GENERAL AND PARTICULAR IN THE INVENTORY AND ASSESSMENT OF GEOSITES IN SOUTHERN DOBRUDJA, ROMANIA

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Abstract

The values attributed to a site/geographic location, in terms of importance, interest and use, result from its perception and exploitation by man. These values express a possible synergy between the geological and geomorphological, bio-ecological and historical-cultural heritage and confers the geosite identity to that site/place.

The present paper analyzes the main methodological guidelines in geosites research at international and national level and proposes for South Dobrudja a method for investigating geosites that highlight the personality of this space. The final value of each geosite, which individualizes it at the level of the South-Dobrudja space, is given by its intrinsic values and its utility on the line of social and tourist valorisation.

Keywords: *geosites, values, criteria, South Dobrudja.*

1. Introduction

The relief is a *tripartite construct* with a clear *polysemy* resulting both from its *qualities* at a geographic site/location (forms, processes of particular importance for understanding of Earth's history) and its *roles* as a factor in the emergence and the development of a geographic location/site with significant (interest) elements/objectives from the point of view of biodiversity, the aesthetic superlative of the landscape, the history of man/society.

The polisemy of relief (Fig. 1) is highlighted by *geosite* research studies.

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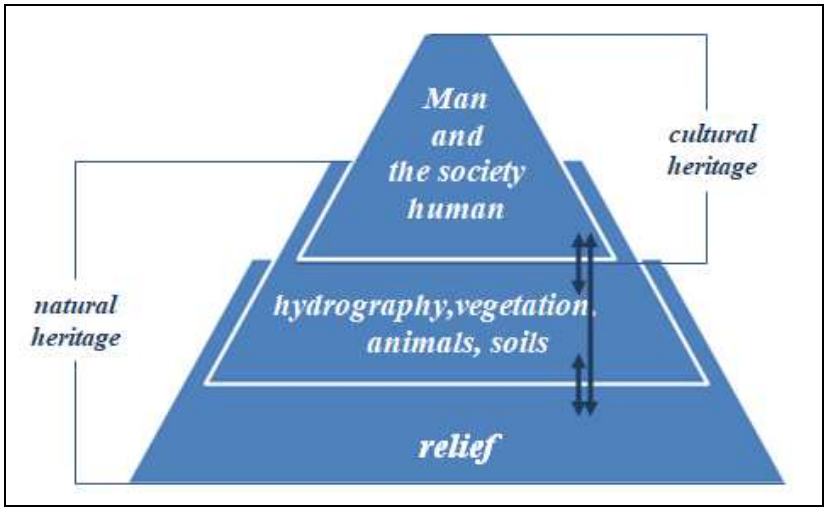

Fig. 1. The polysemy of the relief

The geosites are defined as geographical locations (portions of the geosphere) which, through the perception and interpretation process, are of particular importance for understanding the history of the Earth, the climate and the life (Grandgirard, 1997a, 1997b, 1999; Reynard, 2004a, 2004b, 2005) and/or the evolution of human and human's society (Panizza and Piacente, 1993, 2004, 2008). They are considered a ,,bridge" between scientific research and culture (Panizza and Piacente, 2005), the particular importance of these geographical locations being given not only by the particular aspects of the relief (geology, forms, processes), but also by other scientific, aesthetic, ecological, cultural or socio-economic characteristics deriving from their perception or exploitation by man.

The geosites are, in essence, sites that include relief forms/processes, hydrographic/ botanical/faunistic elements, objectives or anthropic facilities that have acquired a special value through the perception or exploitation of humans (Panizza and Piacente, 1993) and may constitute national or world heritage objects (Grecu, Iosif, 2014a).

The geographical locations designated as geosites are a result of human assessment (Reynard, Coratza, 2013), their research being limited to scientific value (geological and/or geomorphological importance) or extending to their value dimension of an ecological, aesthetic, socio-cultural or economic nature.

By highlighting qualitatively and quantitatively Dobrudja's geosites, it reveals the particular characteristics in a wider context of their analysis in other territorial units, where the relief justifies the variety of geosites.

2. Significance of the geosite's inventory and assessment: What? Why? How?

The inventory and assessment of geosites is in itself a complex process ,,which is between the scientific analysis and the evaluation of the historical, artistic or cultural heritage" (Bruschi and Cendrero, 2005, p. 294). In Grandgirard's opinion (1999) this investigation a geosites has to answer three questions: *What?* (which objects should be inventoried and evaluated), *Why?* (what is the research objective/scope) and *How?* (which method is used).

What objects are subject to inventory and evaluation? The inventory of geosites aims to produce a census of the natural (geological, geomorphological, hydrological, botanical, faunistic, pedological) and/or anthropic objectives of special interest within the studied territories which constitute an essential database on ,,an aspect of the natural heritage generally less well known" (Grandgirard, 1999, p. 61) or an element of cultural heritage that deserves to be promoted and known to present generations and preserved to be passed on to future generations. As a result, in addition to the geological and geomorphological features, they are also considered in an inventory and those goods of scientific, ecological, aesthetic, cultural, economic interest that value the reviewed geographic locations. Analyzing the methods used for the inventory and assessment of geosites and and especially which sites are subject to inventory and evaluation, Martin (2013) distinguishes two approaches (Fig. 2).

