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A CURRICULUM FOR LEARNING NATURE VALUES. CASE STUDY: LEARNING GEODIVERSITY FROM BISTRIŢA ARDELEANĂ GORGE (BISTRIŢA-NĂSĂUD COUNTY, ROMANIA)

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Abstract: In the process of conservation of geological heritage should be involved, in addition to specialists, local communities, rangers, authorities and tourists. This requires an appropriate educational setting to organize and coordinate the activities of identification, evaluation and protection of geodiversity. This framework can be assured by the curricula for learning the values of nature, which is a concept proposed by Grundtvig project "Lena-Learning nature values in Europe" in the period 2012-2014, under the "Lifelong Learning" Program funded by the European Commission, with the participation of environmental associations, groups of specialists and learners from Estonia, Italy, Finland and Romania. A curricula for learning nature values it`s a document structured in such a way to allow all interested parties of nature the acquisition of knowledge and skills to identify, evaluate, promotion, development and preservation of natural elements belonging to biodiversity and geodiversity. This study proposes a curriculum for learning geodiversity, i.e. geological structures (rocks, minerals, fossils), soils and landforms with scientific, ecological, aesthetic, cultural and economic values. The application in practice of this curricula was done with the opportunity of setting up the Action Plan for conservation of geodiversity from Bistriţa Ardeleană Gorge (Bistriţa-Năsăud County, Romania), which was attended by several stakeholders (county and local authorities, local community, students, pupils, mountain rescuers).

Key words: geodiversity, geosite, geomorphosites, geoheritage, geoabundance, geotourism, geoparks, geoconservation, curricula, lifelong learning, Grundtvig

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INTRODUCTION

The geodiversity is a concept used by geologist in the 1990s to describe the variety of abiotic nature. Meanwhile, this new term has received numerous definitions, as follows:

- the link between people, landscape and their culture: it is the variety of geological environments, phenomena and processes that make those landscapes, rocks, minerals, fossils and soils which provide the framework for life on Earth (Stanley, 2001);

-geological diversity or the variety of rocks, fossils and minerals and natural processes (Prosser, 2002);

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- geodiversity underpins biodiversity (Burek, 2001), and represent the abiotic factors, which together with biodiversity give a holistic view of the landscape (Burek, 2002);

- the variety of earth materials (minerals, rocks, sediments, fossils, soils and water), forms (folds, faults, landforms) and processes (tectonics, sediment transport, pedogenesis) that constitute and shape the Earth, either the whole or a specific part of it (Gray, 2003).

The geodiversity, as part of geosystem, has an economic, social, cultural, environmental and educational importance, highlighting by follow aspects:

-it provides the raw materials for building (stone, clay, gravels, sand), the fuel (coal, oil, gas), metals for industry, and the soils for agriculture;

-the location of many settlements is influenced by the distribution of mineral resources (coal, oil, metals), water (ground waters, surface waters), soils (fertile, less fertile), and landforms configuration (altitude, energy, fragmentation, slope, orientation);

-geodiversity plays a major role in defining the landscapes (landforms, soils, natural and anthropic processes);

-the complex relationships between geology, natural processes, landforms, landscape, soils and climate are fundamental to the distribution of habitats and species;

-geodiversity plays a key role in environmental regulation (absorbing pollution, buffering climate change, filtering, purifying and storing water);

-spectacular geology forms the backdrop to many of most popular tourist locations, and the geosites are often of great recreational and tourism value, inspiring people to enjoy or learn about nature;

-many geodiversity sites are used for outdoor education, because they provide a chance to study ancient volcanoes, caves, landslides, environmental change, and collect and record fossils or minerals.

Along with biodiversity and cultural creations, geodiversity it`s part of the total assets of a geographical area, and its knowledge is needed to establish the geological and geomorphological sites and to elaborating the strategies for protection and conservation of natural heritage. The geodiversity concept is associated with other two terms: geoconservation (intention and action to conserve natural abiotic values) and geoheritage (significant abiotic elements to be preserved). In this context, geodiversity is the basis for geoconservation and a way to preserve the geoheritage of a region, because Value + Threat = Conservation Need.

