Final Project Report (to be submitted by 30th September 2016)

Instructions:

- Document length: maximum 10 pages, excluding this cover page and the last page on project tags.
- Start with an abstract (max 1 page).
- Final report text: Do not forget to mention your methodology; the people involved (who, how many, what organization they are from – if applicable); and the expected added value for biodiversity, society and the company. Finally, state whether the results of your project can be implemented at a later stage, and please mention the ideal timing and estimated costs of implementation.
- Annexes are allowed but will not be taken into account by the jury and must be sent separately.
- Word/PDF Final Report files must be less than 10 MB.
- If you choose to submit your final report in your local language, you are required to also upload your final report in English if you wish to take part in the international competition.
- To be validated, your file must be uploaded to the Quarry Life Award website before **30th September 2016** (midnight, Central European Time). To do so, please log in, click on 'My account'/ 'My Final report'.
- In case of questions, please liaise with your national coordinator.

1. Contestant profile

▪ Contestant name:	**Moldovan Ștefan**
▪ Contestant occupation:	Ornithologist
▪ University / Organisation	Romanian Ornithological Society
▪ E-mail:	
▪ Phone (incl. country code):	
▪ Number of people in your team:	**7**

2. Project overview

Title:	Search for the critically endangered Apollo Butterfly at Bicaz Chei Quarry
Contest:	Quarry Life Award
Quarry name:	Bicaz Chei Quarry
Prize category: (select all appropriate)	☐ Education and Raising Awareness X Habitat and Species Research ☐ Biodiversity Management ☐ Student Project ☐ Beyond Quarry Borders

Abstract

The Apollo butterfly (*Parnassius apollo* Linnaues 1758) is a post-glacial relict, considered extinct from the Romanian fauna by most lepideptorologists. The endemic subspecies of the Oriental Carpathians (*Parnassius apollo transsylvanicus*, Schweitzer 1912) has been recorded for the last time in 1996 at Bicaz Gorge, just across the road of Bicaz Chei Quarry, in the Cheile Șugăului-Munticelu Gorge. The species inhabits rocky areas, gravels, limestone rich meadows and also quarries, where the adults can find the host plants for the larvae (*Sedum* species) and rich nectar sources for the adults. Due to the fact that in the past decades lepidopterologists had no access granted inside of the limits of Bicaz Chei Quarry, the purpose of the research was exploring the possibility of a remnant population of Apollo butterfly (which was known historically to inhabit multiple areas of Cheile Bicazului-Hășmaș National Park) inside the quarry (if potential host plant species oft he larvae are found within the perimeters of the quarry) and to locate suitable habitat fragments in the adjacent areas which could sustain a population of Apollo butterfly for a relocation, in case that a viable population will be found in the proximity of the quarry. Between May and August 2016 a team of 7 persons have been searching for the Apollo butterfly and the habitat types with the host plant (*Sedum* species), respectively rich nectar sources for the adults (species of *Cirsium, Scabiosa, Carduus, Centaurea,* etc.) Neither adults nor larvae (caterpillars) were found within the perimeter of the quarry, nevertheless several populations of the potential host plats (*Sedum telephium* subsp. *maximum* = *Sedum maximum, Sedum hispanicum*) have been identified and charted. The search for the butterfly was extended to the territory of the Bicaz Chei- Hășmaș National Park, to the stations where the species has been recorded in the previous decades (Cheile Șugăului – Munticelu Nature Reserve, Suhardu Mic, Piatra Poienii, Cupaș Valley, Cheile Bicazului Gorge, etc.), but without positive results. At the vast majority of this stations only patches of *Sedum maximum* and *Sedum hispanicum* were identified, which suggests that most probably the host plant for the Apollo butterfly was *S. maximum* not *S. album* which could have been erroneously listed as the host plant in most of the Romanian publications (Rákosy 2013). The fact that *Parnassius apollo transsylvanicus* might belong to the telephiophagous group of subspecies (those of specialized for feeding on *S. maximum, S. fabaria* and *S. telephium*) has already been suggested before in the international literature concerning the species (Pekarsky 1953, in Nakonienczny et al. 2007). A less likely alternative scenario would be that the subspecies in question uses as feeding source for the larvae *S. hispanicum*, a species which was found in great numbers in the area and which can be easily misidentified for *S. album.* The less developed vegetation cover from the interior of the quarry can not host a high diversity of day flying butterflies, thus during the three months of the search, we have identified only 39 species of butterflies. However, among these, we identified two vulnerable and protected species of day flying butterflies. Both of these are myrmecophilous species of the genus *Maculinea,* with a highly complex life cycle. *Maculinea arion ligurica* has been recorded in areas inhabited by its host plant, *Origanum vulgare*, and *Maculinea alcon xerophila* has been identified in the egg stage on its host plant*, Gentiana cruciata* subsp. *phlogifolia.*

Final report

1. Introduction

The Apollo butterfly (*Parnassius apollo*, Linnaeus 1758) is one of the most endangered species of day flying butterflies from Romania. In the Catalog of Romanian Lepidoptera (Rákosy, Goia & Kovács 2003), 13 years ago, it has been considered an endangered species (CR, Critically Endangered), but recently is considered an extinct species (EX; Extinct) from the country`s fauna (Rákosy 2013). However, the last documented record of the species is from 1996 (Vizauer 2010, Székely pers.com). From time to time in the media are reported news of a more recent sighting, but without conclusive evidence. The species is protected by international laws: Habitat Directive, Bern Convention, CITES. In Europe is considered only a near threatened species (NT, Near Threatened). Among the most threatening factors for the Apollo butterfly are mentioned over-collection (van Swaay & al. 2010a), global warming (Rákosy 2000), but also shifts in land use (Rákosy 2013). However, we do not fully understand the causes of the local extinction of the populations from Romania.

In general, the Apollo butterfly is a dweller of the large mountainous regions of Europe: Spain, Andorra, Southern France, Italy, Switzerland, Lichtenstein, Austria, South of Germany, Czech Republic, Poland, the Balkan Peninsula (Greece, Bulgaria, Albania, Bosnia and Herzegovina, Croatia, Montenegro, Serbia, Slovenia); in Easter Europe (Russia, Ukraine) and in the North of the continent (South Norway, Sweden and Finland). The boundaries of its distribution are toward East Asia, up to Tien-Shan Mountains, Siberia and Mongolia, from the North of Ural Mountains to Transcaucasia, Turkey and Middle East. The overall population of Apollo butterfly is distributed on the Eurasian continent on a surface of 2700 x 7800 km (Nakonienczny, Kędziorski & Michalczyk 2007).