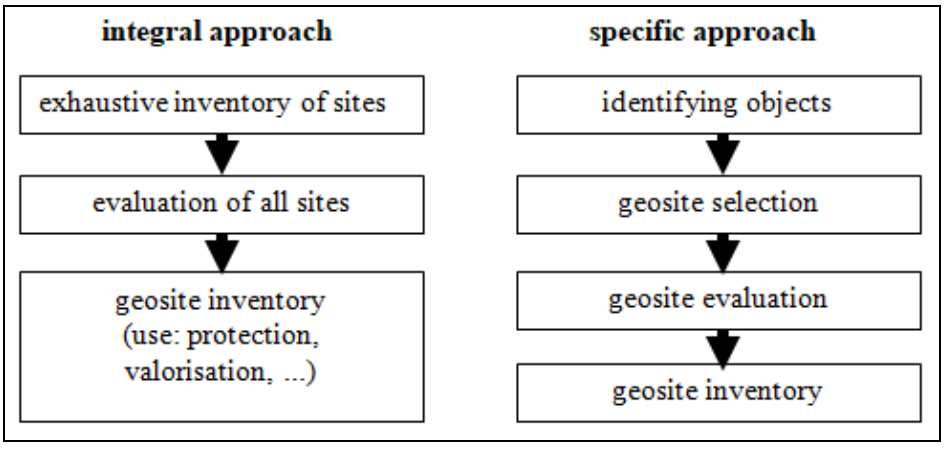

Fig. 2. General and particular in inventory and assessment of geosites (Martin, 2013)

In an *integral* working manner, all sites with geologically and geomorphologically importance are identified[2], inventaried and evaluated. Such an approach is at the level of restrictive research which aim to protect sites containing elements or processes of scientific (geological and/or geomorphological) value for the Earth sciences[3]. Without a prior selection, all geological and/or geomorphological sites in a territory are classified, reviewed and evaluated, being considered as potential geosites.

Such an *complete exhaustive inventory* is difficult to accomplish, considering both the complexity and the spatial and temporal dynamics of forms and processes in a territory, as well as the complexity of the human and financial resources that would involve such an approach. Also, the large budget for such an inventory can sometimes lead to automatism in the evaluation (Wiederkehr, Dufour, Piégay, 2010).

The *specific approach* operates in advance to identify and select sites. Only geosites are identified and evaluated, meaning sites of some importance in terms of scientific, ecological, aesthetic, cultural, economic etc. This approach leads to *thematic inventories* (Kozlik, 2006), the identification and the selection of sites being focused either on a certain type of object (eg structural geosites, paleontological geosites, geomorphosites etc.) or on certain values that give them the characteristic of natural and/or cultural heritage objects. In view of geosite exploration for tourism valorisation, Grecu and Josif (2014a) also believe that a first step in research is the selection of the most important geosites, and the assessment should only include inventory geosites.

Why? (which is the objective/field of research). Studies on inventorying and evaluating of geographic locations with geosite valences and heritage value began at the end of the 20th century. At their onset, the researches focused on highlighting the scientific importance of geological/geomorphological objects and have been geared towards protecting the most important and vulnerable sites, because „by its complexity, dynamics and sensitivity, the natural environment and its history represents a patrimony for human societies" (Martini, 1994, quoted by Grandgirard, 1997b, p. 47). At these environmental impact assessments studies and regional inventories (Strasser et al., 1995; Rivas et al., 1997; Cendrero and Panizza, 1999) have joined those carried out in the context of designing projects/territorial planning (Stürm, 1994; Grandgirard, 1999). Gradually, the inventory and evaluation accounted not only the scientific value/quality of the sites, but also their additional values: ecological, aesthetic,

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[2] With the help of maps (geological, geomorphological, topographical) and specialized literature / other documents (González-Trueba and Serrano Cañadas, 2008), based on field observations and analyzes.

[3] It's presented in Grandgirard's work (1997a, 1997b, 1999), the proposed method for inventory and evaluation of geosites comprising five steps: *the classification of objects, the inventory / census, object evaluation, geosites selection and geosites characterization*.

cultural etc. (Reynard et al., 2007). In the context of the need for management strategies geared to geodiversity, geoconservation, geoeducation or geotourism, the research has expanded, including aspects of the use or potential of using the sites (Bruschi and Cendrero, 2005; Serrano and González-Trueba, 2005; Pralong, 2005; Pereira et al., 2007; Reynard et al., 2012).

