



ENVIRONMENTAL EDUCATION PROGRAM FOR BIODIVERSITY CONSERVATION DURING THE REHABILITATION PROCESS OF LIMESTONE QUARRY

STEP 4 PROJECT REPORT



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Abstract

Post-closed rehabilitation process of the limestone quarry area after finishing the cement production is extremely interesting to use this territory for scientific investigations and develop educational program for pupils and students to demonstrate effect of industrial impact on nature and the methods of habitat rehabilitation. The implementation of educational program will perform involvement of any relevant universities, research institutes and schools in monitoring process of nature conservation actions managed by the company. This process will be considered as involvement of stakeholders demonstrating a range of levels and activities, including information provision, consultation, participatory planning or decision-making and partnership. These activities will increase the popularity of rehabilitation process management and expand knowledge on nature conservation among young generation and local population.

Preliminary study carried out in summer 2012 in the framework of the program "the Quarry Life Award" used for the education program two limestone quarries - Kavtiskhevi and Dedoplistsdkaro. The information for educational program was collected from literature data and during field trips. The field work was carried out using phytosociological methods of plot recording. Plant species composition and diversity was determined for each habitat. Statistical analysis of these data gave a possibility to develop complete database information about species diversity changes among successional stages of vegetation recovery.

Two succession stages: pioneer succession and typical oligotrophic meadows of Kavtiskhevi quarry have been described. The vegetation cover percentage is much lower in pioneer successions (29.4 ± 14.4) than in oligotrophic grasslands (67.8 ± 16.1). The species richness shows similarly low level at pioneer succession (9.7 ± 1.6) than in oligotrophic grasslands (16.4 ± 3.9). Shannon-Wiener index is higher in restored grasslands (1.9 ± 0.48) than in pioneer successions (1.6 ± 0.53). Detrended correspondence analyses (DCA) show that the pioneer succession is mainly clustered with environmental indicator of low soil depth. The mean soil depth in pioneer succession plots is lower (1.7 ± 1.76 cm) than in oligotrophic grasslands (2.75 ± 1.13 cm). The 8 species have revealed higher observed indicator value (IV) in pioneer successions. The following species are present only in pioneer successional plots - *Sisymbrium loeselii*, *Medicago lupulina*, *Lactuca seriola*, *Tussilago farfara*, *Scorzonera biebersteinii*, *Chenopodium album*, *Poa densa*. The three dominant species of pioneer successions - *Lotus corniculatus*, *Melilotus officinalis* and *Taraxacum officinale* showing high cover percentage in plots of pioneer successions are still remained in a logistical successional stage on plots. The pioneer species should be determined for rehabilitation process of quarries and be used in re-vegetation process by sawing the seeds.

The results show relationship of species composition in different successional stages with soil depth and structure. The pioneer species are able to grow on very open limestone ground material with low depth of clay soil and with reduced trophicity of the soil. Naturally restored grasslands remained oligotrophic, because the soil depth is low, but there is already litter and no complete open ground material areas. The restoration of pioneer succession to logistic succession stage will be connected to improvement of soil quality. The area of Kavtiskhevi is semi-arid zone and the vegetation is adapted to dry matter of clay soil. In spite of this fact, the oligotrophic grasslands with low level of dry matter have demonstrated high number of indicator species occurring in almost all plots. These species are characterized for natural habitats of semi-arid zone of this area; however, the species combination is different than in natural habitats of semi-deserts, steppes, xerophytic scrublands, etc.

The obtained data demonstrates the role of phytosociological investigation in determination of plant species used for re-vegetation process during post-closed rehabilitation of limestone quarry.

Introduction

This project might be considered as case study provided in this report to highlight responsible limestone quarry rehabilitation activities from a range of local habitats around the world. To restore vegetation during post-closed quarry rehabilitation process needs knowledge on species diversity in this area to conduct restoration of natural habitats. However, the problem is that the extraction of raw materials for cement production from the earth's crust causes strong impacts on the surrounding natural environment. The biodiversity on active quarries is restricted and even restoration events will not rich the recovery of natural habitats because of changing the environmental conditions including soil quality and landscape topography. Therefore, for contribution in the habitat restoration process, it is necessary, to conduct investigations and determine pioneer plant species starting restoration process and conduct observation on new habitats to be created in the area.

Environmental assessments for limestone landscapes have high value of unique biological, cultural, geological and scenic features. Therefore, this environmental area represents high interest for scientific investigations, environmental education and, as well, attracts large numbers of tourists.

Thus, to think about post-closed rehabilitation of the quarry area after finishing the cement production is extremely interesting to use this territory for scientific investigations and develop educational program for pupils and students to demonstrate effect of industrial impact on nature and the methods of habitat rehabilitation. The implementation of educational program will perform involvement of any relevant universities, research institutes and schools in monitoring process of nature conservation actions managed by the company. This process will be considered as involvement of stakeholders demonstrating a range of levels and activities, including information provision, consultation, participatory planning or decision-making and partnership. These activities will increase the popularity of rehabilitation process management and expand knowledge on nature conservation among young generation and local population.

Objectives

The educational program on biodiversity conservation will be prepared as an illustrated book on plant and animal species diversity in the limestone quarries of *HeidelbergCement AG* in Georgia and online virtual interactive platform. The demonstration of the program online as virtual interactive platform will be made on web-page of Georgian Society of Nature Explorers (GSNE) "Orchis" and it will have open access to the thematic for many pupils and students and will contribute in popularization of biodiversity conservation actions. The results of phytosociological investigations described natural re-vegetation process will provide important database for correct management and implementation of rehabilitation process. The information on species diversity changes during succession re-vegetation process will contribute in correct choice of plant species used in planting greenery process.

The aims of this project will be the following tasks: 1) to maintain and enhance landscape quality and character in the limestone quarries in Kavtiskhevi and Dedoplistsdkaro; 2) to protect the historic environment and natural resources of quarries; 3) to promote public access and understanding of the importance of habitat rehabilitation process; 4) to offer access of pupils and students to education program on habitat natural restoration; 5) to popularize nature conservation process and maintain of habitat quality.

Background information

Two limestone quarries - Kavtiskhevi and Dedoplistsdkaro, will be used for the education program (Map.1A). The habitat types in the quarries are different (Akhalkatsi, 2010). Kavtiskhevi Limestone Quarry is located in semi-arid zone of Kartli region in Georgia and natural habitats are xerophytic scrubland and secondary steppes (Kimeridze, 2009; Map1B). Dedoplistsdkaro area is covered by oak-hornbeam forest (Lachashvili et al., 2007) but the degraded habitats are replaced by shibliak and dry meadow-steppes (Map1C).



Map 1. A - Location of quarries of '*Heidelbergcement AG*' company in Georgia; B - Kavtiskhevi limestone quarry; C - Locations of study habitat types: oak-hornbeam-oriental hornbeam forest, shibliak and dry meadow-steppes in the surrounding of Dedoplistsdkaro limestone quarries.

Limestone mining in Kavtiskhevi quarry was started since 1936 and continues till today, represents one of the most interesting areas for development of educational program for both pupils and students demonstrating natural habitat restoration process, already representing by different succession stages of vegetation cover and containing restoration area of planted natural trees. Total area of the quarry is 182.98 hectares, 80% is opened. The climate is dry moderate continental; average annual temperature is +11.5°C, average annual precipitation is 500 mm (Maruashvili, 1964). This area was investigated during the Quarry Life Award program in 2012.

Dedoplistsdkaro Limestone Quarry operation was started in 1954 and is active till today. It is located in Kakheti region, historically Kiziki province, near Dedoplistsdkaro district center on lower montane belt of south-western extremities of Gombori range. Near quarry is the protected area "Artsvis Kheoba" representing climax succession stage of limestone landscape. This area will be interesting for comparison of natural and impacted habitats. Total area of the quarry is 26.7 hectares, 95% is opened. The climate is dry acutely continental; average annual temperature is 11.2°C, average annual precipitation is 400-600 mm. Soil type is the forest brown-calcareous soils with humus (Maruashvili, 1964). The investigation in Dedoplistsdkaro quarry was carried out in 2010-2011 in the framework of *HeidelbergCement AG* student educational program and bachelor thesis - "Geophytes dominated plant communities on calcareous soils around the quarry Dedoplistsdkaro/Orchids" was done by George Arabuli with supervisor, Maia Akhalkatsi.

During this bachelor thesis project we have studied plant diversity in Dedoplistsdkaro's quarry (N 41.48°, E 46.10°, 850-930 m a.s.l.). The total number of species in the area was 230 (Table 1; Annex 1). Three habitat types dominated by geophytes have been determined in the surrounding of limestone quarry: 1) Oak-Hornbeam-Oriental Hornbeam forest with *Quercus iberica* and *Carpinus orientalis* (total number of plant species=137; geophytes=18); 2) Shibliak (total number of plant species = 186, geophytes = 19); 3) Dry meadow-steppes (total number of plant species = 130, geophytes - 13). Number of species according to life forms in different habitats is presented in Fig. 1.1.