The taxon is considered extinct from Romania, Latvia and Belarus (van Swaay & al. 2010b). An obvious decline (above 30%) has been recorded in Austria, Bosnia and Herzegovina, Germany, Poland, Slovakia, Slovenia and Ukraine. A decline on a smaller scale (6-30%) has been reported from Bulgaria, France, Norway, Spain and Sweden. Therefore, we can state that the populations from Europe are in a general decline, the overall population numbers and their size are falling (van Swaay & al. 2010b). The causes of this decline at the continental level are multiple and complex, and can be classified in three major categories (Nakonienczny, Kędziorski & Michalczyk 2007): 1. natural factors, which comprises the long term climate changes, natural succession of habitats, and short term wheatear anomalies; 2. anthropogenic factors (pollution, direct impact on habitats), over collecting; and 3. intrapopulational factors: negative genetic processes in small and isolated populations.

The species includes many described subspecies, from which two are considered as valid taxa from Romania: *Parnassius apollo transsylvanicus* Shweitzer, 1912 from the Oriental Carpathians (Tulgheș, jud.Harghita) and *Parnassius apollo jaraensis* Kertész 1922 from the Occidental Carpathians (Valea Ierii, jud. Cluj). There are several other records from the Southern Carpathians and Dobrudja, but these taxa have gone extinct before they were described officially at infraspecific level. (Rákosy 2013, Székely 2008). Several authors tend to believe that

in Romania there is a single subspecies of *P. apollo* (Niculescu 1961, Ruști & Dragomirescu 1991) while others consider that the two above mention taxa are valid and present subspecies (Popescu-Gorj 1987; Rákosy, Goia & Kovács 2003).

The high number of infraspecific taxa (subspecies, forms and aberrations) is a result of long term isolation of different fragments of populations and their adaptation to a large variety of stationary conditions. The Apollo butterfly inhabits the mountainous regions, on sunny slopes with scarce vegetation, especially on rocky habitats. According to van Swaay & al. (2010b), in Europe the species inhabits alpine and subalpine meadows (23%), dry fields on limestone (19%), rocky areas (11%), slopes and gravels (9%), evergreen forests (7%) and deciduous forests (7%). However, their ecology is identical. The females lay eggs on small patches of *Sedum* sp., (usually *S. maximum, S. telephium, S. fabaria, S. album*). The caterpillars tend to hibernate inside the eggs, and emerge in March, still under the snow cover, feeding first on small shoots than later on leafs of the host plants (van Swaay & al. 2010b). The metamorphosis from caterpillar to chrysalis takes place in a safe place, usually under a rock or stone crop. The imagoes (adults) emerge in a single generation during the summer, in Romania between June-August (Székely 2008, Rákosy 2013). The imagoes feed on the nectar from *Cirsium* sp*., Carduus* sp*., Centaurea* sp*., Chrysanthemum* sp*., Knautia* sp*., Scabiosa* sp*., Onopordium* sp*., Hieracium* sp*., Eupatorium cannabinum, Dipsacus* sp. etc. (Nakonienczny et al. 2007, Rákosy 2013). The males patrol around the patches of the host plants, searching for the females (Rákosy 2013).

P. apollo transsylvanicus has been recorded in the Oriental Carpathians, in limestone rich areas, from about 50 locations (Rákosy 2013): Hășmaș Mountains (Cheile Șugăului – Munticelu Nature Reserve, Cheile Bicazului-Hășmaș National Park, Lacu Roșu area, Suhardul Mic, Cupaș Valley, Tulgheș), Rarău Mountains, Ceahlău Mountains, Călimani Mountains, Rodnei Mountains, Borsec, Vatra Dornei, Cheile Zugreni, etc. (Székely 2008, Rákosy 2013). According to Rákosy (2013), more accurate investigations are needed in order to clarify the existence or non-existence of the taxon in the Oriental Carpathians.

Following the assessment by IUCN (2001), *„a taxon is considered extinct (EX) when there is no reasonable doubt that the last individual has died. In the case of invertebrates, a taxon is considered extinct when it has not been seen for at least 20 years, despite deliberate efforts to locate it. Therefore, the presumption that the population has gone extinct, is possible."* (Rákosy 2003). The last definite record from the area is from 1996, Șugăului Gorge (Székely, com.pers.). It has been 20 years since the last record, during which period we are not aware of any deliberate actions to prove/dismiss the presence of the species in Romania. Even if the informational panels from the Cheile Bicazului-Hășmaș National Park are indicating the presence of the species in the protected area, there are no published data, neither did the specialists from the area systematically search for the species, with the exception of occasional visits to the locations where the species has been recorded and collected in the past (pers. com. dr. Székely Levente – Săcele; Sándor Lehel Csaba –„Tarisznyás Márton Museum" from Gheorgeni, etc.).

2. Purpose of the research

Although 20 years have past since the last record of the species, we do not consider it extinct from the Romanian fauna, because targeted searches has not been done. Because the last documented record of the species is from the proximity of the Bicaz Chei Quarry, we hypothesized that within the area of the quarry could exist a small remnant population. The quarry which has not been accessible for researchers and collectors in the past, therefore a fragment of the original population could remain undetected.

- *Question 1) Is there a colony of Apollo butterfly which managed to survive in the perimeter of Bicaz Chei Quarry?*

If the Apollo butterfly will not be located in the perimeter of the quarry, there are chances to find patches of the host plants (*Sedum* sp.), on the bare limestone rocks. In case fragments of potential habitat for the Apollo butterfly are found and we identify a population in the proximity of the quarry, there are good chances to relocate some of the caterpillars on the guarded territory of the quarry. There are known cases of such translocations of this species in Northern Europe (see Fred & Brommer 2015).