Inventory of geodiversity and geoconservation has strong traditions in Australia, Tasmania, the Nordic countries (Sweden, Norway, Finland, Denmark, Iceland), the United Kingdom and the United States, where it have been drawn up Geodiversity Audits and Action Plans for the conservation of the various geosites. There are many geoconservation method, such as secrecy, physical restraint, reburial, excavation/ curation, permitting/licensing, supervision, benevolent ownership, legislation, policy and education (Gray, 2008b).

The last of this methods, education, can be applied to all elements of geodiversity, because knowing the nature is first step towards geoconservation, and the greatest threat to geodiversity is ignorance (Gray, 2003). In the Action Plans for geoconservation are more themes, among which we can mention the following three, aiming learning geodiversity values: to enhance local understanding of geodiversity, raise awareness, understanding and inspire people to value their local geodiversity, and collecting and managing information on local geodiversity.

Gray (2008 b) argues that education on geodiversity issues can be done in school and university using a suitable Earth science curricula. In addition with the systematic study of geodiversity other forms of learning can be organized, such as: training courses for local government and planning officers, politicians, nature conservation and ranger

staff, etc.; television shows; magazine and newspaper articles; websites; museums; visitor centres; parks and geoparks; site-interpretation panels; visitor activities such as fossil and mineral collecting; geological trails with accompanying leaflets; special events such as geology weeks etc. (Gray, 2003), and learning projects for natural values.

One such project it`s Grundtvig: Learning natural values in Europe (LENA), during the period 1 August 2012 - 31 July 2014 in the framework of "Lifelong learning" Program, funded by the European Commission, with the participation of environmental associations, specialists and learner from Estonia, Italy, Finland and Romania.

The project aims to implement nature conservation activities in Europe through education and providing opportunities for adults to improve their own lives, and the objectives of the project are:

- bringing together people of different target groups who are interested in nature and its values;
- educating people with long-term experiential experts on nature and outdoor learning methods (biologists, geographers, geologists, guide managers, curators, etc.);
- improving knowledge of people about the nature and values in Europe;
- helping adults people improve their way of living;
- development of educational methods of nature conservation;
- knowing people through international cooperation;
- raising awareness about environmental issues and providing advanced solutions to address them through education (www.learning-nature.eu, http://harta-verde.ro /proiecte/learning-natural-values-europe).

The final result of this project will be the development of a curriculum for learning natural values in Europe to serve all those who perform nature-related activities such as geoconservation, ecotourism planning etc.

In this context, the present study proposes a curriculum model for learning natural values of the geodiversity, which can be used both by local communities, specialists and other stakeholders who want to gain more knowledge about their abiotic environment, to act the protection and conservation of natural values.

METHODOLOGY

To accomplish this study were taken the following steps:

-consulting literature in geodiversity (Azevedo, 2006; Bâca, 2011; Brilha, 2005; Burek, 2001; Burek & Potter, 2002; Burek & Potter, 2006; Farsani et al., 2011; Gordon et al., 2012; Gray, 2003; Gray, 2008a; Gray, 2008b; Ilieş, Josan, 2007; Ilieş et al., 2009; Ilieş, Josan, 2009a; Ilieş, Josan, 2009b; Martinez-Frias et al., 2009; Kiernan, 1996; Kiernan, 1997; Kozlowski, 2004; Nieto, 2001; Pemberton, 2000; Piacente & Coratza, 2005; Prosser, 2002; Ruban, 2010; Soutberg, 1990; Sharples, 1993; Stanley, 2001);

-consulting some Geodiversity Audits and Action Plans and Reports drawn up for specific areas (Australian Natural Heritage Charter, 1997; Australian Natural Heritage Charter, 2002; Durham Geodiversity Audit, 2004; Doncaster Geodiversity Assessment, 2007; Local Geodiversity Action Plans–Setting the context for geological conservation, 2006; North Pennines-Geodiversity Action Plan, 2010);

- participation to Grundtvig project LENA-Learning nature values in Europe 2012-2014;

-conducting field research to establish the practical methodology for learning natural values;

-camp theme for inventory, assessment and learning geodiversity in Bistriţa Ardeleană Gorge (Bistriţa-Năsăud County, Romania) and to elaborate The Action Plan for this geographic unit;

-consulting papers about Bistriţa Ardeleană Gorge area (Naum & Butnaru, 1989; Bâca & Şteff, 2010; Bâca & Ştefănescu, 2014).