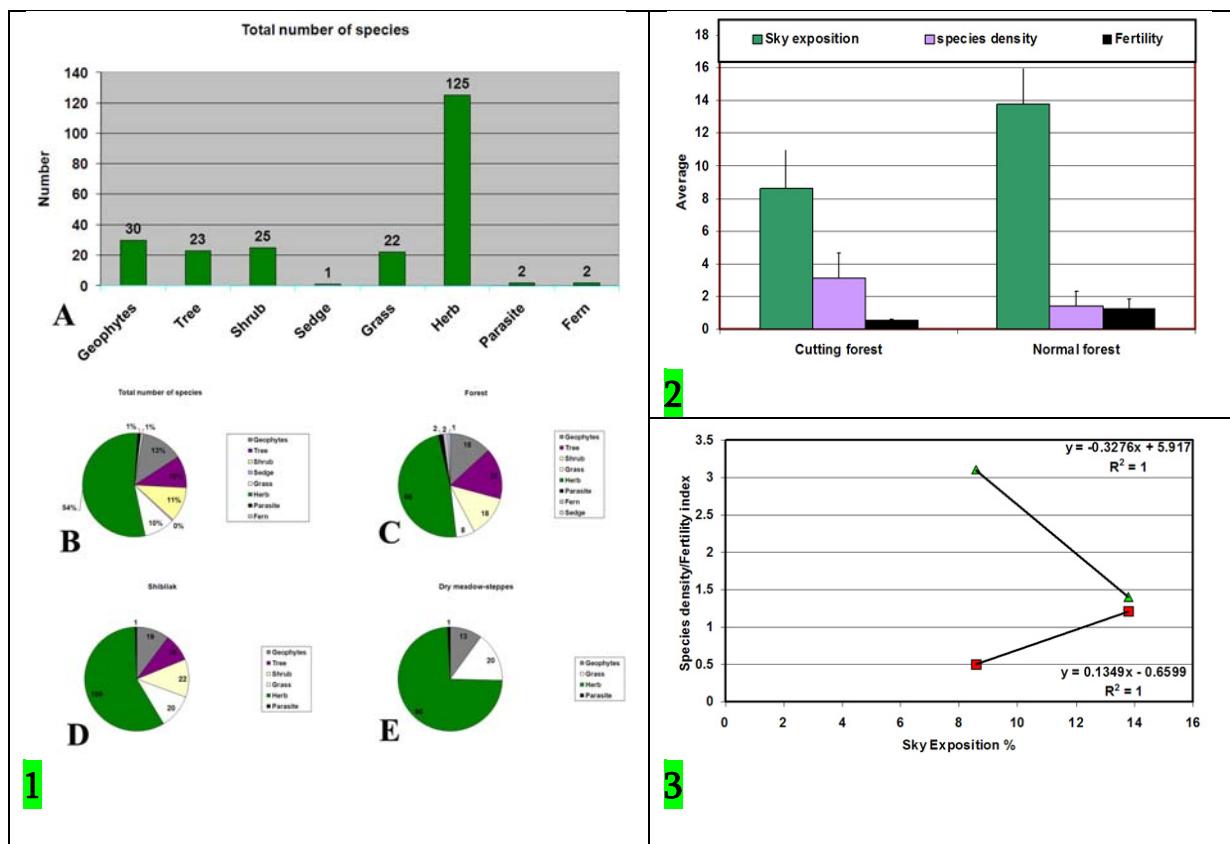


Figure 1. Plant diversity in Dedoplistsdkaro limestone quarry. **1A** - Number of species of different life forms in the three plant communities of the study area. (n=230); **1B** - Percentage of species composition according to life forms in the studied three habitats. (n=230); **1C** - Number of species of different life forms in oak-oriental hornbeam forest (n=137); **1D** - Number of species of different life forms in shibliak habitat (n=186); **1E** - Number of species of different life forms in dry meadow-steppe habitat (n=130). **2** - Mean and standard deviation of sky exposition, species density and fertility on 1 m² plots in cutting Dedoplistsdkaro and normal Nekresi oak-hornbeam-oriental hornbeam forests. (n=20). **3** - Correlation between species diversity and sky exposition (green triangles) and fertility and sky exposition (red quadrates) in cutting (with sky exposition 8.6±2.4%) and normal (sky exposition 13.8±2.14%) oak-hornbeam-oriental hornbeam forests. (n=20).

Habitat disturbances effect on species density and fertility of orchids as indicator species has shown that the decrease of sky exposition due to wood cutting in forest caused diminishing of species fertility index but increased of species density by vegetative propagation of non-flowering individuals (Fig.1.2). Negative linear correlation was determined between species density and sky exposition (Fig. 1.3). More orchid individuals occurred in cutting forest with lower sky exposition and lower number was found in normal forest. Positive linear correlation was found between fertility and sky exposition. As higher is sky exposition as many orchid individuals are in flowering stage. This fact will negatively affect population because of diminishing the gene recombination and increase of clones of the species. This will increase threat to species extinction due to restricted genetic diversity in the population. Thus, during the possible restoration of area of limestone quarry geophytes of open meadows and shibliak will be restored from the early stages. However, orchids of forest habitats will appear in the area only in case if their typical habitat of oak-hornbeam forest will be restored.

Protected area "Artsvis Kheoba" located near limestone quarry in Dedoplistsdkaro shows the influence of anthropogenic impact on species diversity, which is identified in this area as strong wood cutting.

Methods and Activity

To develop an educational program, this project needed collection of information about the limestone quarries from literature data and during field trips. The characterization of the quarries should include: the geomorphologic features found in limestone deposits; history of the origin of the limestone deposits and fossils; biodiversity descriptions of limestone habitats; anthropogenic impact assessment. To evaluate most effective thematic for the educational program one MS student and one PhD student were involved in the process of project development. The field work was carried out using methods of plot recording. For this purpose twelve 1 m² plots were chosen within each successional stages of re-vegetation process -pioneer and logistic successions (Map 2).



Map 2. A - Kavtiskhevi limestone quarry located in Shida Kartli region of Georgia; B - Limestone quarry with study sites (red and green spots); C - research plots of pioneer (red) and oligotrophic (green) successions.

During field trips the following data were collected: 1. Data for documentation of the record: plot No., figure(s), ref. map, and date of field data collection; 2. Environmental data: Species composition of successional stages; location, exact GPS coordinates, altitude and sloping characters (inclination, exposition); Vegetation cover (%) and canopy height (cm; m); Habitat type and description of existing disturbances; 3. Plant community characteristics (1 m² plots): Species richness and cover (%); The data were analyzed by statistical programs PCORD 5.32 and SPSS v. 16. Statistical analysis of these data gave a possibility to develop complete database information about species diversity changes among successional stages of vegetation recovery.

The process of project development will start in 5th March and continue to the end of September 2012. These activities were undertaken in the following schedule: 1. March-April, 2012: Collection of literature data and preparation of field plans and missions. 2. May-July 2012: Field trips in Kavtiskhevi and Dedoplistsdkaro regions to assess plant communities of different successional stages. 3. August-September 2012: data analyses and preparation of project for environmental educational program on biodiversity conservation.

The project participants are two organizations: Ilia State University and GSNE "Orchis"; We offered the possibility to MS and PhD students to participate in the field work in the Kavtiskhevi limestone quarry. The following students have expressed the wishes to be participants - Tamar Bragvadze, George Arabuli, Natia Chikheidze and Zezva Asanidze, from Ilia State University. Additionally, one PhD student from Ukraine, National University of Mohyla Academy, Olena Kozak, expressed the wishes to arrive in Tbilisi and get knowledge on this methodology. From scientists, there were involved Marine Mosulishvili, Nana Shakarishvili, Mirian Gvritishvili and Maia Akhalkatsi. As consultant for species identification was involved in the work GSNE "Orchis" chair, Mariam Kimeridze.

The field trips were funded by the program the Quarry Life Award. Itemized total budget was 856 GEL used for per diem (15 GEL x 10 x 5 day = 750) and petrol (106 GEL). The field trips were in Kavtiskhevi and Dedoplostskaro in May-July. During field trips were made phytosociological descriptions of vegetation in different successional stages of habitats.

Results

The degraded habitat of limestone quarry in the Kavtiskhevi is covered by few plant species of semi-arid vegetation. Total number of plant species described on the territory of the quarry (182.98 h) is 114 (Table 2, **Annex 2**). The natural habitat types in the quarry area are represented by xerophytes scrublands and secondary steppe grasslands. Xerophytes scrublands are almost completely degraded. However, the remnants of species are remained on small grounds, mainly in stony slopes. Secondary steppes are in the surrounding area. The degraded grassland area is presented by pioneer successions of plant pioneer species and logistic successions identified as oligotrophic meadows and mesotrophic meadows.

The scrublands and steppe vegetation contains some endemic and rare species which are under threat and only few locations of them are discovered in Georgia. The endemics are 3 shrubs: *Cotoneaster saxatilis* Pojark., *Daphne caucasica* Pall. and *D. axilliflora* (Keissl.) Pobed. Endemic herbs are 4 species: *Onobrychis iberica* Grossh., *O. radiata* (Desf.) M. Bieb., *Scorzonera biebersteinii* Lipsch. and *Thymus tiflensis* Klok. & Shost. The life forms are presented in Fig.2.1.

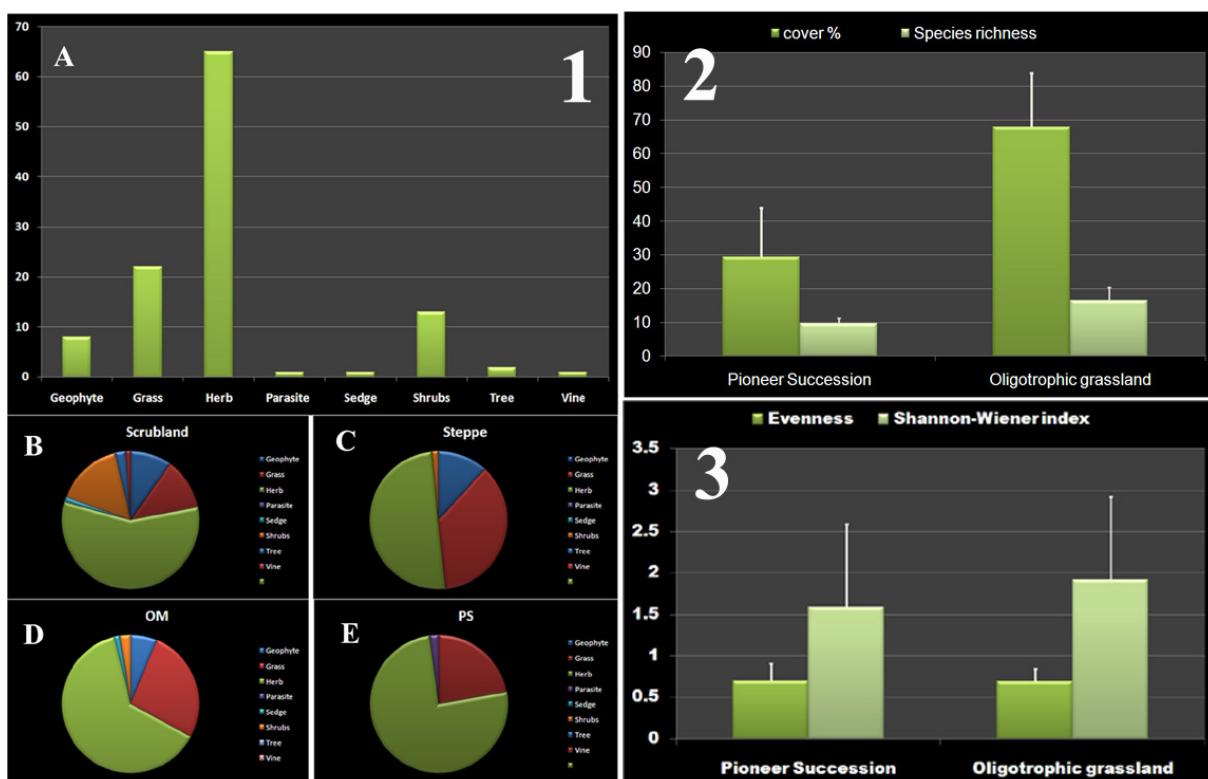


Figure 2. Plant diversity in Kavtiskhevi limestone quarry. **1A** - Number of species of different life forms in four habitats of the study area. (n=114); **1B** - Number of species of different life forms in xerophytes scrublands (n=83); **1C** - Number of species of different life forms in secondary steppes (n=61); **1D** - Number of species of different life forms in oligotrophic meadows of logistic successional plots (n=82); **1E** - Number of species of different life forms in pioneer successions of the study site (n=46). **2** - Species cover percentage and species richness at the pioneer successions and naturally restored oligotrophic grasslands (n=67); **3** - Evenness and Shannon-Wiener diversity index at pioneer successions and naturally restored oligotrophic grasslands (n=67).

Two successional stages: pioneer succession and typical oligotrophic meadows of Kavtiskhevi quarry have been described (Fig.2.2, Fig.2.3). The vegetation cover percentage is much lower in pioneer successions (29.4 ± 14.4) than in oligotrophic grasslands (67.8 ± 16.1). The

species richness shows similarly low level at pioneer succession (9.7 ± 1.6) and higher value at the restored oligotrophic grasslands (16.4 ± 3.9). However, evenness is not significantly different between pioneer successions (0.7 ± 0.2) and restored oligotrophic grasslands (0.69 ± 0.15). Shannon-Wiener index is higher in restored grasslands (1.9 ± 0.48) than in pioneer successions (1.6 ± 0.53).