- *Question 2a) If potential habitats are identified within the quarry, do these present all the necessary ecological factors for relocation (adequate host plant species in abundance, nectar source for the imagoes, and long-term preservation of vegetation cover)?*

- *Question 2b) Is there any population of Apollo butterfly to be found in Cheile Bicazului-Hășmaș National Park, at optimal proximity of the quarry for a potential relocation?*

We have to stress the lack of any systematic data from Romania regarding the qualitative and quantitative composition of the day flying butterflies from mining sites and quarries. In contrast, in Great Britain for example, there are specially designated protected areas for day flying butterfly conservation in active quarries (Broadcroft Quarry Butterfly Reserve, Isle of Portland, and Dorset, England). With a granted permit to visit the interior of the Bicaz Chei Quarry, we decided to evaluate the resident day flying butterfly community, focusing on the Apollo and other protected butterfly species.

Question 3) Does Bicaz Chei Quarry have the potential to host and safeguard other species of day flying butterflies beside the Apollo butterfly?

3. The team involved

According to the project proposal only three specialists where indicated, but after the first field work it was clear that we must supplement the team. Overall, 6 experts and a logistic manager completed the main tasks.

Ștefan Moldovan (Bsc biologist): specialized in data deficient species from Romania and Egypt where most of his contracts assign him as an independent ornithologist. He is a member of the Romanian Ornithological Society, Romanian Lepidopterological Society and the Ornithological Society of the Middle East. Has published

many scientific articles, most of them in relevant world wide recognized publications: Birding World, Journal of Arid Environments, Egyptian Journal of Natural History, Mauritania, Sandgrouse Magazine, African Journal of Ecology, etc.

Örs Nimrod Páczai (Msc. Environmental Protection): field ornithologist with 10+ years of experience, also wide experience in data processing and project management. Member of the Romanian Ornithological Society

Attila Mátis (Bsc biologist): botanist specialized in species and habitats with 13+ years experience.

Csaba Vizauer (Msc ecologist): lepideptorologist with 20+ years of field experience, active member of the Romanian Lepidopterological Society from 1993. Fields of activity include day flying butterfly conservation in Romania, especially of those vulnerable; studies on the day flying butterfly communities in several type of land use; conservation and management plans of protected areas. Has published more than 15 scientific articles in teams or individually in national and international journals (Sociobiology, Journal of Insect Conservation, and Newsletter of Romanian Lepidopterological Society etc.), had 40 presentations at scientific meetings, different publications on public awareness.

Krisztina Havadtői (Msc biologist): botanist with 6+ years of experience in field research and biodiversity mapping.

Ágnes Kastal (Bsc biologist): lepidopterologist with 5+ years of experience, member of the Romanian Lepidopterological Society and founding member of the Butterfly Action Group in Romania.

Erika Török (logistic manager): the single non-specialist member of the team has managed the logistical issues of the field trips.

4. Methodologies

Research on location started on 10 May 2016 and continued up to the end of August. Field trips were conducted on o monthly basis. From a total of 19 days 5 days were spent for searching within the perimeters of the quarry and 14 days were necessary to cover the adjacent areas in order to locate suitable habitats and potential population of the species (Cheile Șugăului-Munticelu Nature Reserve, Cheile Bicazului-Hășmaș National Park, Valea Cupaș, Suhardul Mic, Piatra Poienii, etc.).

A) The main target of the first field trip (11-13 May 2016) has been the localization of suitable habitats with *Sedum* species within the quarry. This activity has been extended also for the following field trips, along the searching for the imagoes. For mapping the distribution of the potential host plants a 15.4 km long track was done along the perimeter of the quarry. Using a GPS (Garmin Etrex Legend HCx), all occurrences of the host species were noted and the surrounding habitats evaluated (species list, abiotic characteristics). Plant species were identified using the field guide by Sârbu et al. (2013) and the nomenclature follows Flora Europaea (Tutin et al. 2010).

Because the European and the Romanian literature concerning the feeding habits of the different subspecies of the Apollo butterfly contains contradicting information regarding the identity of the host species (Pekarsky 1953, Witkowski 1997, Fred & Brommer 2003, 2009, Rákosy 2013), we opted for surveying all the *Crassulaceae* species (*Sedum maximum, Sedum acre, Sedum album, Sedum hispanicum, Jovibarba globifera*) from the quarry and its vicinity. For evaluating the populations of the potential host species we used a scaling according to Fred & Brommer (2003, 2009):1- between 1-10 individuals; 2- between 10-100 individuals; 3- between 100-1000 individuals.

B) The field trips between July and August 2016 were focused on the localization of potential Apollo butterfly population within the quarry and on the location where they have been recorded in the past. For this reason systematic search along linear transects was conducted, covering all the suitable habitat fragments identified during the previous field trip and also in areas where reliable sightings of the species occurred during the '90.

C) Concomitant with the search for the Apollo butterfly along transects, other day flying butterfly species were recorded systematically (locations marked with GPS, numbers registered), with focus on protected species.

5. Results

A) In order to properly evaluate and map the populations of the suitable host plant species (*Sedum* sp.), during May 2016 a 15.4 km long transect was conducted along the rim of the quarry and also several were done in the adjacent areas (including Cheile Șugăului-Munticelu Nature Reserve, Cheile Bicazului-Hășmaș National Park, Valea Cupaș, Suhardul Mic, etc.). There have been 15 location identified and mapped with patches of *Sedum* sp., of which 7 were inside the quarry and 8 in Cheile Șugăului-Munticelu Nature Reserve. In the vast majority of the fragments only *S. hispanicum* and *S. maximum* have been recorded with low abundancy (1-10 individuals), in the rock crevices, the forest and pasture fragments along the rim of the quarry, besides other habitat-specific plant species: *Jovibarba globifera, Campanula carpatica, Asplenium trichomanes* etc. (Annex: Fig. 9. și Fig. 10.).

Due to the fact that for proper identification of all the Sedum species and the evaluation of their population May proved to be too early, this process was repeated during the field trips in July and August, offering a complete evaluation of host plant population, with more location identified and better population estimates (Annex: Fig. 1. and Table 1.). A total of **24** location where identified containing *Sedum* species, with different abundances. *Sedum album*, the species indicated in the national literature as the main host species for the Apollo butterfly was not found within the quarry or in the adjacent investigated areas. This particular species is very similar to *S. hispanicum*, especially in non-flowering stages and can be easily misidentify. It is very likely that the confusion of the two species persisted throughout past researches regarding the Apollo butterfly in Romania. Instead, according to Pekarsky 1953, this subspecies should be using *S. fabaria*. We did not find this particular plant species during our survey, but the closely related *S. maximum* was present in significant numbers. We hypothesize that the most likely scenario is that the Transylvanian subspecies of the Apollo butterfly's caterpillar feeds on this species instead, and was never properly investigated in the past.