RESULTS AND DISCUSSION

The curriculum for learning geodiversity is a document that can be used by people involved in the act of ecotourism (guides, instructors, animators, planners, local communities), in geoconservation action, in landscaping, and in learning activities for different age groups.

The structure of a such curriculum was discussed and outlined in the Grundtvig project LENA-Learning Nature Values in Europe 2012-2014 (Lifelong Learning Programme, with reference number GRU-12-P-LP-220-BN-EE) in meetings in Rome (Italy, Figure 1) and Haapsalu (Estonia, Figure 2) and is as follows (table 1):

Figure 1. A learners group at Ostia Beach in Italy, 2012

Figure 2. A learners group at Salajoe Karst Area in Estonia, 2013

Table 1. The structure of curricula for learning natrual values

Chapter of curricula	**Specificity**
Argument	Developing a curriculum for learning natural values, in this case the number and complexity of geological features and landforms, is particularly important because the landscape is the support of all components of environment (water units, plants, animals, soils, human settlements, economic activities), and an attractive target during any type of recreational outdoor activities (hiking, cycling, climbing, etc). Once developed, this curriculum will help educate local communities and specialists in planning, and will support the actions of the inventory and evaluation of geodiversity.
Objectives	a) General objective The general objective of this curriculum is the acquisition of knowledge about the genesis, evolution, typology, distribution, impact, economic exploitation, protection and preservation of geodiversity in a reference area.
	b) Specific objectives As specific objectives for this curricula can be mentioned: -to learn more about landforms, geological and geomorphological processes; -to identify landforms, rocks, mineral and soil types; -to learn about the effects of human impact to lanforms and geomorphological landscape; -to protect the landforms, the geosites and the geomorphosites; -to educate local communities, local government and planning officers, politicians, nature conservation and ranger staff.

Learning tools	-representative places of learning (protected areas, geomorphosites, geological structures, outcrops, etc.); -books; -photos and videos; -topographic, geological, geomorphological and tourism maps; -equipment (clothing, footwear, photo camera, video camera, binoculars, GPS, notebook, etc.).
Learning methods	-explanation; -direct observation; -non-direct observation; -comparison; -demonstration; -discussions.
Stages of learning	a) Indoor stage: -consultation of specialized materials about rocks, minerals, fossils, landforms (genetic types, models of evolution, environmental impact, economic use); -setting the parameters characterizing landforms geomorphometry (altitude, slope, fragmentation, energy) and attractive features (peaks, ridges, cliffs, beaches, waterfalls, gorges, canyons, rock formations, etc); -watching photo and video materials about specific geomorphological processes (erosion, accumulation, volcanic eruptions, etc) and landforms;
	b) Outdoor stage: -study trip and camps in nature; -completion of routes and representative field identification of rocks, minerals, fossils, soils, landforms, present pedologic, geologic and geomorphological processes; -performing hiking, thematic camps or trips; -establish the regional geosites.
Actions	-preparation of materials and equipment; -establish the route or place of learning; -identification of landforms, minerals, rocks, soils and providing specialized information related to it; -observation, analysis and comparison of the landforms, rocks, soils and minerals; -taking pictures and video with landforms and rocks encountered; -mapping landforms, rocks and processes; -completion of observation sheet; -creating portfolios (conventional and digital); -creating the local geodiversity map or geotourist map.
Assessment of learning process	a) Quantitative aspects -enumeration of rocks, minerals, fossils, soils and landforms identified on the ground; -the development of the inventory sheets or portofolias for rocks, minerals, soils and landforms types.
	b) Quality aspects -genetic and evolutionary classification of rocks, minerals, soils and landforms; -mentioning the attractiveness of rocks, minerals, solis and landforms; -description of modeling processes and anthropogenic impact acting on the rocks and landforms; -setting the geoconservation ways; -establish the relationship between geodiversity and biodiversity.
Results	-acquisition of knowledge and skills to identify rocks, minerals, fossils, soils and landforms in the field, to specify their economic, environmental and attractive potential and to establish the recovery and conservation mode.