Dominance-diversity curves (Fig. 3A) show the abundance distribution among species in plots of the pioneer successions and oligotrophic grasslands. The scatterplot (Fig. 3B) of the relationships between frequency and abundance of the plant species (log base 10 of the sum of the species cover) in the succession plots at the Kavtiskhevi quarry demonstrates the species which are very frequent in the area regardless of the fact that they have lower abundance and are distinguished from the dominant species presented in only a few instances but with high cover.

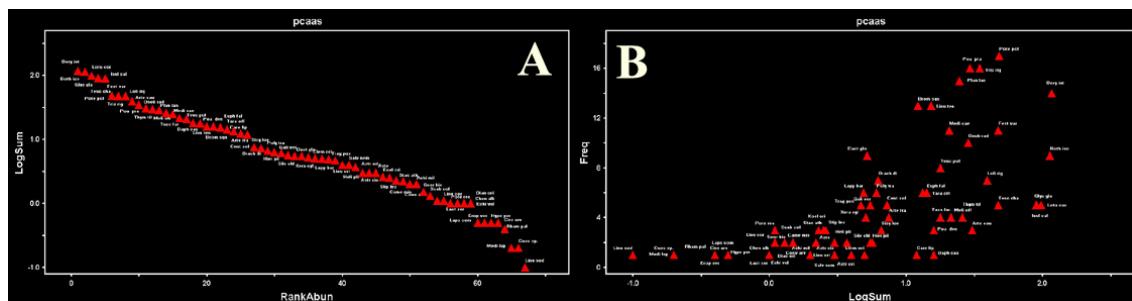


Figure 3. A - Dominant species in Kavtiskhevi quarry plant communities. (n=67); B - Frequency of plant species (n=67).

Detrended correspondence analyses (DCA) show (Fig. 4A) that the pioneer succession are mainly clustered in right segment of first axis area with environmental indicator of low soil depth and the oligotrophic grassland plots are concentrated in the area with more higher soil depth and litter occurrence. There are only four plots of pioneer succession with higher soil depth and they are clustered in left segment of the first axis. One oligotrophic plot (OM6) is associated with lower soil depth. The mean soil depth (Fig.4B) in pioneer succession plots is lower (1.7 ± 1.76 cm) than in oligotrophic grasslands (2.75 ± 1.13 cm).

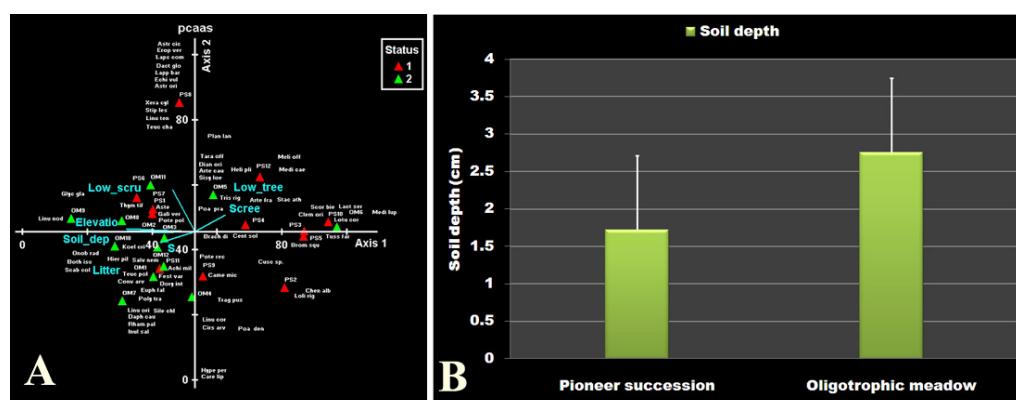


Figure 4. A - DCA analyses of pioneer succession plots (red triangular) and oligotrophic grasslands (green triangular; n=24/67);

The 8 species have revealed higher observed indicator value (IV) in pioneer successions (Fig.5). These species mainly cover the mining sites where limestone material was extracted ca 2-3 years ago. Most of these species are not present in other habitats of quarry covered by restored vegetation types and have to be determined as a pioneer species.

Species	Family	Life Form	Observed indicator value (IV)	IV from randomized groups		P*
				Mean	Standard deviation	
Pioneer successions						
<i>Lotus corniculatus</i> L.	Fabaceae	herb	41.7	20.5	7.94	0.0372
<i>Taraxacum officinale</i> F. H. Wigg.	Asteraceae	herb	40.1	23.6	8.78	0.0876
<i>Lolium rigidum</i> Gaudin	Poaceae	grass	37.3	24.3	8.23	0.0698
<i>Tussilago farfara</i> L.	Asteraceae	herb	33.3	17.3	7.00	0.0938
<i>Medicago caerulea</i> Less. ex Ledeb.	Fabaceae	herb	30.1	33.6	8.92	0.5667
<i>Melilotus officinalis</i> (L.) Lam.	Fabaceae	herb	24.4	17.9	7.53	0.2245
<i>Scorzonera biebersteinii</i> Lipsch.	Asteraceae	herb	16.7	10.8	5.55	0.473
<i>Sisymbrium loeselii</i> L.	Brassicaceae	herb	16.4	15.6	5.98	0.4713
Oligotrophic grasslands						
<i>Onobrychis radiata</i> (Desf.) M. Bieb.	Fabaceae	herb	83.3	31.7	9.09	0.0001
<i>Dorycnium intermedium</i> Ledeb.	Fabaceae	herb	80.7	39.8	8.75	0.0005
<i>Linum tenuifolium</i> L.	Linaceae	herb	69.7	39	9.53	0.0062
<i>Festuca varia</i> Haenke	Poaceae	grass	67.1	34	8.98	0.0044
<i>Teucrium polium</i> L.	Lamiaceae	herb	66.7	28.8	9.36	0.0014
<i>Bothriochloa ischaemum</i> (L.) Keng	Poaceae	grass	64.3	29.3	8.77	0.0026
<i>Poa pratensis</i> L.	Poaceae	grass	60.1	45	9.31	0.0792
<i>Poterium polygamum</i> Waldst. & Kit.	Rosaceae	herb	53.1	46.5	8.69	0.2116
<i>Euphorbia falcata</i> L.	Euphorbiaceae	herb	50.0	24.7	8.83	0.0127
<i>Plantago lanceolata</i> L.	Plantaginaceae	herb	46.2	41.7	8.56	0.2582
<i>Inula salicina</i> DC. subsp. <i>aspera</i> (Poir.) Hayek	Asteraceae	herb	41.7	19.7	7.76	0.0350
<i>Teucrium chamaedrys</i> L.	Lamiaceae	herb	41.7	22.5	8.02	0.0357
<i>Trisetum rigidum</i> (M. Bieb.) Roem.	Poaceae	grass	39.8	44.5	9.17	0.6249
<i>Thymus tiflensis</i> Klok. & Shost.	Lamiaceae	herb	33.3	16.7	7.03	0.0977
<i>Tragopogon pusillus</i> M. Bieb.	Asteraceae	herb	29.8	19.4	7.57	0.1467
<i>Dactylis glomerata</i> L.	Poaceae	grass	28.2	32.2	9.83	0.6041
<i>Brachypodium distachyon</i> (L.) P. Beauv.	Poaceae	grass	27.5	25.5	9.39	0.4238

Figure 5. Differences of Indicator Values (IV) of the indicator species between pioneer successions and oligotrophic naturally restored grasslands at the Kavtiskhevi limestone quarry. The table shows the indicator values, mean and standard deviation of species cover on plots and results of the Monte Carlo test of significance - P. (n=24).

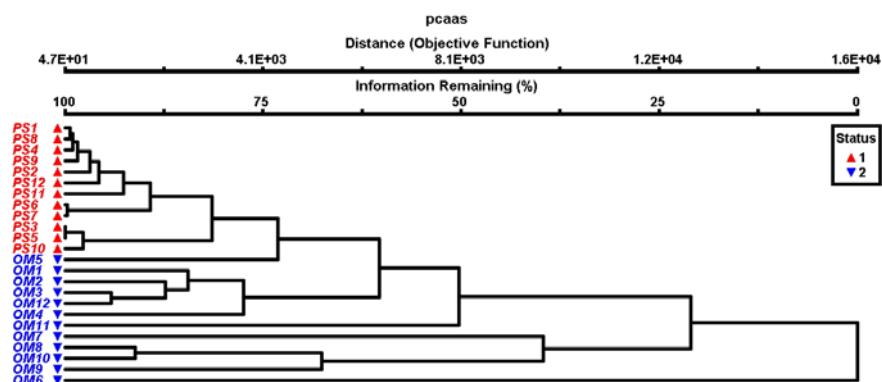


Fig.6. Cluster analyses of pioneer successions (PS) and oligotrophic grasslands (OM). (n=24).

The dendrogram (Fig. 6) shows the resulting hierarchy of clusters composed by two successional stages of naturally restoring vegetation at the limestone quarry. The first cluster group contains all plots of pioneer succession to show high similarity and only one logistic successional plot of oligotrophic grassland - OM5 shows lower similarity to the pioneer successions. This is the only one logistical plot containing pioneer species - *Taraxacum officinale*, which occurs in almost all pioneer successional plots but not in any other logistical plots. One oligotrophic grassland plot (OM6) is completely separated to other logistical plots. This plot contains as well the pioneer species - *Lotus corniculatus*, occurring only in plots of pioneer succession. The plot OM11 contains pioneer species - *Melilotus officinalis* and is separated by low level of similarity to cluster of oligotrophic grasslands.

Discussion

The cluster results demonstrate importance of species composition for determining of successional stages. The following species are present only in pioneer successional plots - *Sisymbrium loeselii*, *Medicago lupulina*, *Lactuca seriola*, *Tussilago farfara*, *Scorzonera biebersteinii*, *Chenopodium album*, *Poa densa*. The three dominant species of pioneer successions- *Lotus corniculatus*, *Melilotus officinalis* and *Taraxacum officinale* showing high cover percentage in plots of pioneer successions are still remained in a logistical successional stage on plots. The pioneer species should be determined for rehabilitation process of quarries and be used in re-vegetation process by sawing the seeds.

The results show relationship of species composition in different successional stages with soil depth and structure. The pioneer species are able to grow on very open limestone ground material with low depth of clay soil and with reduced trophicity of the soil. Naturally restored grasslands remained oligotrophic, because the soil depth is low, but there is already litter and no complete open ground material areas. The restoration of pioneer succession to logistic succession stage will be connected to improvement of soil quality. The area of Kavtiskhevi is semi-arid zone and the vegetation is adapted to dry matter of clay soil. In spite of this fact, the oligotrophic grasslands with low level of dry matter have demonstrated high number of indicator species occurring in almost all plots. These species are characterized for natural habitats of semi-arid zone of this area, however, the species combination is different than in natural habitats of semi-deserts, steppes, xerophytic scrublands etc.

