), red fox (*Vulpes vulpes*), European pine marten (*Martes martes*), beech marten (*Martes foina*), badger (*Meles meles*) red squirrel (*Sciurus vulgaris*) wild boar (*Sus scrofa*). We have also mounted a camera trap on the road between the quarry and the forest and we caught on tape some movement as we show in the video. As a conclusion we mention that the mammal fauna from this area is using the quarry surface as a feeding and sheltering habitat.

Through this project, an important scientific value is added to the knowledge regarding the biodiversity of the quarry and its ecosystems services, through the emphasis of the relations between the key species, as no other study similar to ours have been done for this area. The aim of this project is to help ensure a proper biodiversity conservation strategy for obtaining a quarry ecosystem sustainability. A good managed biodiversity conservation project leads to a healthy ecosystem which in turn leads to healthy people. Therefore, the society and the company will benefit from the implementation of the subjected project.

## 5. Final conclusions.

We have identified a total of 354 species within the quarry site and in the vicinity, from which, 281 were identified as key species for a sustainable quarry site from which – 3 plant species, 2 day butterfly species, 3 other insect species, 3 amphibian species, 2 reptile species, 7 bird species, 2 large mammal species, 3 small mammals species, 7 bat species are rare species; 4 day butterfly species, 5 other insect species, 5 amphibian species, 3 reptile species, 9 bat species are decline species and all the other species that were not listed in the above categories are thriving, summing 240 species. All the key species are contributing to the exchange of energy between the quarry and the natural habitats being producer or/and consumers. Numerous birds, bats and other small mammals, nesting and/or borrowing in the quarry vicinity are coming to the quarry site to feed on insects or bush fruits depending in the case. Several butterflies are using flowering plant from the quarry's site for nectar, being after food for birds. Deer's are coming to feed on the grasslands and bushes from the quarry site, but they live in the forest around it. The bobcat is hunting in the forests but his shelter is right in the cave from the quarry wall. Therefore, we can see that important channels of energy exchange exists between the quarry and the surrounding natural habitats, and maintaining them bring integrity and sustainability to the quarry.

During our work in the studied area we found three major threats that are directly or indirectly affecting biodiversity and especially key species conservation: **habitat loss, poaching and timber theft, household garbage pollution**. Studying this three main vulnerabilities of the quarry and surrounding area we developed the next necessary measures in order to increase the key species local conservation status and ensure a sustainable management of the quarry: **1. Reducing pollutants that degrade quality of ecosystems – we have started and greening campaign which will continue in the next years; 2. Reducing poaching and timber theft – we have developed an ecological education plan based on mutual benefits; 3. Preserving caves as habitats of particular importance for biodiversity conservation; 4. Habitat restoration – we started an ecological restoration plan which includes also natural ecological restoration sustaining measures; 5. Reducing overgrazing activities; 6. Maintaining grasslands and meadows at optimal productive levels, including green channels inside the quarry; 7. Maintaining the quality of water bodies inside and in the vicinity of the quarry. By applying the best conservation methods for the needing species will then be easier to apply and to long-term maintain environmental rehabilitation. By highlighting the connections between the quarry ecosystem and surrounding habitats through the key species we ensure public awareness of the habitat complexity of a quarry.**

**To be kept and filled in at the end of your report**

<p><b>Project tags (select all appropriate):</b></p> <p>This will be use to classify your project in the project archive (that is also available online)</p>	
<p><b>Project focus:</b></p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Beyond quarry borders</li> <li><input checked="" type="checkbox"/> Biodiversity management</li> <li><input type="checkbox"/> Cooperation programmes</li> <li><input type="checkbox"/> Connecting with local communities</li> <li><input type="checkbox"/> Education and Raising awareness</li> <li><input type="checkbox"/> Invasive species</li> <li><input type="checkbox"/> Landscape management</li> <li><input type="checkbox"/> Pollination</li> <li><input checked="" type="checkbox"/> Rehabilitation &amp; habitat research</li> <li><input type="checkbox"/> Scientific research</li> <li><input type="checkbox"/> Soil management</li> <li><input checked="" type="checkbox"/> Species research</li> <li><input type="checkbox"/> Student class project</li> <li><input type="checkbox"/> Urban ecology</li> <li><input type="checkbox"/> Water management</li> </ul> <p><b>Flora:</b></p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Trees &amp; shrubs</li> <li><input checked="" type="checkbox"/> Ferns</li> <li><input checked="" type="checkbox"/> Flowering plants</li> <li><input checked="" type="checkbox"/> Fungi</li> <li><input checked="" type="checkbox"/> Mosses and liverworts</li> </ul> <p><b>Fauna:</b></p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Amphibians</li> <li><input checked="" type="checkbox"/> Birds</li> <li><input checked="" type="checkbox"/> Insects</li> <li><input type="checkbox"/> Fish</li> <li><input checked="" type="checkbox"/> Mammals</li> <li><input checked="" type="checkbox"/> Reptiles</li> <li><input checked="" type="checkbox"/> Other invertebrates</li> <li><input checked="" type="checkbox"/> Other insects</li> <li><input type="checkbox"/> Other species</li> </ul>	<p><b>Habitat:</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Artificial / cultivated land</li> <li><input checked="" type="checkbox"/> Cave</li> <li><input type="checkbox"/> Coastal</li> <li><input checked="" type="checkbox"/> Grassland</li> <li><input type="checkbox"/> Human settlement</li> <li><input checked="" type="checkbox"/> Open areas of rocky grounds</li> <li><input type="checkbox"/> Recreational areas</li> <li><input checked="" type="checkbox"/> Sandy and rocky habitat</li> <li><input type="checkbox"/> Scree</li> <li><input checked="" type="checkbox"/> Shrub &amp; groves</li> <li><input type="checkbox"/> Soil</li> <li><input type="checkbox"/> Wander biotopes</li> <li><input checked="" type="checkbox"/> Water bodies (flowing, standing)</li> <li><input type="checkbox"/> Wetland</li> <li><input checked="" type="checkbox"/> Woodland</li> </ul> <p><b>Stakeholders:</b></p> <ul style="list-style-type: none"> <li><input checked="" type="checkbox"/> Authorities</li> <li><input checked="" type="checkbox"/> Local community</li> <li><input checked="" type="checkbox"/> NGOs</li> <li><input type="checkbox"/> Schools</li> <li><input checked="" type="checkbox"/> Universities</li> </ul>