This curriculum model is general, but it may be adapted, in particular, depending on targeted field (rocks, minerals, fossils, soils, landforms, geological and geomorphological processes, etc.), and purpose (inventory, evaluating, planning, conservation) (Figure 3).

Participants in this project for learning the values of nature will be able to convey this curriculum to others in their environment, interested in the natural values, on different occasions (travel, visits in protected areas, development of recreational areas, conferences, symposiums, etc.).

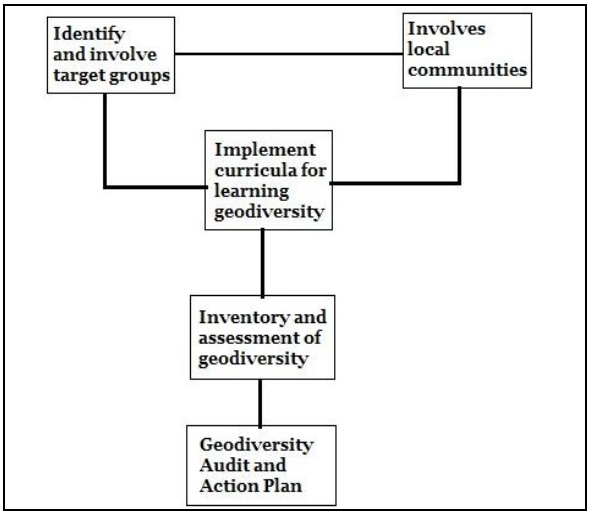

Figure 3. The implement model of curricula for learning nature values and rise public awareness

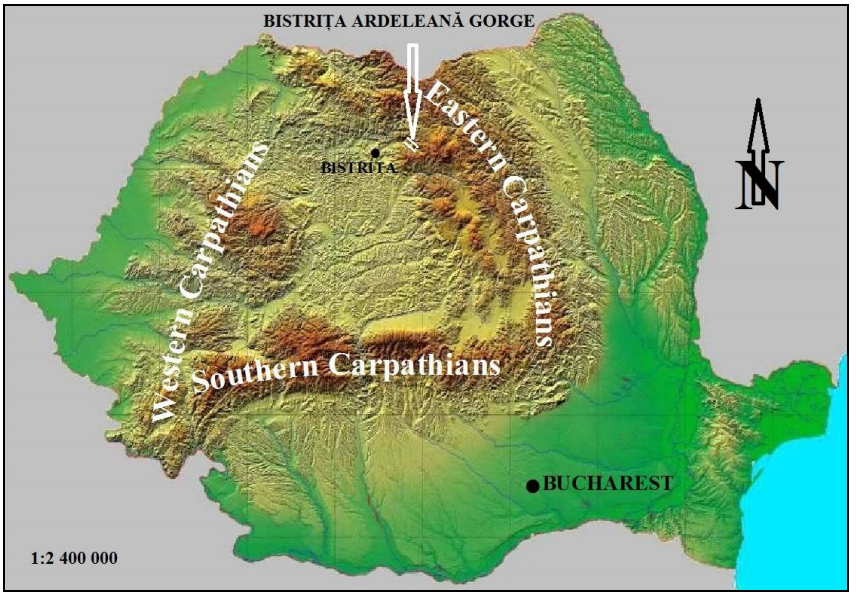

Figure 4. Geographical position of Bistriţa Ardeleană Gorge in Easthern Carpathian Chain of Romania (source: http://www.welcometoromania.ro-with changes)

CASE STUDY: LEARNING GEODIVERSITY OF BISTRIŢA ARDELEANĂ GORGE (BISTRIŢA-NĂSĂUD COUNTY, ROMANIA)

This model of curriculum for learning geodiversity were applied for inventory and assessment of geodiversity from Bistriţa Ardeleană Gorge, and to elaborate The Action Plan for geoconservation in this area.