We have compared vegetation cover, species richness and biodiversity indexes between pioneer successions located at the mineral extraction sites before 2-3 years and restored oligotrophic grasslands covering areas of the mineral extraction sites after 5 years of naturally restoration process of the vegetation in the Kavtiskhevi limestone quarry of *HeidelbergCement AG*. Both pioneer successions and oligotrophic grasslands are characterized by low dry matter yields which can be explained through the reduced quantities of rainfall from spring and, of course, through the reduced trophicity of the soil.

Species abundance patterns in different trophical successional stages provide the niche in groups of species that are closely associated ecologically in the same microhabitats. The first group of dominant species is - *Dorycnium intermedium*, *Bothriochloa ischaemum*, *Lotus corniculatus*, *Glycyrrhiza glabra*, *Inula salicina* subsp. *aspera*. The second group contains species - *Festuca varia*, *Teucrium chamaedrys*, *Poterium polygamum*, *Lolium rigidum*, *Trisetum rigidum*, *Poa pratensis*, *Artemisia caucasica*, *Onobrychis radiata*, *Plantago lanceolata* etc.

These data indicate that the pioneer species and dominants of logistic successional plots should be used for re-vegetation process. A very common goal in plant community analysis is to detect and describe the value of different species for indicating the environmental conditions. This type of investigations will contribute in rehabilitation process of the limestone quarry.

The vegetation of calcareous soil and limestone ground material habitats are characterized by high diversity and highest level of endemism. The study area is based on limestone ground material and plants are adapted to these concrete conditions. Therefore, there are many species typical for calcareous soils and limestone areas. After mining process of the quarry structure and conditions is changed and the restoration process should be determined depending on current structure and quality of environmental conditions of the quarry.

Thus, the educational program that contains study of species diversity and natural successional re-vegetation process will contribute to rehabilitation process. The monitoring of the rehabilitation process will be used for educational program to provide knowledge of young generation on effective protection of nature.

Conclusions

To develop educational program on biodiversity conservation during the rehabilitation process of limestone quarry contains action of environmental assessments for limestone landscapes having high value of unique biological, cultural, geological and scenic features. It is characterized by high biodiversity involving many endemic and rare plant and animal species. Paleontological remains in limestone deposits have provided great insights into prehistoric flora and fauna. Geological remains demonstrate invaluable information about past environmental conditions, including climate.

The main goal of creation of the education program is development of online virtual interactive platform in internet with free access of students and pupils on the web site of GSNE "Orchis". The process of construction of this program needs project activity demonstrated in the schedules. Timetable for the proposed activities needs 24 months in total. A detailed list of the planned activities is outlined in the timetable below (Fig.7).

N	Action	1st year				2nd year			
		Quarter	I	II	III	IV	I	II	III
1	Preparation of working plans								
2	Field trips and collection of field data								
3	Photos data base								
4	Statistical analyses of field data								
5	Preparation of publications								
6	Development of electronic educational program								
7	Presentations of the investigation results								
8	Preparation of final project report								

Figure 7. Duration and indicative action plan for the implementing the action (duration of the project is 24 months)

The budget of the proposed project is presented in **Annex 3**.

This project will be coordinated by researcher of this proposal - Maia Akhalkatsi (see CV, **Annex 4**).

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Annex 1

Table 1. List of plant species in geophytes dominated habitats near '*Heidelbergcement AG*' limestone quarry in Dedoplistsdkaro. Occurrence of species are indicated for three habitat types: oak-hornbeam-oriental hornbeam forest (F) and forest edges (FE); dry scrubland - shibliak (SH) and dry meadow-steppe (DM). Rare and endemic species: ● - local endemic; ○- Caucasian endemic, □- Georgian Red List (2006) species; Nomenclature by Lachashvili et al., 2007; Orchid nomenclature according to Akhalkatsi et al., 2007).

N	Species	Family	Life form	F+FE	SH	DM
1.	<i>Acer campestre</i> L.	Aceraceae	Tree	+	-	-
2.	<i>Acer laetum</i> C. A. Mey.	Aceraceae	Tree	+	-	-
3.	<i>Achillea millefolium</i> L.	Asteraceae	Herb	-	+	+
4.	<i>Acinos arvensis</i> (Lam.) Dandy	Lamiaceae	Herb	+	+	+
5.	<i>Aegilops cylindrica</i> Host.	Poaceae	Grass	-	+	+
6.	<i>Aegilops tauschii</i> Coss.	Poaceae	Grass	-	+	+
7.	<i>Aegilops triuncialis</i> L.	Poaceae	Grass	-	+	+
8.	<i>Aegonychon purpureocaeruleum</i> (L.) Holub.	Boraginaceae	Herb	-	+	+
9.	<i>Ailanthus altissima</i> (Mill.) Swingle	Simaroubaceae	Tree	+	+	-
10.	<i>Ajuga genevensis</i> L.	Lamiaceae	Herb	+	-	-
11.	<i>Ajuga orientalis</i> L.	Lamiaceae	Herb	+	+	+
12.	<i>Alcea rugosa</i> Alef.	Malvaceae	Herb	-	+	+
13.	<i>Alliaria petiolata</i> (M. Bieb.) Cavara & Grande	Brassicaceae	Herb	+	+	+
14.	<i>Allium atroviolaceum</i> Boiss.	Alliaceae	Geophytes	-	+	+
15.	<i>Allium pseudoflavum</i> Vved.	Alliaceae	Geophytes	-	+	+
16.	<i>Allium rotundum</i> L.	Alliaceae	Geophytes	-	+	+
17.	<i>Allysum alyssoides</i> (L.) L.	Brassicaceae	Herb	-	+	+
18.	<i>Allysum tortuosum</i> Waldst. & Kit. ex Willd.	Brassicaceae	Herb	-	-	+
19.	<i>Amygdalus incana</i> Pall.	Rosaceae	Tree	+	+	-
20.	<i>Anacamptis pyramidalis</i> (L.) Rich.	Orchidaceae	Geophytes	+	+	+
21.	<i>Anagallis arvensis</i> L.	Primulaceae	Herb	-	+	+
22.	<i>Anchusa leptophylla</i> Roem. & Schult.	Boraginaceae	Herb	-	+	+
23.	<i>Anthriscus longirostris</i> Bertol.	Apiaceae	Herb	+	-	-
24.	<i>Anthyllis lachnophora</i> Juz. ○	Fabaceae	Herb	-	+	+
25.	<i>Asparagus verticillatus</i> L.	Asparagaceae	Herb	+	+	-
26.	<i>Asplenium trichomanes</i> L.	Aspleniaceae	Fern	+	-	-
27.	<i>Astragalus brachycarpus</i> M. Bieb.	Fabaceae	Herb	-	+	+
28.	<i>Avena fatua</i> L.	Poaceae	Grass	-	+	+
29.	<i>Berberis vulgaris</i> L.	Berberidaceae	Shrub	+	+	-
30.	<i>Brachypodium pinnatum</i> (L.) P. Beauv.	Poaceae	Grass	+	+	-
31.	<i>Brachypodium sylvaticum</i> (Huds.) P. Beauv.	Poaceae	Grass	+	-	-
32.	<i>Briza elatior</i> Sibth. & Smith	Poaceae	Grass	-	+	+
33.	<i>Bromopsis japonicus</i> Thunb.	Poaceae	Grass	-	+	+
34.	<i>Bromopsis riparia</i> (Rehm.) Holub	Poaceae	Grass	-	+	+
35.	<i>Bryonia dioica</i> Jacq.	Brassicaceae	Herb	-	+	-
36.	<i>Buglossoides arvensis</i> (L.) Johnst.	Boraginaceae	Herb	-	+	+
37.	<i>Calystegia silvatica</i> (Kit.) Griseb.	Convolvulaceae	Herb	+	+	-
38.	<i>Campanula kachetica</i> Kantsch. ●	Campanulaceae	Herb	-	-	+
39.	<i>Campanula oblongifolia</i> (K. Koch) Charadze	Campanulaceae	Herb	+	+	-
40.	<i>Campanula rapunculoides</i> L.	Campanulaceae	Herb	+	+	-
41.	<i>Carex sylvatica</i> Huds.	Cyperaceae	Sedge	+	-	-

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42.	<i>Carpinus caucasica</i> Grossh.	Corylaceae	Tree	+	-	-
43.	<i>Carpinus orientalis</i> Mill.	Corylaceae	Tree	+	+	-
44.	<i>Celtis caucasica</i> Willd. □	Celtidaceae	Tree	+	+	-
45.	<i>Cephalanthera damasonium</i> (Mill.) Druce	Orchidaceae	Geophytes	+	-	-
46.	<i>Cephalanthera longifolia</i> (L.) Fritsch	Orchidaceae	Geophytes	+	-	-
47.	<i>Cephalanthera rubra</i> (L.) Rich.	Orchidaceae	Geophytes	+	-	-
48.	<i>Cephalaria media</i> Litv.	Dipsacaceae	Herb	+	+	+
49.	<i>Ceterach officinarum</i> Willd.	Aspleniaceae	Fern	+	+	-
50.	<i>Chaerophyllum bulbosum</i> L.	Apiaceae	Herb	+	+	+
51.	<i>Cichorium intybus</i> L.	Asteraceae	Herb	+	+	+
52.	<i>Colchicum szovitzii</i> Fritsch. ex Mey.	Colchicaceae	Geophytes	-	+	+
53.	<i>Convallaria transcaucasica</i> Utkin ex Grossh.	Convallariaceae	Geophytes	+	-	-
54.	<i>Convolvulus arvensis</i> L.	Convolvulaceae	Herb	+	+	+
55.	<i>Cornus mas</i> L.	Cornaceae	Shrub	+	-	-
56.	<i>Corydalis marschalliana</i> (Pall. ex Willd.) Pers.	Fumaraceae	Herb	+	+	-
57.	<i>Corylus avellana</i> L.	Corylaceae	Shrub	+	+	-
58.	<i>Cotinus coggygria</i> Scop.	Aquifoliaceae	Shrub	-	+	-
59.	<i>Cotoneaster integerrimus</i> Medik.	Rosaceae	Shrub	+	+	-
60.	<i>Cotoneaster morulus</i> Pojark.	Rosaceae	Shrub	+	+	-
61.	<i>Crataegus pentagyna</i> Waldst. & Kit.	Rosaceae	Shrub	+	+	-
62.	<i>Crepis marschallii</i> (C. A. Mey.) F. Schultz	Asteraceae	Herb	+	-	-
63.	<i>Crocus adamii</i> J. Gay	Iridaceae	Geophytes	-	+	+
64.	<i>Cruciata laevipes</i> Opiz	Rosaceae	Herb	+	+	+
65.	<i>Cyclamen coum</i> subsp. <i>caucasicum</i> (K. Koch) O. Schwarz p. p.	Primulaceae	Geophytes	+	+	-
66.	<i>Cydonia oblonga</i> Mill.	Rosaceae	Tree	+	+	-
67.	<i>Cynosurus echinatus</i> L.	Poaceae	Grass	-	+	+
68.	<i>Dactylis glomerata</i> L.	Poaceae	Grass	+	+	+
69.	<i>Dianthus orientalis</i> Adams	Caryophyllaceae	Herb	-	+	+
70.	<i>Dipsacus laciniatus</i> L.	Dipsacaceae	Herb	+	+	+
71.	<i>Echium rubrum</i> Jacq.	Boraginaceae	Herb	-	+	+
72.	<i>Echium vulgare</i> L.	Boraginaceae	Herb	-	+	+
73.	<i>Epipactis helleborine</i> subsp. <i>bithynica</i> (Robatsch) Kreutz	Orchidaceae	Geophytes	+	-	-
74.	<i>Epipactis persica</i> (Soó) Nannfeldt subsp. <i>persica</i>	Orchidaceae	Geophytes	+	-	-
75.	<i>Eryngium campestre</i> L.	Apiaceae	Herb	-	+	+
76.	<i>Erodium cicutarium</i> (L.) L'Her.	Geraniaceae	Herb	+	+	+
77.	<i>Erysimum aureum</i> M. Bieb. ©	Brassicaceae	Herb	+	+	+
78.	<i>Euonymus europaea</i> L.	Celastraceae	Shrub	+	-	-
79.	<i>Euphorbia helioscopia</i> L.	Euphorbiaceae	Herb	+	+	+
80.	<i>Euphorbia squamosa</i> Willd.	Euphorbiaceae	Herb	-	+	+
81.	<i>Euphorbia stricta</i> L.	Euphorbiaceae	Herb	+	+	-
82.	<i>Ficus carica</i> L.	Moraceae	Tree	-	+	-
83.	<i>Filipendula vulgaris</i> Moench	Rosaceae	Herb	-	+	+
84.	<i>Fragaria vesca</i> L.	Rosaceae	Herb	+	+	+
85.	<i>Fraxinus excelsior</i> L.	Oleaceae	Tree	+	-	-
86.	<i>Gagea chanae</i> Grossh.	Liliaceae	Geophytes	-	+	+
87.	<i>Galanthus lagodechianus</i> Kem.-Nath. ©	Amaryllidaceae	Geophytes	+	-	-
88.	<i>Galium coronatum</i> Sibth. & Smith	Rosaceae	Herb	-	-	+
89.	<i>Galium praemontanum</i> T. Mardalejshvili ●	Rosaceae	Herb	-	-	+
90.	<i>Galium vaillantii</i> DC.	Rosaceae	Herb	+	+	+
91.	<i>Galium verticillatum</i> Danth.	Rosaceae	Herb	-	-	+
92.	<i>Galium verum</i> L.	Rosaceae	Herb	-	+	+