Along the track we investigated the vegetation on the inner and outer slopes of the quarry rim, in the areas where no active exploitation occurs. After abandonment the process of natural re-vegetation started on most of the slopes of rocky debris, with the vegetation in different phases of succession. Colonizing plant species are pioneer generalist species but also many are typical of the natural habitat types that occurred in the area before the exploitation (*Hieracium bifidum subsp. canitiosum, Galium anisophyllum, Asplenium trichomanes, Biscutella laevigata, Erysimum wittmanni, Poa rehmanni, Seseli libanotis, Saxifraga paniculata, Potentilla heptaphylla, Epilobium angustifolium, Campanula carpatica, Campanula sibirica* subsp. *divergentiformis, Sedum maximum, Sedum hispanicum, Jovibarba globifera, Acinos alpinus, Silene nutans* subsp. *dubia, Laserpitium latifolium, Coronilla varia, Geranium macrorrhizum, Scabiosa lucida* subsp. *barbata* (Annex: Fig. 12)*, Anthyllis vulneraria, Valeriana tripteris, Carduus defloratus* subsp. *glaucus* (Annex: Fig. 11)*, Juniperus sabina, Rosa tomentosa, Rosa pendulina, Salix caprea, Salix purpurea, Populus tremula, Picea abies, Corylus avellana, Acer pseudoplatanus, Fagus sylvatica, Pinus sylvestris*). Also, in a few locations, on the outer slopes of the quarry walls, some of the original vegetation cover was preserved. According to the Natura 2000 classification these are: 8120, Calcareous and calcashist screes of the montane to alpine levels (Thlaspietea rotundifolii) and 8210, Calcareous rocky slopes with chasmophytic vegetation. Although the natural colonization of the abandoned screes would be very efficient in restoring the suitable habitats favoured by the target species, this process is currently hindered by the presence of a large grazing sheep and goat herds in the vicinity and even the interior of the quarry.

Within and in close proximity to the quarry (on mountain meadow used for hay making, natural chasmophytic vegetation on rocky slopes) significant population of potential nectar source plant species for feeding imagoes were found: *Carduus defloratus* subsp. *glaucus, Cirsium vulgare, Cirsium rivulare, Cirsium erisithales, Centaurea apiculata* subsp. *spinulosa, Scabiosa lucida* subsp. *barbata, Hieracium pojoritense, Eupatorium cannabinum.*

B) Between July and August, several filed trips, in places were the Apollo butterfly was recorded in the past. In order to investigate the presence/absence of the species we spent 14 days in the following areas: Suhardul Mic (Annex: Fig. 6.), Cheile Șugăului – Munticelu (Annex: Fig. 8.), Piatra Poienii (Annex: Fig. 4.), Lacu Roșu, Valea Cupaș (Annex: Fig. 7.), and the Bicaz Chei Quarry (Annex: Fig. 5. and Fig. 13.). The focus of the search was on the larvae from the patches of vegetation with *Sedum* species in May and on feeding imagoes in July-August. Although many fragments of suitable vegetation cover were found, neither the flying adult nor the larvae were not detected.

C) In four consecutive months (May, June, July, August) the area of the quarry has been surveyed totally or partially by a transect of 4,323 - 6,555 km, from the top of the quarry (1115 m altitude) to the base (648 m altitude), using the Pollard method (Rákosy 2013, van Swaay et al. 2012). The transect has been divided in 12 sections according to the main habitats, the open area of the quarry, the pastures and hay fields from the perimeters of the quarry rim and the main road of the quarry (Annex: Fig. 3.).

A number of 40 species of butterflies (156 specimens) were recorded (Annex: Tabel nr. 2), of which 34 day flying butterfly (138 specimens). The biodiversity index calculated from these numbers shows a relative low diversity

which is partially the result of the scarce and underdeveloped vegetation cover within the quarry, where mostly migratory or erratic species were recorded. However, even the well vegetated habitats from the outer limits of the quarry are poor in butterflies due to the overgrazing. The average height of the vegetation barely is higher than 14 cm. On 16 of July 2016, the nectar source flowering species abundance was low, which considerably decrease the chances of survival of a viable *P. apollo* population.

On 13 July 2016 two species of protected day flying butterfly species were identified within the quarry: *Maculinea (Phengaris) arion ligurica* (Wagner, 1904), respectively *Maculinea (Phengaris) alcon xerophila* Berger, 1946 or `*cruciata*` form. Both species are protected in Romania under the Law 46/2011 (Anexa 4A and 4B), the first species being also listed on the Habitats Directive (Anex IV). Butterflies belonging to genus *Maculinea* Van Eeecke, 1915 (Lepidoptera: Lycaenidae), are extremely specialized myrmecophilous species, which developed during their evolution a very tight relationship with ants, a very complex form of social parasitism. The female butterflies lay eggs on certain species of plants (*Asteraceae* and *Rosaceae*), close to the flowers. The larvae will feed on ovary or unripe seeds of the host plant. The caterpillars will be adopted by certain ant species of *Myrmica* genus. In order to be adopted by the ants, the caterpillars rely on different strategies and morphological, physiological and behavioral adaptations. The ants transport the caterpillar to the ant nest, where it will feed on the ants larvae (predation) or will be fed by the ants („cuckoo" type). The caterpillar will turn to a chrysalis in the upper chambers of the ant nest (solarium). It takes to weeks from this moment to emerge the adult *Maculinea* butterfly, which in this form is an intruder and must leave the ant nest very fast in order to avoid to be attacked and eaten by the ants (Timuș 2013). Due to this strong dependence to certain host plants and host ants, *Maculinea* butterflies are very sensitive indicators of the biodiversity and to the changes in their habitat (Timuș 2013).