The Bistriţa Ardeleană Gorge are located in the eastern part of the Bistriţa-Năsăud County, in Bistriţa Bârgăului commune (Figure 4, 5), are oriented in the WNW-ESE direction, have a length of 6 km and connecting The Bistriţa Bârgăului Depression and Colibiţa Depression. This geographical unit were carved in the volcanic conglomerates of Călimani Plateau (ashes, sands, gravels, andesitic blocks) from the upper pliocene by paleo Bistriţa River.

In this project attended by volunteers from the local community Bistriţa Bârgăului, City Hall Bistriţa Bârgăului employees, students from Faculty of Geography and Phisical Education and Sport from Babeş-Bolyai University, Bistriţa Extension, Mountain Rescue Team of Bistriţa-Năsăud County.

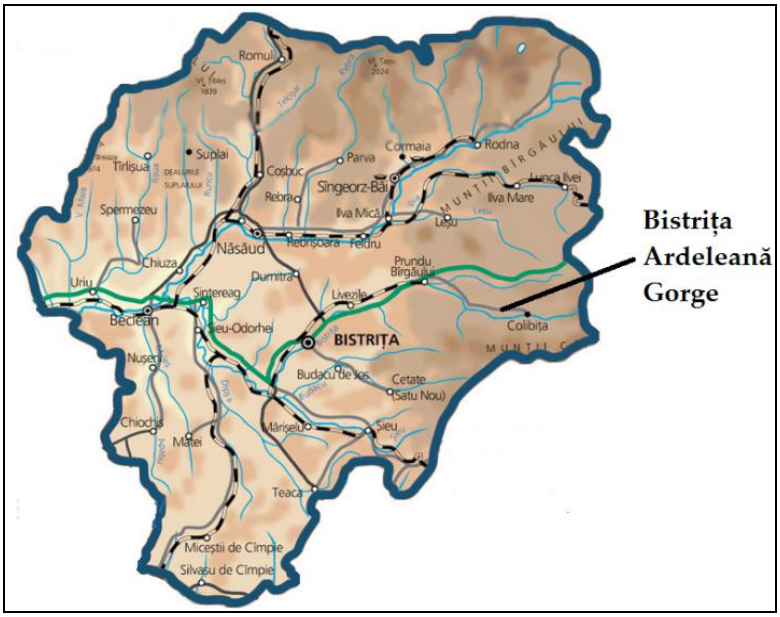

Figure 5. Geographical localisation of Bistriţa Ardeleană Gorge in Bistriţa-Năsăud County (source: http://hartaromaniei.eu/judete/Bistrita-Nasaud.jpg-with changes)

The project has completed the following steps:

a) the presentation of the area and its geodiversity represented by landforms carved on volcanic conglomerates (video and photo);

b) the development of inventory sheets for identify the main landforms (Figure 6);

c) field trip in Bistriţa Ardeleană Gorge to identify the geodiversity and to complet the inventory sheets;

d) establish of regionaly geosites in Bistriţa Ardeleană Gorge;

e) achieving of an indicative map with the main elements of geodiversity (Figure 7);

f) drafting the action plan for geoconservation of this area.

After inventory and assessment operation were established the following geosites: Şoimu Valley, Stegea Valley, Repedea Valley and Piatra Mare Massif, wich was evaluated by few criteria (table 2). At the end of this project, at Bistriţa Bârgăului City Hall, was

structurated The Geodiversity Action Plan for Bistriţa Ardeleană Gorge which will form the basis of the proposal to create a geopark and an adventure park in this area (table 3).