93.	<i>Geranium columbinum</i> L.	Geraniaceae	Herb	+	+	-
94.	<i>Geranium lucidum</i> L.	Geraniaceae	Herb	+	+	+
95.	<i>Geranium molle</i> L.	Geraniaceae	Herb	+	+	+
96.	<i>Geranium robertianum</i> L.	Geraniaceae	Herb	+	-	-
97.	<i>Geum urbanum</i> L.	Rosaceae	Herb	+	+	-
98.	<i>Gypsophila elegans</i> M. Bieb.	Caryophylaceae	Herb	-	+	+
99.	<i>Helianthemum nummularium</i> (L.) Mill.	Cistaceae	Herb	-	+	+
100.	<i>Helianthemum salicifolium</i> (L.) Mill.	Cistaceae	Herb	-	+	+
101.	<i>Hesperis matronalis</i> L.	Brassicaceae	Herb	+	+	-
102.	<i>Hieracium pilosella</i> L.	Asteraceae	Herb	-	+	+
103.	<i>Hieracium vulgatum</i> Fries	Asteraceae	Herb	-	+	+
104.	<i>Hordeum bulbosum</i> L.	Poaceae	Geophytes	-	+	+
105.	<i>Hordeum gussoneanum</i> Parl.	Poaceae	Grass	-	+	+
106.	<i>Hordeum leporinum</i> Link	Poaceae	Grass	-	+	+
107.	<i>Hypericum perforatum</i> L.	Hypericaceae	Herb	+	+	+
108.	<i>Isatis iberica</i> Steven ©	Brassicaceae	Herb	-	+	+
109.	<i>Jasminum fruticans</i> L.	Oleaceae	Shrub	+	+	-
110.	<i>Juniperus oblonga</i> M. Bieb.	Cupressaceae	Shrub	+	+	-
111.	<i>Lamium album</i> L.	Lamiaceae	Herb	+	+	+
112.	<i>Lappula barbata</i> (M. Bieb.) Guerke	Boraginaceae	Herb	+	+	+
113.	<i>Laser trilobum</i> (L.) Borkh.	Apiaceae	Herb	+	-	-
114.	<i>Lathyrus nissolia</i> L.	Fabaceae	Herb	-	+	+
115.	<i>Lens ervoides</i> (Brign.) Grande	Fabaceae	Herb	-	-	+
116.	<i>Ligustrum vulgare</i> L.	Oleaceae	Herb	+	+	-
117.	<i>Linaria genistifolia</i> (L.) Mill.	Scrophulariaceae	Herb	-	+	+
118.	<i>Linum austriacum</i> L.	Linaceae	Herb	-	+	+
119.	<i>Lolium rigidum</i> Gaudin	Poaceae	Grass	+	+	+
120.	<i>Lonicera caprifolium</i> L.	Caprifoliaceae	Shrub	+	+	-
121.	<i>Lonicera caucasica</i> Pall.	Caprifoliaceae	Shrub	+	+	-
122.	<i>Lonicera iberica</i> M. Bieb.	Caprifoliaceae	Shrub	+	+	-
123.	<i>Lotus caucasicus</i> Kuprian. ex Juz. ©	Fabaceae	Herb	-	+	+
124.	<i>Malus orientalis</i> Uglitzk.	Rosaceae	Tree	+	+	-
125.	<i>Medicago coerulea</i> Less. ex Lebed.	Fabaceae	Herb	-	+	+
126.	<i>Melandrium latifolium</i> (Poir.) Maire	Caryophylaceae	Herb	-	+	+
127.	<i>Melica taurica</i> K. Koch	Poaceae	Grass	-	-	+
128.	<i>Melica transsilvanica</i> Schur	Poaceae	Grass	-	-	+
129.	<i>Melilotus officinalis</i> (L.) Pall.	Fabaceae	Herb	+	+	+
130.	<i>Merendera trigina</i> (Steven ex Adams) Stapf	Colchicaceae	Geophytes	-	+	+
131.	<i>Mespilus germanica</i> L.	Rosaceae	Tree	+	+	-
132.	<i>Milium vernale</i> M. Bieb.	Poaceae	Grass	+	+	-
133.	<i>Minuartia micrantha</i> Schischk.	Caryophylaceae	Herb	-	+	+
134.	<i>Morus alba</i> L.	Moraceae	Tree	+	+	-
135.	<i>Muscari szovitsianum</i> Baker	Hyacinthaceae	Geophytes	-	+	+
136.	<i>Muscari tenuiflorum</i> Tausch	Hyacinthaceae	Geophytes	-	+	+
137.	<i>Myosotis arvensis</i> (L.) Hill	Boraginaceae	Herb	+	+	+
138.	<i>Myosotis sparsiflora</i> Pohl	Boraginaceae	Herb	+	+	+
139.	<i>Neottia nidus-avis</i> (L.) Rich.	Orchidaceae	Geophytes	+	-	-
140.	<i>Nepeta mussinii</i> Spreng.	Lamiaceae	Herb	+	+	-
141.	<i>Nigella arvensis</i> L.	Helleboraceae	Herb	-	+	+
142.	<i>Onobrychis cyri</i> Grossh. ©	Fabaceae	Herb	-	+	+
143.	<i>Onosma tenuiflora</i> Willd.	Boraginaceae	Herb	-	+	+
144.	<i>Ophrys oestrifera</i> M. Bieb. subsp. <i>oestrifera</i>	Orchidaceae	Geophytes	+	+	-
145.	<i>Ophrys spegodes</i> Mill. subsp. <i>caucasica</i> (Woronow ex)	Orchidaceae	Geophytes	+	+	-

	Grossh.) Soó					
146.	<i>Orchis morio</i> subsp. <i>caucasica</i> (K.Koch) E.G.Camus, Bergon & A. Camus	Orchidaceae	Geophytes	-	+	-
147.	<i>Orchis purpurea</i> subsp. <i>caucasica</i> (Regel) B. Baumann, H. Baumann, R. Lorenz & R. Peter	Orchidaceae	Geophytes	+	+	-
148.	<i>Orchis simia</i> Lam.	Orchidaceae	Geophytes	+	+	-
149.	<i>Origanum vulgare</i> L.	Lamiaceae	Herb	-	+	+
150.	<i>Orobanche ramosa</i> L.	Orobanchaceae	Parasite	+	+	+
151.	<i>Oxalis acetosella</i> L.	Oxalidaceae	Herb	+	+	+
152.	<i>Paliurus spina-christi</i> Mill.	Rhamnaceae	Shrub	-	+	-
153.	<i>Papaver macrostomum</i> Boiss. & Huet	Papaveraceae	Herb	-	+	+
154.	<i>Parietaria judaica</i> L.	Urticaceae	Herb	-	-	+
155.	<i>Parietaria officinalis</i> L.	Urticaceae	Herb	-	-	+
156.	<i>Peucedanum ruthenicum</i> M. Bieb.	Apiaceae	Herb	+	-	-
157.	<i>Phleum phleoides</i> (L.) Karst.	Poaceae	Grass	+	+	+
158.	<i>Phleum pratense</i> L.	Poaceae	Grass	-	+	+
159.	<i>Plantago lanceolata</i> L.	Plantaginaceae	Herb	+	+	+
160.	<i>Platanthera montana</i> (F. W. Schmidt) Rchb. fil.	Orchidaceae	Geophytes	+	-	-
161.	<i>Platycladus orientalis</i> (L.) Franko	Cupressaceae	Shrub	-	+	-
162.	<i>Poa bulbosa</i> L.	Poaceae	Grass	-	+	+
163.	<i>Poa bulbosa</i> L. var. <i>vivipara</i> Koel.	Poaceae	Grass	+	+	+
164.	<i>Poa nemoralis</i> L.	Poaceae	Grass	+	+	+
165.	<i>Polygala transcaucasica</i> Tamamsch.	Polygalaceae	Herb	+	+	+
166.	<i>Polygonatum glaberrimum</i> K. Koch	Convallariaceae	Geophytes	+	-	-
167.	<i>Populus tremula</i> L.	Salicaceae	Tree	+	-	-
168.	<i>Potentilla erecta</i> (L.) Raeusch.	Rosaceae	Herb	-	+	+
169.	<i>Potentilla recta</i> L.	Rosaceae	Herb	-	+	+
170.	<i>Primula macrocalyx</i> Bunge	Primulaceae	Herb	+	+	-
171.	<i>Primula woronowii</i> Losinsk. ©	Primulaceae	Herb	+	+	-
172.	<i>Prunus avium</i> L.	Rosaceae	Tree	+	+	-
173.	<i>Prunus divaricata</i> Ledeb.	Rosaceae	Tree	+	+	-
174.	<i>Prunus mahaleb</i> L.	Rosaceae	Tree	+	+	-
175.	<i>Prunus microcarpa</i> C. A. Mey. □	Rosaceae	Tree	+	+	-
176.	<i>Prunus spinosa</i> L.	Rosaceae	Shrub	-	+	-
177.	<i>Punica granatum</i> L.	Punicaceae	Shrub	+	+	-
178.	<i>Pyracantha coccinea</i> M. Roen.	Rosaceae	Shrub	+	+	-
179.	<i>Pyrethrum corymbosum</i> (L.) Willd.	Asteraceae	Herb	-	+	+
180.	<i>Pyrus caucasica</i> Fed. ©	Rosaceae	Tree	+	+	-
181.	<i>Quercus iberica</i> Steven	Fagaceae	Tree	+	-	-
182.	<i>Ranunculus bulbosus</i> L.	Ranunculaceae	Herb	+	+	-
183.	<i>Ranunculus grandiflorus</i> L.	Ranunculaceae	Herb	+	+	-
184.	<i>Rhamnus cathartica</i> L.	Rhamnaceae	Shrub	-	+	-
185.	<i>Rhamnus palasii</i> Fisch. & C.A. Mey.	Rhamnaceae	Shrub	-	+	-
186.	<i>Robinia pseudoacacia</i> L.	Fabaceae	Tree	+	+	-
187.	<i>Rosa canina</i> L.	Rosaceae	Shrub	+	+	-
188.	<i>Rubus anatolicus</i> (Focke) Focke ex Hausskn.	Rosaceae	Shrub	+	+	-
189.	<i>Rumex crispus</i> L.	Polygonaceae	Herb	+	+	-
190.	<i>Sambucus ebulus</i> L.	Sambucaceae	Herb	+	+	-
191.	<i>Satureja spicigera</i> (K. Koch) Boiss.	Lamiaceae	Herb	-	-	+
192.	<i>Scabiosa columbaria</i> L.	Dipsacaceae	Herb	+	+	+
193.	<i>Scilla sibirica</i> Huw.	Hyacinthaceae	Geophytes	+	-	-
194.	<i>Scrophularia grossheimii</i> Schischk.	Scrophulariaceae	Herb	+	+	+
195.	<i>Sedum caucasicum</i> (Grossh.) Boriss.	Crassulaceae	Herb	-	+	+