Maculinea (Phengaris) arion forma *ligurica* (Wagner, 1904) inhabits limestone rich habitats or meadows on limestone grounds rich with *Thymus* sp. and *Origanum vulgare* acting as primary host species. It is a predator type species, feeding on the larvae of the host ants. Adults fly in June-July (Rákosy 2013), in a single generation, but this period can extend to early August (Trascău Mountains: Cheile Runcului 2010, Vizauer pers.com.). This form is phenologically different from *M. (Ph.) arion arion* (Linaeus, 1758) which flies in May-June and which is not territorial (Rákosy 2013). We do not have any information regarding the host ants of this species (Tartally 2009, Rákosy 2013). *Maculinea (Phengaris) alcon xerophila* Berger, 1946 or `*cruciata*` form, is considered by some scholars a distinct species from *M. (Ph.) alcon alcon* ([Denis & Schiffermüller], 1775), and others consider it only an ecotype. In Romanian literature it has been mentioned as *M. rebeli* și *M. alcon sevastos* (Rákosy 2013). This taxon inhabits mesophile meadows on limestone or clay, characterized by the presence of the host plant *Gentiana cruciata.* It is different ecologically and phonologically from *M. (Ph.) alcon alcon* as the nomotypic subspecies inhabits moors and wet meadows, eggs are laid on *Gentiana phenumonanthe* and adults fly later (July - August). Studies from Transylvania show that *M. (Ph.) alcon* `*cruciata*` form flies between 14-26 June, and *M. (Ph.) alcon alcon* between 9 July-8 August on Cluj Hills (Timuș et al. 2013). On limestone meadows (Rimetea, Trascău Mountains) *M. (Ph.) alcon,* `*cruciata*` form has been recorded between 16 June–16 July (Osváth-Ferencz et al. 2016). It is a „cuckoo" type species.

On 13th of July 2016, at Bicaz Chei Quarry there have been identified a single specimen of *Maculinea (Phengaris) arion ligurica* and eggs of *M. (Ph.) alcon* `*cruciata*` form, laid on *Gentiana cruciata* subsp*. phlogifolia.* In the quarry were identified two areas with host plants for the two *Maculinea* species. The first area is located in the Northen (Annex: Fig. 15) and lower part of the quarry (average elevation 745 m, 50x30 m area) and is rich in *Origanum vulgare*, but also 43 specimens of *Gentiana cruciata* subsp*. phlogifolia* were investigated, from which on 4 plants eggs of *M. alcon* (9,30%) were noted (Annex: Fig. 2., Fig. 3. and Fig. 16.). The second area on the eastern side of the quarry (average altitude 876 m, 100x20 m area) *Maculinea arion* has been identified respectively*,* 95 specimens of *Gentiana cruciata* subsp*. phlogifolia* were investigated, from which on 50 we have identified *M. alcon* eggs (52.63%). In mid July (12-14 iulie 2016) the last flying specimens of the *Maculinea* species were recorded. At Cupas Valley and Cheile Șugăului-Munticelu Gorge, areas with more humid and cooler environment compared to the quarry, even more specimens of *M. (Ph.) arion* were founded, including an adult *M. (Ph.) alcon* forma `*cruciata*`(Annex: Fig. 2).

During our survey at Suhardul Mic peak, on 17th of June 2016, we have identified a significant population of *Euphydryas aurinia*, a protected species of Habitats Directive (Annex II), also mentioned by Law 49/2011 (Annex 3 and 4B). Worth mentioning that none of these species is included in the list of the protected species of Cheile Bicazului-Hășmaș National Park, therefore this field data will supplement the Management Plan of the protected area (Annex: Fig. 2. and Fig. 14.).

6. Conclusions:

1. The Apollo butterfly (*Parnassius apollo transsylvanica* Schweitzer, 1912) has not been found at Bicaz Chei Quarry, nor in any of the historically known places of occurrence before 1990, at Bicaz Chei-Hășmaș National Park (Suhardul Mic, Șugăului-Munticelu Gorge, Piatra Poienii, Lacu Roșu, Cupaș Valley) during July-August 2016.

2. On most of the surveyed areas known host plants of the genus *Sedum* (*S. maximum, S. hispanicum*) and *Jovibarba globifera* were recorded, and also the presence of nectar sources for adults (*Cirsium* sp., *Centaurea* sp., *Scabiosa* sp., *Knautia* sp.) was detected. Between May-July 2016 within Bicaz Chei Quarry several patches of host plants (*Sedum* sp.) were identified and mapped.

3. Inside the perimeters of Bicaz Chei Quarry 40 butterfly species were identified, from which 35 were day flying butterfly species, a total of 138 individuals, from which 126 were day flying butterfly species. The biodiversity index calculated from this numbers shows a relative low diversity which is partially the result of the underdeveloped vegetation cover in the quarry. However, even the well vegetated habitats from the outer rims of the quarry are poor in butterflies, due to overgrazing. The average height of the vegetation barely is higher than 14 cm. On 16 of July 2016, the nectar source flowering species abundance was low, which considerably decrease the chances of survival of a viable *P. apollo* population.

4. At Cheile Bicazului-Hășmaș National Park three species of internationally protected day flying butterfly species were identified which are not listed yet in the management plan of the natural protected area. Between June and July 2016, the populations of the following species were mapped: *Euphydryas aurinia* (Suhardul Mic, 17 of June 2016) with 23 counted specimens on a wet meadow and in the surroundings on a 750x200 m area; *Maculinea (Phengaris) arion ligurica* at Piatra Poienii (15 iunie 2016, 1 ind.), Cupas Valley (12 iulie 2016, 2 ind.) and Șugăului-Munticelu Gorge (12-14 iulie 2016, 6 ind.); *Maculinea (Phengaris) alcon* `*cruciata*` form has been recorded at Cupaș Valley (12 iulie 2016, 3 ind.), Șugăului – Munticelu Gorge (12-14 July, 3 ind. + 2 specimens of *Gentiana cruciata subsp. phlogifolia* with eggs).