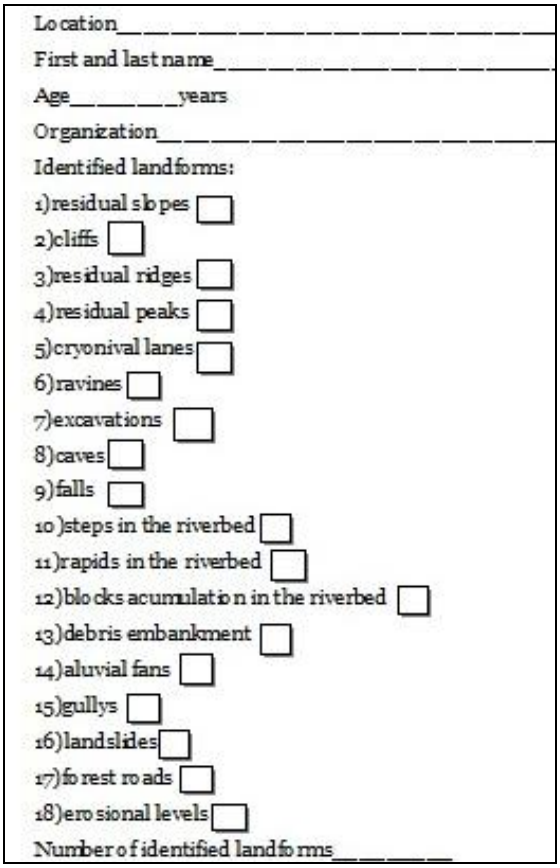
Location_____
First and last name_____
Age_____years
Organization_____
Identified landforms:
1)residual slopes ☐
2)cliffs ☐
3)residual ridges ☐
4)residual peaks ☐
5)cryonival lanes ☐
6)ravines ☐
7)excavations ☐
8)caves ☐
9)falls ☐
10)steps in the riverbed ☐
11)rapids in the riverbed ☐
12)blocks acumulation in the riverbed ☐
13)debris embankment ☐
14)aluvial fans ☐
15)gullys ☐
16)landslides ☐
17)forest roads ☐
18)erosional levels ☐
Number of identified landforms_____

Figure 6. The model of the inventory sheet for geodiversity of Bistrița Ardeleană Gorge

Table 2. Regionaly geosites in Bistriţa Ardeleană Gorge

Geosite	Şoimu Valley	Stegea Valley	Repedea Valley	Piatra Mare Peak
Acces	Forest road	Forest road	Forest road	Paths
Scientific value	Erosional processes in volcanic conglomerates	Erosional processes in volcanic conglomerates	Erosional processes in volcanic conglomerates	Erosional processes in volcanic conglomerates
Ecological value	Forests, mammals, birds, reptiles	Forests, mammals, birds, reptiles	Forests, mammals, birds, reptiles, protected area	Forests, mammals, birds, reptiles
Aestetic value	Residual rocky formations	Residual rocky formations	Residual rocky formations	Scenic point, residual rocky formations
Educationl value	Residual landforms, forest ecosystem, consequences of deforestation	Residual landforms, forest ecosystem, consequences of deforestation	Residual landforms, flood erosion consequences, protected area	Residual landforms Observation point

Economic value	Forest exploitation, capture hydropower plant, collect the berries and mushrooms	Forest exploitation, collect the berries and mushrooms	Forest exploitation, collect the berries and mushrooms, capture hydropower plant	Collect the berries and mushrooms
Threats	Deforestation, floods erosion	Deforestation, floods erosion	Deforestation, floods erosion	Deforestation