196.	<i>Senecio vernalis</i> Waldst. & Kit.	Asteraceae	Herb	-	+	+
197.	<i>Silene spergulifolia</i> (Willd.) M. Bieb.	Caryophylaceae	Herb	+	+	+
198.	<i>Solidago virgaurea</i> L.	Asteraceae	Herb	+	+	-
199.	<i>Spiraea hypericifolia</i> L.	Rosaceae	Shrub	+	+	-
200.	<i>Stachys atherocalyx</i> K. Koch	Lamiaceae	Herb	+	+	+
201.	<i>Stachys sylvatica</i> L.	Lamiaceae	Herb	+	+	-
202.	<i>Stellaria holostea</i> L.	Caryophylaceae	Herb	+	+	+
203.	<i>Stipa pulcherrima</i> K. Koch	Poaceae	Grass	-	+	+
204.	<i>Stipa tirsa</i> Steven	Poaceae	Grass	-	+	+
205.	<i>Swida australis</i> (C.A. Mey.) Pojark.	Cornaceae	Shrub	+	+	-
206.	<i>Taraxacum officinale</i> Wigg.	Asteraceae	Herb	+	+	+
207.	<i>Thymus karjaginii</i> Grossh. ©	Lamiaceae	Herb	-	+	+
208.	<i>Tilia begoniifolia</i> Steven	Tiliaceae	Tree	+	-	-
209.	<i>Trifolium arvense</i> L.	Fabaceae	Herb	-	+	+
210.	<i>Trifolium campestre</i> Schreb.	Fabaceae	Herb	-	+	+
211.	<i>Trifolium scabrum</i> L.	Fabaceae	Herb	-	+	+
212.	<i>Trifolium tumens</i> Steven ex M. Bieb.	Fabaceae	Herb	-	+	+
213.	<i>Ulmus minor</i> Mill. □	Ulmaceae	Tree	+	+	-
214.	<i>Urtica dioica</i> L.	Urticaceae	Herb	+	+	+
215.	<i>Valeriana officinalis</i> L.	Valerianaceae	Herb	+	+	-
216.	<i>Verbascum pyramidatum</i> M. Bieb.	Scrophulariaceae	Herb	-	+	+
217.	<i>Verbascum saccatum</i> K. Koch	Scrophulariaceae	Herb	-	+	+
218.	<i>Veronica officinalis</i> L.	Scrophulariaceae	Herb	+	+	-
219.	<i>Viburnum lantana</i> L.	Viburnaceae	Shrub	+	-	-
220.	<i>Vicia grandiflora</i> Scop.	Fabaceae	Herb	+	+	+
221.	<i>Vicia lutea</i> L.	Fabaceae	Herb	-	+	+
222.	<i>Vicia sativa</i> L.	Fabaceae	Herb	+	+	+
223.	<i>Vicia trunculata</i> Fisch. ex M. Bieb.	Fabaceae	Herb	+	+	+
224.	<i>Vinca herbacea</i> Waldst. & Kit.	Apocynaceae	Herb	-	+	+
225.	<i>Viola nemausensis</i> Jord.	Violaceae	Herb	+	+	+
226.	<i>Viola odorata</i> L.	Violaceae	Herb	+	+	+
227.	<i>Viola reichenbachiana</i> Jord. ex Boreau	Violaceae	Herb	+	+	+
228.	<i>Viola suavis</i> M. Bieb.	Violaceae	Herb	+	+	+
229.	<i>Viscum album</i> L.	Viscaceae	Parasite	+	+	-
230.	<i>Xeranthemum squulosum</i> Boiss.	Asteraceae	Herb	-	+	+

Annex 2

Table 2. List of plant species in habitats in 'Heidelbergcement AG' limestone quarry in Kavtiskhevi. Occurrence of species are indicated for four habitat types: pioneer primary succession (PS); logistic succession oligotrophic meadows (OM); secondary steppes (St) and dry xerophyte scrubland (Sc). © - Caucasian endemic species.

N	Species	Family	Life forms	PS	OM	St	Sc
1.	<i>Achillea millefolium</i> L.	Asteraceae	Herb	-	+	+	-
2.	<i>Acroptilon repens</i> (L.) DC.	Asteraceae	Herb	-	-	+	-
3.	<i>Adonis aestivalis</i> L.	Ranunculaceae	Herb	-	-	+	-
4.	<i>Adonis flammea</i> Jacq.	Ranunculaceae	Herb	-	-	+	-
5.	<i>Aegilops cylindrica</i> Host.	Poaceae	Grass	-	+	+	+
6.	<i>Aegilops tauschii</i> Coss.	Poaceae	Grass	-	-	+	+
7.	<i>Aegilops triuncialis</i> L.	Poaceae	Grass	-	+	+	+
8.	<i>Allium atrovioletum</i> Boiss.	Alliaceae	Geophyte	-	-	+	+
9.	<i>Allium pseudoflavum</i> Vved.	Alliaceae	Geophyte	-	-	+	+
10.	<i>Allium rotundum</i> L.	Alliaceae	Geophyte	-	-	+	+
11.	<i>Amberboa moschata</i> (L.) DC.	Asteraceae	Herb	-	-	-	+
12.	<i>Artemisia caucasica</i> Willd.	Asteraceae	Herb	+	+	+	-
13.	<i>Artemisia fragrans</i> Willd.	Asteraceae	Herb	+	+	+	+
14.	<i>Astracantha caucasica</i> (Pall.) Podlech	Fabaceae	Shrub	-	-	-	+
15.	<i>Astragalus cicer</i> L.	Fabaceae	Herb	+	+	-	-
16.	<i>Astrodaucus orientalis</i> (L.) Drude	Apiaceae	Herb	+	+	+	+
17.	<i>Avena barbata</i> Pott ex Link	Poaceae	Grass	-	+	+	-
18.	<i>Bothriochloa ischaemum</i> (L.) Keng	Poaceae	Grass	+	+	+	+
19.	<i>Brachypodium distachyon</i> (L.) P. Beauv.	Poaceae	Grass	+	+	+	-
20.	<i>Bromopsis japonicus</i> Thunb.	Poaceae	Grass	-	+	+	+
21.	<i>Bromus squarrosus</i> L.	Poaceae	Grass	+	+	+	+
22.	<i>Camelina microcarpa</i> Andrz. ex DC.	Brassicaceae	Herb	+	+	-	+
23.	<i>Capparis spinosa</i> L.	Capparaceae	Shrub	-	-	-	+
24.	<i>Cardaria draba</i> (L.) Desv.	Brassicaceae	Herb	-	-	-	+
25.	<i>Carex lyparocarpos</i> subsp. <i>bordzilowskii</i> (V. I. Krecz.) T. V. Egorova	Cyperaceae	Sedge	-	+	-	+
26.	<i>Centaurea depressa</i> M. Bieb.	Asteraceae	Herb	-	-	+	+
27.	<i>Centaurea solstitialis</i> L.	Asteraceae	Herb	+	+	+	+
28.	<i>Cerasus incana</i> (Pall.) Spach	Rosaceae		-	-	-	+
29.	<i>Chenopodium album</i> L.	Chenopodiaceae	Herb	+	-	-	-
30.	<i>Cirsium arvense</i> (L.) Scop.	Asteraceae	Herb	+	+	+	+
31.	<i>Clematis orientalis</i> L.	Ranunculaceae	Vine	-	+	-	+
32.	<i>Convolvulus arvensis</i> L.	Convolvulaceae	Herb	+	+	-	+
33.	<i>Cotoneaster saxatilis</i> Pojark. ©	Rosaceae	Shrub	-	-	-	+
34.	<i>Cotinus coggygria</i> Scop.	Anacardiaceae	Shrub	-	-	-	+
35.	<i>Crocus adamii</i> J. Gay	Iridaceae	Geophyte	-	+	+	+
36.	<i>Cuscuta europaea</i> L.	Cuscutaceae	Parasite	+	+	-	+
37.	<i>Cynosurus echinatus</i> L.	Poaceae	Herb	-	+	+	+
38.	<i>Dactylis glomerata</i> L.	Poaceae	Grass	+	+	+	+
39.	<i>Daphne axilliflora</i> (Keissl.) Pobed. ©	Thymelaeaceae	Shrub	-	-	-	+
40.	<i>Daphne caucasica</i> Pall. ©	Thymelaeaceae	Shrub	-	+	-	+