5. At Bicaz Chei Quarry two protected species were identified: *Maculinea (Phengaris) arion ligurica*, a single individual on 13 July 2016, and several patches of the host plant *Origanum vulgare*, respectively *Maculinea (Phengaris) alcon* `*cruciata*` form on 13 July 2016, in two different places with egg infested host plants of *Gentiana cruciata subsp. phlogifolia.* In the two locations with a total surface of 3500 m^2 a total of 138 plant specimens wer investigated from which 54 were infested with eggs of *M. alcon.*

7. Future prospects

Considering the constellation of favorable factors identified within the quarry and the surroundings (presence of significant numbers of several *Sedum* species, abundant nectar sources for the imagoes, natural regeneration of the vegetation in the abandoned parts of the quarry, the relative security offered by the guarded area of the quarry, the favorable attitude of Heidelberg Cement toward nature conservation and environment protection, and the protected status of the surrounding areas) it can be concluded that with a constant and concentrate effort on longer periods, with substantial financial resources and involvement of increased expertise, there is a good chance for surviving Apollo butterfly population to be found in the area and to secure a source of relocation on a larger scale. The collateral results of this pilot project (identification of multiple protected butterfly species within the limits of the quarry and in the nearby preserve, identification of the areas with a strong potential for natural regeneration of the vegetation) are opening new horizons for more detailed and long term studies on the potential of the quarry in biodiversity conservation activities. For the continuation of the project we propose two lines of research:

1. To enlarge the search area of the endemic Apollo butterfly (*P. apollo transsylvanicus*) to cover larger areas in the Oriental Carpathians (Călimani Mountains, Ceahlău Mountains, Giumalău Mountains, Hășmaș Mountains etc.), to locate possible sources for recolonizing the fenced interior of the Bicaz Chei Quarry.
2. A research on *Maculinea arion* and *Maculinea alcon* from Bicaz Chei quarry: the evaluation of their population and the dynamic of the populations, a study on the ant communities, assessment of the conservation status of the habitats and host plants in correlation with the populations outside the limits of the quarry.

*) *Bibliographic references, maps, species lists and photos are presented in the Annex of the present Final Report.*

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

Project tags (select all appropriate):

This will be use to classify your project in the project archive (that is also available online)

Project focus:

- ☐Biodiversity management
- ☐Cooperation programmes
- ☐Education and Raising awareness
- X Endangered and protected species
- ☐Invasive species
- ☐Landscape management - rehabilitation
- ☐Rehabilitation
- X Scientific research
- ☐Soil management
- ☐Urban ecology
- ☐Water management

Flora:

- ☐Conifers and cycads
- ☐Ferns
- ☐Flowering plants
- ☐Fungi
- ☐Mosses and liverworts

Fauna:

- ☐Amphibians
- ☐Birds
- X Dragonflies & Butterflies
- ☐Fish
- ☐Mammals
- ☐Reptiles
- ☐Spiders
- ☐Other insects
- ☐Other species

Habitat:

- ☐Cave
- ☐Cliffs
- ☐Fields - crops/culture
- ☐Forest
- ☐Grassland
- ☐Human settlement
- X Open areas of rocky grounds
- ☐Recreational areas
- X Screes
- ☐Shrubs & groves
- ☐Soil
- ☐Wander biotopes
- ☐Water bodies (flowing, standing)
- ☐Wetland

Stakeholders:

- X Authorities
- X Local community
- ☐NGOs
- ☐Schools
- ☐Universities

ANNEX

to the Final Report concerning the project „Search for the critically endangered Apollo Butterfly at Bicaz Chei Quarry"

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Fig. 1. Distribution map of *Sedum* species within the target area

Legend: arabic numbers (292 – 324) – GPS location numbers (see Table nr.1); green dots – occurrence of *Sedum* species on Suhardul Mic; purple dots - occurrence of *Sedum* species in Valea Cupaș; yellow dots - occurrence of *Sedum* species in Cheile Șugăului – Munticelu Nature Reserve; orange dots - occurrence of *Sedum* species within Bicaz Chei Quarry

Table nr. 1. Abundance of *Sedum* species in each of the identified occurrence, registered on 16-17 June (locations 292-314) and 12-14 July 2016 (locations 317-324)

Nr. GPS location	*Sedum hispanicum*	*Sedum maximum*	*Jovibarba globifera*	*Sedum acre*
292	2			
293	2	1		
294		2	1	
295		2	2	
296	1	2	2	
297	3	3	3	
298	3	3	3	
299	2	2	2	
300	3	3	3	
301	3	2	2	
302	3	3		
303	3	3		
304	2	1	2	
307	3	3	3	
309	1	1		
314	2	2		
317	2	2		
318	1	2		
319	1			
320	3	3	3	2
321	3	3	3	3
322	3	3	3	
323	3	3	3	
324	1	2		

Legend: 1-3 – Scale according to conform Fred & Brommer (2003, 2009): 1 = 1 – 10 individuals, 2 = 10 – 100 individuals, 3 = 100 – 1000 individuals, 4 = > 1000.