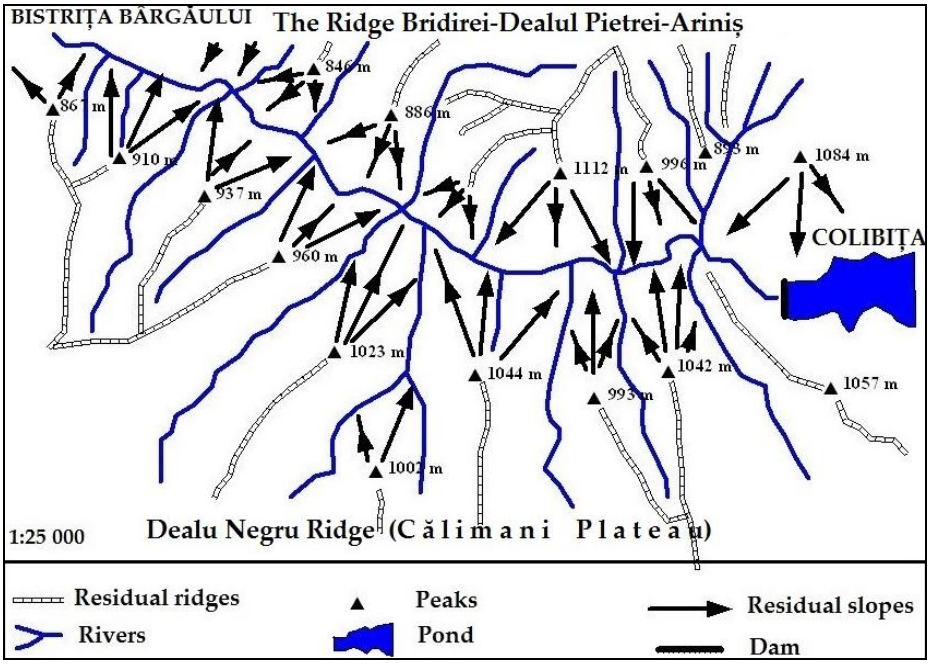

Figure 7. The geomorphological map of Bistriţa Ardeleană Gorge

Table 3. The structure of Geodiversity Action Plan for Bistriţa Ardeleană Gorge

Themes	Objectives	Actions	Timescale	Costs	Partners	Obs.
Enhance local understanding of geodiversity	Rise awareness and interest of local communities, local authorities, and tourists	Field trips, video projections, symposium, development of brochures, location of information boards	2014-2016	in the course of establishment	Primary School of Bistriţa Bârgăului, Babeş-Bolyai University, Bistriţa Bârgăului City Hall, Local Action Group Bârgău-Călimani	
Collecting and managing information on local geodiversity	Implementation of a database	Development of questionnaires Processing information from the locals	2014-2016	in the course of establishment	Primary School of Bistriţa Bârgăului, Prundu Bârgăului Highe School, Babeş -Bolyai University Harta Verde Association	

Conserving and managing local geodiversity	Development of strategies	The establishment of thematic routes, identify high-value geosites	2014-2016	in the course of establish ment	Bistriţa Bârgăului Forest administration Bistriţa Bârgăului City Hall Babeş-Bolyai University Harta Verde Association	
Construction of facilities for tourism and leisure	Tourist exploitation of the area, increasing the income of the local population, promoting the image of the area	Arranging places to rest, observation towers, information boards, camping	2014-2016	in the course of establish ment	Bistriţa Bârgăului Forest administration Bistriţa Bârgăului City Hall Local Action Group Bârgău-Călimani	
Achiving geopark status	Protection and conservation of geodiversity	Drawing up the specific documents	2014-2016	in the course of establish ment	National Agency of Environment, County Council Bistriţa-Năsăud	

CONCLUSIONS

Learning natural values of biodiversity and geodiversity is a necessity, because education is the basis for all planning activities, recovery and conservation of natural heritage. Community awareness of the natural values of its life is a task that must be well established methodological framework with which must operate all who developed cultural and educational activities, management, planning and conservation (teachers, students, guides and tourist entertainers, tourists, managers, planners, nature rangers, professionals, volunteers).

Therefore, a curriculum for learning natural values is particularly important because it provides learning algorithm and ensure goals and objectives for rational use of natural elements and their conservation. The function and utility of this curriculum has been demonstrated in the project Bistriţa Ardeleană Gorge Geodiversity-Action Plan where were involved numerous persons and institutions who have contributed to the identification and evaluation of geodiversity of this area.

Aknowlegements

This contribution presents some results from researches Grundtvig Project LENA-Learning nature values in Europe 2012-2014, and The Geodiversity Audit and Action Plan of Bistriţa Ardeleană Gorge Project, developed in partnership between Bistriţa Bârgăului Local Council and Babeş-Bolyai University, Faculty of Geography-Faculty of Physical Education and Sport, Bistriţa Extension. The author wished to thank to Harta Verde Association Bistriţa, Romania, for opportunity to participate at this project, and to anonymous reviewer for their thoughtful suggestions and comments.

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