41.	<i>Dianthus orientalis</i> Adams	Caryophyllaceae	Herb	-	+	-	+
42.	<i>Dorycnium intermedium</i> Ledeb.	Fabaceae	Herb	+	+	+	+
43.	<i>Echium vulgare</i> L.	Boraginaceae	Herb	+	+	+	+
44.	<i>Elaeagnus angustifolia</i> L.	Elaeagnaceae	Tree	-	-	-	+
45.	<i>Eremopyrum orientale</i> (L.) Iaub. et Spach.	Poaceae	Grass	-	+	+	-
46.	<i>Eremopyrum triticeum</i> (Gaertn.) Nevski	Poaceae	Grass	-	+	+	-
47.	<i>Erophila verna</i> (L.) Chevall.	Brassicaceae	Herb	+	-	-	+
48.	<i>Euphorbia falcata</i> L.	Euphorbiaceae	Herb	+	+	-	+
49.	<i>Euphorbia heleoscopia</i> L.	Euphorbiaceae	Herb	-	+	+	+
50.	<i>Festuca varia</i> Haenke	Poaceae	Grass	+	+	+	-
51.	<i>Gagea chanae</i> Grossh.	Liliaceae	Geophyte	-	+	+	+
52.	<i>Gagea chlorantha</i> (M. Bieb.) Schult. & Schult. fil.	Liliaceae	Geophyte	-	+	+	+
53.	<i>Galium verum</i> L.	Rubiaceae	Herb	+	+	+	+
54.	<i>Glycyrrhiza glabra</i> L.	Fabaceae	Shrub	-	+	+	+
55.	<i>Helichrysum plintocalyx</i> (K. Koch) Sosn.	Asteraceae	Herb	-	+	+	+
56.	<i>Hieracium pilosella</i> L.	Asteraceae	Herb	-	+	-	+
57.	<i>Hordeum leporinum</i> Link	Poaceae	Grass	-	+	+	-
58.	<i>Hypericum perforatum</i> L.	Hypericaceae	Herb	-	+	+	+
59.	<i>Inula salicina</i> DC. subsp. <i>aspera</i> (Poir.) Hayek	Asteraceae	Herb	+	+	-	+
60.	<i>Jurinea blanda</i> (M. Bieb.) C. A. Mey.	Asteraceae	Herb	-	+	+	-
61.	<i>Koeleria cristata</i> (L.) Pers.	Poaceae	Grass	-	+	+	+
62.	<i>Lactuca seriola</i> L.	Asteraceae	Herb	+	-	-	+
63.	<i>Lamium amplexicaule</i> L.	Lamiaceae	Herb	-	+	-	+
64.	<i>Lappula barbata</i> (M. Bieb.) Guerke	Boraginaceae	Herb	+	+	-	+
65.	<i>Lapsana communis</i> L.	Asteraceae	Herb	+	+	-	+
66.	<i>Linum angustifolium</i> Huds.	Linaceae	Herb	-	+	-	+
67.	<i>Linum nodiflorum</i> L.	Linaceae	Herb	-	+	+	-
68.	<i>Linum orientale</i> (Boiss. & Heldr.) Boiss.	Linaceae	Herb	-	+	+	-
69.	<i>Linum tenuifolium</i> L.	Linaceae	Herb	+	+	-	+
70.	<i>Linum corymbulosum</i> Rchb.	Linaceae	Herb	-	+	+	-
71.	<i>Lolium rigidum</i> Gaudin	Poaceae	Grass	+	+	+	-
72.	<i>Lotus corniculatus</i> L.	Fabaceae	Herb	+	+	-	-
73.	<i>Medicago caerulea</i> Less. ex Ledeb.	Fabaceae	Herb	+	+	-	+
74.	<i>Medicago lupulina</i> L.	Fabaceae	Herb	+	+	-	+
75.	<i>Melandrium latifolium</i> (Poir.) Maire	Caryophyllaceae	Herb	-	+	-	+
76.	<i>Melilotus officinalis</i> (L.) Lam.	Fabaceae	Herb	+	-	-	-
77.	<i>Merendera trigina</i> (Steven ex Adams) Stapf	Colchicaceae	Geophyte	-	+	+	+
78.	<i>Muscari szovitsianum</i> Baker	Hyacinthaceae	Geophyte	-	+	+	+
79.	<i>Onobrychis iberica</i> Grossh. ©	Fabaceae	Herb	-	+	-	+
80.	<i>Onobrychis radiata</i> (Desf.) M. Bieb. ©	Fabaceae	Herb	+	+	-	+
81.	<i>Paliurus spina-christi</i> Mill.	Rhamnaceae	Shrub	-	-	-	+
82.	<i>Papaver arenarium</i> Bieb.	Papaveraceae	Herb	-	-	+	+
83.	<i>Papaver hybridum</i> L.	Papaveraceae	Herb	-	-	+	+

84.	<i>Plantago lanceolata</i> L.	Plantaginaceae	Herb	+	+	-	+
85.	<i>Poa pratensis</i> L.	Poaceae	Grass	+	+	+	+
86.	<i>Poa densa</i> Troitsky	Poaceae	Grass	+	+	+	-
87.	<i>Polygala transcaucasica</i> Tamamsch.	Polygalaceae	Herb	+	+	+	+
88.	<i>Potentilla recta</i> L.	Rosaceae	Herb	+	+	-	+
89.	<i>Poterium polygammum</i> Waldst. & Kit.	Rosaceae	Herb	+	+	-	+
90.	<i>Pyrus salicifolia</i> Pall.	Rosaceae	Tree	-	-	-	+
91.	<i>Rhamnus palasii</i> Fisch. & C. A. Mey.	Rhamnaceae	Shrub	-	-	-	+
92.	<i>Rhamnus spathulifolia</i> Fisch. & C. A. Mey	Rhamnaceae	Shrub	-	-	-	+
93.	<i>Rosa pimpinellifolia</i> L.	Rosaceae	Shrub	-	-	-	+
94.	<i>Salvia nemorosa</i> L.	Lamiaceae	Herb	-	+	-	+
95.	<i>Scabiosa columbaria</i> L.	Dipsacaceae	Herb		+	+	
96.	<i>Scorzonera biebersteinii</i> Lipsch. ©	Asteraceae	Herb	+	-	+	-
97.	<i>Senecio vulgaris</i> L.	Asteraceae	Herb	-	-	-	+
98.	<i>Silene chlorifolia</i> Smith	Caryophyllaceae	Herb	+	+	-	+
99.	<i>Sisymbrium loeselii</i> L.	Brassicaceae	Herb	+	+	-	-
100.	<i>Stachys atherocalyx</i> K. Koch	Lamiaceae	Herb	+	+	-	+
101.	<i>Stipa capillata</i> L.	Poaceae	Grass	-	+	+	-
102.	<i>Stipa caucasica</i> Schmalh.	Poaceae	Grass	-	+	+	-
103.	<i>Stipa pulcherimma</i> K. Koch	Poaceae	Grass	-	+	+	-
104.	<i>Stipa lessingiana</i> Trin. & Rupr.	Poaceae	Grass	+	+	+	-
105.	<i>Tamarix hohenackeri</i> Bunge	Tamaricaceae	Shrub	-	-	-	+
106.	<i>Tamarix ramosissima</i> Ledeb.	Tamaricaceae	Shrub	-	-	-	+
107.	<i>Taraxacum officinale</i> F. H. Wigg.	Asteraceae	Herb	+	+	-	-
108.	<i>Teucrium polium</i> L.	Lamiaceae	Herb	-	+	+	+
109.	<i>Teucrium chamaedrys</i> L.	Lamiaceae	Herb	-	+	+	+
110.	<i>Thymus tiflensis</i> Klok. & Shost. ©	Lamiaceae	Herb	-	+	+	+
111.	<i>Tragopogon pusillus</i> M. Bieb.	Asteraceae	Herb	-	+	-	+
112.	<i>Trisetum rigidum</i> (M. Bieb.) Roem.	Poaceae	Grass	+	+	+	+
113.	<i>Tussilago farfara</i> L.	Asteraceae	Herb	+	+	-	-
114.	<i>Xeranthemum cylindraceum</i> Sibth. & Smith	Asteraceae	Herb	-	+	+	-
Total number:114 species/7endemic		33	7	46	82	61	83

Annex 3**Project Budget****24 Months**

Budget Description	Unit	# of units	Unit rate (EUR)	Cost in (EUR)
<i>Project staff</i>				
Project Coordinator	Month	24	300	7,200
Project Manager	Month	24	300	7,200
Project Assistant	Month	24	200	4,800
Driver	Month	5	500	5,000
			Sum	€ 24,200
<i>Expeditions</i>				
Petrol	Days	50	30	1,500
Per diem	Days/persons	50/5	25	6,250
			Sum	€ 7,750
<i>Office Equipment</i>				
Video camera /Photo camera/Projector			Sum	€ 5,000
<i>Activities</i>				
Trainings/Workshops	Persons	25	50	1,250
Electronic web-page	Preparation	1	1200	1200
Publication	Book	2	600	1200
			Sum	€ 3,650
			Grand Total	€ 40,600

Annex 4

CVs and Qualifications of Project Coordinator CURRICULUM VITAE Assoc. Prof., Dr. Dr. Maia Akhalkatsi

Date and place of birth: December 30th, 1959, Gurjaani, Georgia.

Nationality: Georgian

Gender: Female

Postal Address: Ilia State University, Cholokashvili Ave. 3/5, 0162 Tbilisi, Georgia.

E-mail: akhalkatsim@yahoo.com, maia_akhalkatsi@iliauni.edu.ge;

Mobil: +995 99 193529.

Present position: Head of the Department of Plant Genetic Resources, Institute of Botany; Associated Professor, Faculty of Sciences and Art, Ilia State University.

Education:

1966-1976 2nd Public School, Shilda, Georgia, graduated with gold medal.

1976-1981 Tbilisi State University, Tbilisi, Georgia, graduated with red diploma.

1981-1984 Postgraduate School at the Komarov Botanical Institute, St.Peterburg, Russia.

1997-04-07 IREX Fellowship, Portland, Oregon, USA.

1997-1999 Alexander von Humboldt Fellowship, Duesseldorf, Germany

Degrees:

1981/June 25th Master of Science (Molecular Biology), Tbilisi State University. Diploma G-1 # 171724.

1986/January 15th PhD. (Cand. Biol. Sci., Botany), the Komarov Botanical Institute, St.Peterburg, Russia. Diploma BL # 016282.

2006/ May 15th Doctor of Sciences (Botany), Institute of Zoology, Georgian Academy of Sciences, Diploma # 001669.

Experience:

1985-1992 Scientific worker, Institute of Botany, Georgian Academy of Sciences, Tbilisi.

1992-2002 Senior scientist, Institute of Botany, Georgian Academy of Sciences, Tbilisi.

1997-2011 Chairman of the NGO “GSNE Orchis” (<http://www.itic.org.ge/orchis>).

Since 2002 Head of the Department of Plant Genetic Resources, Institute of Botany, Ilia State University, Tbilisi.

2006-2009 Associated Professor, Faculty of Life Sciences, Ilia Chavchavadze State University, Tbilisi.

Since 2010 Associated Professor, Faculty of Sciences and Art, Ilia State University, Tbilisi.

Lecturer:

1992- 1994 Biology course, College of Natural Sciences at the Institute of Physics of Georgian Academy of Sciences, Tbilisi.

1999-2001 Biology course, Faculty of Physics, I. Javakhishvili Tbilisi State University.

2006-2009 Plant morphology, Faculty of Life Sciences, Ilia Chavchavadze State University.

2010 -2011 Plant morphology and genetic resources, Institute of Ecology, Ilia State University, Tbilisi.

Since 2012 Plant morphology, Plant genetic resources and forest ecology. Faculty of Sciences and Art, Ilia State University.

Main Professional Interests:

Plant genetic resources, crop domestication, agrobiodiversity, plant diversity, plant reproductive ecology, vegetation mapping, plant conservation.

Main Professional experience:

Light microscopy, electron microscopy, tissue culture, comprehensive biometric methods, GIS.

Fellowships:

Austria - 1992,1993,1994, 2000, 2001, - Austrian Academy of Sciences; 2008 -OeBF.