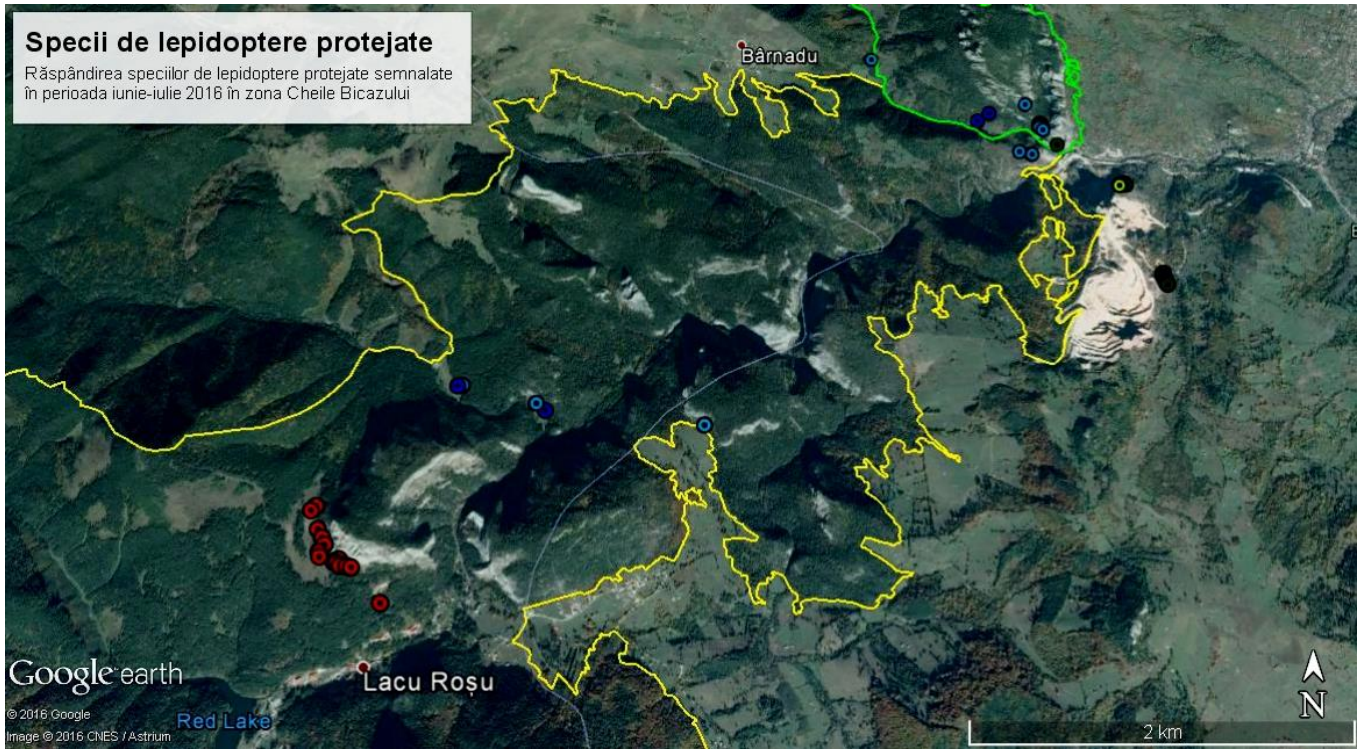

Fig. 2. Map of the distribution of the protected butterfly species in Cheile Bicazului

Legend: yellow line – boundaries of the ROSCI0027 Cheile Bicazului – Hășmaș Protected Area; green line – boundaries of ROSCI0033 Cheile Șugăului – Munticelu Nature Reserve; grey line – conty border; red dots – occurrence of *Euphydryas aurinia*; dark blue dots – occurrence of *Maculinea alcon xerophila*; light blue dots – occurrence of *Maculinea arion ligurica*; dark green dots – occurrence of eggs of *M. alcon xerophila* on *Gentiana cruciata* subsp. *phlogifolia*; light green dots – occurrence of *Gentiana cruciata* subsp. *phlogifola* without eggs of *M.alcon xerophila*.

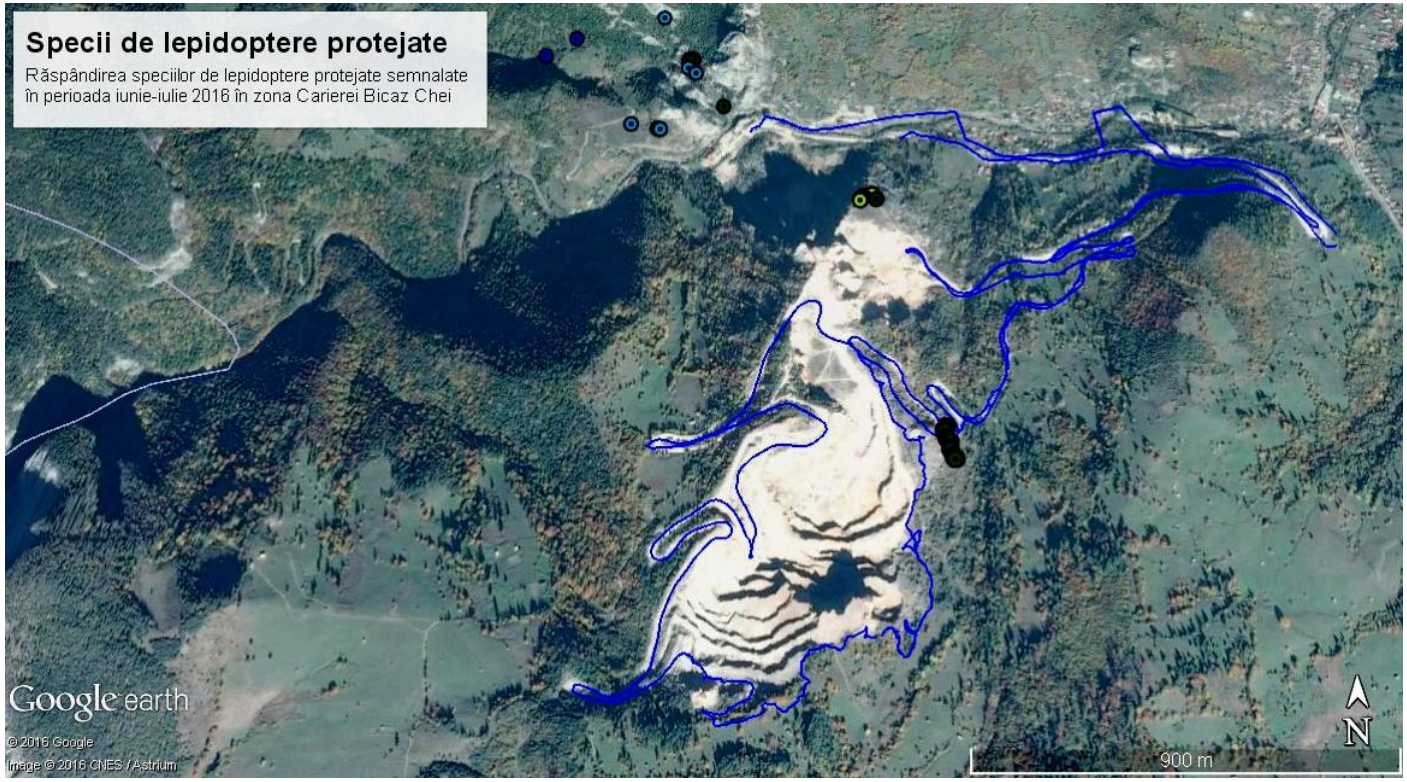

Fig. 3. Map of the distribution of the protected butterfly species in Bicaz Chei Quarry

Legend: blue line – transect for species with diurnal activity in May-August 2016; dark blue dots – occurrence of *Maculinea alcon xerophila*; light blue dots – occurrence of *Maculinea arion ligurica*; light green dots – occurrence of eggs of *M. alcon xerophila* on *Gentiana cruciata* subsp. *phlogifolia*; light green dots – occurrence of *Gentiana cruciata* subsp. *phlogifola* without eggs of *M.alcon xerophila*.

Table nr. 2. Taxonomic list of diurnal butterfly species detected within Bicaz Chei Quarry between May-August 2016 (nomenclature according to Rákosy et al. 2003)

Nr. crt.	Family	Species
1	Zygaenidae	*Zygaena filipendulae*
2	Sphingidae	*Macroglossum stellatarum*
3	Hesperiidae	*Thymelicus sylvestris*
4	Hesperiidae	*Erynnis tages*
5	Papilionidae	*Papilio machaon*
6	Pieridae	*Leptidea sinapis/juvernica*
7	Pieridae	*Anthocaris cardamines*
8	Pieridae	*Pieris brassicae*
9	Pieridae	*Pieris rapae*
10	Pieridae	*Pieris napi*
11	Pieridae	*Colias alfacariensis*
12	Pieridae	*Gonepteryx rhamni*
13	Lycaenidae	*Callophrys rubi*
14	Lycaenidae	*Cupido minimus*
15	Lycaenidae	*Glaucopsyche alexis*
16	Lycaenidae	***Maculinea arion ligurica***
17	Lycaenidae	***Maculinea alcon xerophila***
18	Lycaenidae	*Plebeius idas*
19	Lycaenidae	*Polyommatus semiargus*
20	Lycaenidae	*Polyommatus icarus*
21	Nymphalidae	*Boloria dia*
22	Nymphalidae	*Vanessa atalanta*
23	Nymphalidae	*Vanessa cardui*
24	Nymphalidae	*Inachis io*
25	Nymphalidae	*Aglais urticae*
26	Nymphalidae	*Melitaea britomartis*
27	Nymphalidae	*Melitaea athalia*
28	Nymphalidae	*Neptis rivularis*
29	Nymphalidae	*Lasiommata megera*
30	Nymphalidae	*Lasiommata maera*
31	Nymphalidae	*Coenonympha glycerion*
32	Nymphalidae	*Coenonympha pamphilus*
33	Nymphalidae	*Aphantopus hyperantus*
34	Nymphalidae	*Maniola jurtina*
35	Nymphalidae	*Erebia medusa*
36	Nymphalidae	*Melanargia galathea*
37	Geometridae	*Chiasmia clathrata*
38	Geometridae	*Siona lineata*
39	Noctuidae	*Euclidia glyphica*
40	Noctuidae	*Autographa gamma*

Original photos (Junie-July 2016) by:

- Vizauer Csaba: Fig. 4, 5, 6, 7, 8, 14, 15 and 16
- Mátis Attila: Fig. 9, 10, 11, 12 and 13

Relevant photos of the area and the activities

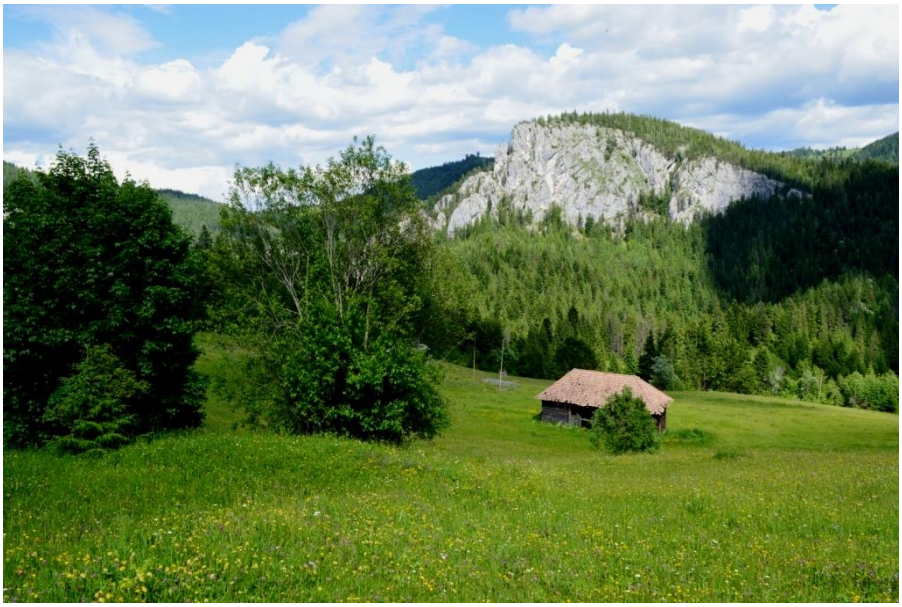

Fig. 4. Piatra Poienii, where *Maculinea arion* was identified

Fig. 5. Working inside the Bicaz Chei Quarry (botanist Mátis Attila)

Fig. 6. Information board at the Suhardul Mic, with the Apollo butterfly

Fig. 7. Searching for the host plants in Cupaș Valley (Mátis Attila and Moldovan Ștefan)

Fig. 8. Cheile Șugăului – Munticelu Nature Reserve (with Mátis Attila, Török Erika, Moldovan Ștefan)

Fig. 9. Suitable habitat for the larvae of the Apollo butterfly, with *Sedum hispanicum*, *S. maximum* and *Jovibarba globifera*

Fig. 10. *Sedum hispanicum* and *Sedum maximum,* potential host plants for the larvae of the Apollo butterfly

Fig. 11. *Carduus defloratus* subsp. *glaucus*, nectar source for the imago

Fig. 12. *Scabiosa lucida* subsp. *barbata*, nectar source for the imago

Lepidopterologists and protected butterfly species from Cheile Bicazului

Fig. 13. The lepidopterologist team (Vizauer Csaba and Moldovan Ștefan)

Fig. 14. *Euphydryas aurinia*, protected species from Suhardul Mic

Fig. 15. Habitat of *Maculinea arion* și *Maculinea alcon* from Bicaz Chei Quarry

Fig. 16. *Gentiana cruciata* subsp. *phlogifolia* infested with eggs of *Maculinea alcon xerophila* in Bicaz Chei Quarry, 17 July 2016