Germany – 1993 Ministry of Culture and Education of Bayern, 1995 - DAAD, 1997-1999,

2000, 2004; 2007 -Alexander von Humboldt Foundation; 2000 - Dönhoff Foundation, 2008, 2010- Giessen University.

USA – 1997-IREX; 2004 – GRDF/CRDF.

Switzerland – 2000 – SNF, Scopes, travel grant; 2008 - WSL, 2009- GTZ.

Grants:

1. International Science Foundation 1994 (MX000), 1996 (MX200) “Reproductive biology and seed development in three *Astragalus* species in Georgia.”
2. Georgian Academy of Sciences - 1997-1999: “Reproductive Biology of Flowering Plants”;
3. COBASE Grants Program – 1997 – Project Development Grant: “Phylogenetic studies in *Iris* subgenus *Iris* using morphological and molecular data.” US visitor C. Wilson, Portland State University, Portland, Oregon, USA.
4. Georgian Academy of Sciences 2000-2002, 2003-2005: „Study of seed development of some rare species of Georgian flora and their conservation in the stations of the Institute of Botany“.
5. EU 5th Framework Program, 2000-2003 – GLORIA-EUROPE – “The Global Observation Research Initiative in Apline Environments”. Project coordinator G. Grabherr, University of Vienna, Vienna, Austria.
6. Volkswagen Foundation – 2002-2005: “Pharmaceutical value of onions and related species (*Allium* L.) Of middle Asia and the Caucasus (PharmAll).”; Coordinator M. Keusgen, University of Marburg, Germany.
7. The Willowwood Foundation – 2002. “Rare plant introduction in the Kazbegi Research Station.” Coordinator GSNE “Orchis”.
8. bp Economy and Ecology in Harmony I, 2002-2003, “Inventory and Conservation of Orchid Diversity in Georgia.” Coordinator GSNE “Orchis”.
9. GRDF/CRDF – Georgia-US Bilateral Grants Program I, 2002-2005: “Alpine Tree line Stability in a Changing Global Environment: Mechanisms of Tree Seedling Establishment.” (Award # GP1-3322-TB-02). US coordinator W.K. Smith, Wake Forest University, NC, USA.
10. CRDF – Caucasus – U.S. Scientific Workshops Program 2003. “Plant Interactions and the Effect of Global Warming on Alpine Biodiversity.” (Award GX0-1043-TB-02). U.S. Organizer: Ragan M. Callaway, University of Montana, Missoula, Montana, USA.
11. bp Economy and Ecology in Harmony II, 2004-2005, “Diversity and Conservation of the Economically Important Plant Family Iridaceae in Georgia.” Coordinator GSNE “Orchis”.
12. GRDF/CRDF – US-Georgia Bilateral Program II - 2005-2006: “Ecological Facilitation in the Alpine Treeline Ecotone of Georgia: Implications for Future Global Change.” (Award GEB1- 3335-TB-03). US coordinator W.K. Smith, Wake Forest University, NC, USA.
13. bp Economy and Ecology in Harmony III, 2005-2006, “Diversity and Conservation of Iris Family in Georgia.” Coordinator GSNE “Orchis”.
14. UNDP – 2005-2006, “Conservation and Sustainable Utilization of the Endangered Medicinal Plants in Samtskhe-Javakheti.” in the framework of the ELKANA agrobiodiversity Program.
15. Swiss Agency for Development and Cooperation (SDC), 2005-2006, Pilot project on “Optimizing grazing regimes in subalpine grassland in the Central Caucasus.” Swiss

- coordinator: Prof. Ch. Körner (Chair Global Mountain Biodiversity Assessment, GMBA of DIVERSITAS, Paris; Institute of Botany, University of Basel, Schönbeinstr. 6, CH-4056 Basel, Switzerland.
- 16. NSF - 10.08.2005-31.07.2007.; U.S.-Georgia: "Ecological Facilitation by *Rhododendron caucasicum* Extends the *Betula litwinowii* Alpine Treeline, Caucasus Mountains of Georgia." (Award #0523130). US coordinator W.K. Smith, Wake Forest University, NC, USA.
 - 17. bp Economy and Ecology in Harmony IV, 2006-2007, "Inventory and Sustainable Utilization of the Endangered Edible Trees and Shrubs in Georgia." Coordinator GSNE "Orchis".
 - 18. Scope - 2006-2008. (Project no. 110670) – "Towards sustainable use of mountain pastures in the Central Caucasus: effects of recent land use changes on plant diversity and soil stability." Swiss coordinator: Prof. Ch. Körner (Chair Global Mountain Biodiversity Assessment, GMBA of DIVERSITAS, Paris; Institute of Botany, University of Basel, Schönbeinstr. 6, CH-4056 Basel, Switzerland.
 - 19. EU 6th Framework Program – 2007-2009, "Management and Conservation of Grapevine Genetic Resources (GrapeGen06)." Grant under Council Regulation (EC) No 870/2004, Proposal GEN RES 2005 008. Roberto Bacilieri, Institut National de la Recherche Agronomique – INRA, Att: Bernard ITIER 2, Place P. Viala F – 34060 Montpellier, France.
 - 20. Georgian Centers of Research and Education (CoRE) Program 2006, - "Exploring biodiversity of the Caucasian "biodiversity hotspot" with modern molecular-genetic methods and analytical tools". Proposed Center Name: Center of biodiversity studies at the Faculty of Life Sciences of the Ilia Chavchavadze State University. Applicant: David Tarkhnishvili..
 - 21. GRDF/CRDF – US-Georgia Bilateral Program III - 2007-2009: "Facilitation of birch seedling establishment by an evergreen Rhododendron at alpine treeline in the Caucasus Mountains of Georgia." (Award GEB2-3341-TB-06). US coordinator W.K. Smith, Wake Forest University, NC, USA.
 - 22. UNDP – 2008-2009, "Conservation and Sustainable Utilization of the Crop Wild Relatives in Samtskhe-Javakheti." in the framework of the ELKANA agrobiodiversity Program.
 - 23. IPK-Gatersleben - 2008-2012, "Collection of crop genetic resources in Georgia". German Coordinator K. Pistrick, Leibniz Institute of Plant Genetic and Cultivated Plants (IPK), Gatersleben, Germany.
 - 24. Volkswagen Foundation Program "Between Europe and the Orient" – 2010-2014: "Analysing multiple interrelationships between environmental and societal processes in mountainous regions of Georgia - Interdisciplinary research to foster sustainable land use, land development, and quality of life." German Coordinator Annette Otte, University Giessen.
 - 25. Scope - 2009-2012. (Project no. IZ73Z0_128057) – "Mountain biodiversity in the Caucasus and its functional significance". Swiss coordinator: Prof. Ch. Körner (Chair Global Mountain Biodiversity Assessment, GMBA of DIVERSITAS; Institute of Botany, University of Basel, Basel, Switzerland.
 - 26. NSF program 'phylogenetic systematics' award #1020826: Phylogeny and development in *Iris* subgenus *Iris* and related species: September 1, 2010/August 31, 2013. Principal Investigator - Carol Wilson (carol.wilson@cgu.edu), Rancho Santa Ana Botanic Garden
1500 North College Avenue Claremont, CA 91711 714/626-3922, USA.
 - 27. The Quarry Life Award 2012. - Environmental Education Program for Biodiversity Conservation during the Rehabilitation Process of Limestone Quarry.
<http://www.quarrylifeaward.com/project/environmental-education-program-biodiversity-conservation-during-rehabilitation-process>.

Conference visits:

1. GMBA mountain biodiversity conference. Stepantsminda, 21-24 June 2012. Akhalkatsi M. Crop diversity in mountain regions of Georgia. M. Akhalkatsi. Genetic diversity of ancient crops in mountain regions of Georgia.
 2. XXIII IUFRO World Congress. Forests for the Future: Sustaining Society and the Environment. 23-28 August 2010, COEX Seoul, Republic of Korea. Akhalkatsi, M., Kimeridze, M. Implementation of the classification system of forest habitats in accordance with the Natura2000 standards in the Georgian Legislation.
 3. 2nd International GMBA-DIVERSITAS conference "Functional significance of mountain biodiversity" in Chandolin (Valais), Switzerland, 26-30th July 2010. Nakhutsrishvili, G. Abdaladze, O. Akhalkatsi, M., Batsatsashvili, K. Sharikadze, Kh. Alpine plant diversity and function in the Central Caucasus.
 4. Climate Change Curricula in Higher Education in Tbilisi, 7 June, 2010, Tbilisi, Georgia.
 5. Kickoff Meeting AMIES - Analysing multiple interrelationships between environmental and societal processes in mountainous regions of Georgia. Interdisciplinary research to foster sustainable land use, land development, and quality of life 23-29, May, 2010 Tbilisi-Kazbegi-Bakuriani.
 6. Between Europe and the Orient –A Focus on Research and Higher Education in/on Central Asia and the Caucasus. 19-21 May, 2010, Tbilisi, Georgia.
 7. Hintermann & Weber AG - Biodiversity monitoring training courses, September 2009 in Basel-Bern, Switzerland.
 8. "The role of botanic gardens in Georgia – Opportunities and challenges for the future". BGCI Georgia Workshop, 21-23 May 2009, Tbilisi, Georgia.
 9. "Scientific Cooperation with Developing Countries - the Swiss Guidelines and their Implementation", Volkswagen Foundation workshop. 13-14 November 2008. Bonn, Germany.
 10. "Natura 2000" Training Courses in OeBF. 7-12 September, Vienna, Austria.
 11. Swiss Federal Institute -WSL training courses and botanical excursion in Swiss Alps. 20-31 July, 2008, Birmensdorf, Switzerland.
 12. Training courses in Giessen University, Institute of Landscape Ecology, 01-16 May, 2008.
 13. "Botanikertagung 2007", September 3 -7 2007, Hamburg, Germany.
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 19. "Botanikertagung 2004", 5 -11 September 2004, Braunschweig, Germany.
 20. Annual Meeting of the Botanical Society of America. 5-8 August 2004. Salt Lake City, USA.
 21. Plant Interactions and Global Warming Effect on Alpine Biodiversity, Kazbegi, 30 June-5 July 2003.
 22. Third EUFORGEN Conifers Network meeting, Kostrzyca, Poland, 17-19 October 2002.
 23. Botanikertagung 2002, Freiburg Germany. 22-29 September 2002.
 24. Botanikertagung 2000 Jena, Germany, 17-22 September 2000.
 25. GMBA conference, Rigi-Kaltbad, Switzerland, 7-10 September 2000.
 26. Stigma-Pollen Interaction Conference, Oxford, UK, 18-21 July 1999.
 27. Botanikertagung, 1998, Bremen, Germany, 30.08-6.09 1998.
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28. XVth International Congress on Sexual Plant Reproduction, Wageningen, the Netherlands, 16–21 August 1998.
29. VIIth International Congress of Ecology, Florence, Italy, 19–25 July 1998.
30. XI Int. Symp. Embryology and Seed Reproduction, Russia, 1990.

Memberships:

Botanical Society of America since 1997.
Botanical Society of Germany since 1998;
Member of NGO “GSNE Orchis” since 1997.

Languages: Reading, speaking and writing fluent in English, German, Russian, Georgian.

Tbilisi, 27.09.2012

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