How? (which method is used). From the theoretical and methodological developments existing in the studied literature, it is clear that the geosite inventory and the evaluation method must be consistent with the objectives of the assessment and adapted to the geographic reality of the studied space. Among the methods established in the literature are those of the IAG (International Geomorphological Association) work group. These methods were proposed by: Bruschi and Cendrero in 2005 (University of Cantabria), Coratza and Giusti in 2005 (University of Modena and Reggio Emilia), Pralong in 2005 (University of Lausanne), Serrano and Gonzales-Trueba in 2005 (University of Valladolid), Reynard et al. in 2007 (University of Lausanne), Pereira et al. in 2007 (University of Minho).

Inventory and geosites/geomorphosites evaluation has prompted the interest of many european specialists, with different methodologies or working procedures being proposed by Zouros (2007), Vujičić et al., (2011), Erhartič (2010), Rybár (2010), Kubalíková (2013), and in the mapping of geomorphosites by Carton et al. (2005) and Regolini (2012).

In Romania, the studies of geosites with geomorphological interest (called geomorphosites, Panizza, 2001) in order to protect and preserve them, and especially for the purpose of promoting (geo)tourism, are based on methodological approaches adapted to the physico-geographic and socio-economic particularities of spaces studied and were carried out by geomorphology specialists from the University of Bucharest (Comănescu, Dobre, 2009; Comănescu, Nedelea, 2010, 2012; Comănescu et al. 2009, 2011a, 2011b, 2012, 2013, 2017; Grecu, Iosif, 2014a, 2014b, 2015, 2016; Iosif, 2014; Grecu, 2017), the University of Oradea (Ilieş, Josan, 2007, 2008, 2009; Ilieș et al., 2009 etc.), the University of Cluj Napoca (Cocean, 2011, 2012; Cocean și Surdeanu, 2011 etc.).

Viewed as a whole, geosite evaluation is strongly influenced by the way it is made. Grandgirard (1999) makes the difference between an *approach based on expert judgment* and a *systematic approach*. If in the first case the sites are proposed by experts (eg the Geotope inventory in Switzerland, which was developed by the working group on the protection of geotopes on the basis of proposals made by experts, Berger et al., 2011), a systematic approach requires extensive activity investigation based primarily on bibliographic research and field observations. All the methods proposed by the members of the IAG work group are based on a systematic approach.

The Working Group on „*Geomorphological sites: research, evaluation and improvement*" created in 2001 within the IAG focused on the creation of a

standardized method for geosites inventory and assessment. This method was to limit to the maximum the subjectivity of the investigator (Reynard et al., 2006).

Given that each research approach pursues certain research objectives (protection, preservation, promotion, valorisation), it focuses on certain research areas (which differ in terms of relief and territorial expansion), or concerns only certain sites (for example, predominates investigations focused on the identification of geomorphosites), a standard and unitary methodology remains only at the stage of desideratum. Current geosite inventory and assessment methods have common fields of vision and operationalization of research, but ultimately each presents specific features related to the context of research, the stages of research and, in particular, the valuation values and criteria.

3. Analyzes and general data. Values and criteria for geosites assessment – examples from the literature

Inventory and evaluation are the two stages of geosite investigation. Inventory is, in fact, the *qualitative assessment* stage of geographic locations in a particular territory, considered *special*, potential patrimonial objects. The end of this process is the inventory, a geosite's database in that territory, grouped and classified according to different criteria. This inventory becomes *the tool* used in the second stage of *quantitative assessment* research, when quantifying the qualities/ values that each geosite possesses. This quantitative evaluation provides the necessary information in actions related to site's management strategies (protection and conservation and/or promotion and valorisation). The methodological developments regarding the quantitative/numerical assessment of sites have been increasing over the last decade, but yet there is still no unanimously accepted method used by the European Geo-Sciences community. Overall, quantitative assessments are designed to ensure that subjectivity is minimized in the research act and are based on assigned values based on criteria and indicators, to which numerical scores/parameters are applied (Coratza and Giusti, 2005; Bruschi and Cendrero 2005; Serrano and González-Trueba, 2005; Pralong, 2005; Reynard et al., 2007; Pereira et al., 2007; Zouros, 2007; Pereira and Pereira, 2010; Bruschi et al. 2011; Fassoulas et al., 2012; Pereira and Pereira, 2012; Kubalíková, 2013; Reynard et al., 2014; Brilha, 2015 and others).

Each assigned value is evaluated by different criteria, each criterion is described by several indicators, each indicator is quantified by a numeric parameter (receives a score). The values considered, the number of criteria, the indicators or the scores given differ from one method to another, these aspects of the assessment being directly correlated with the research objectives or with the spatial context (inventory and assessment of geosites at local, regional or national level).

An analysis of the set of values attributed to the geosite evaluation highlights the fact that the identity of a geosite[4] it's given by three coordinates/value axes that take into account: geosite properties as an object belonging to the natural sciences[5] (*intrinsic values*), geosite utility (*use /management values*), geosite protection (*protection value*) (Figure 3).

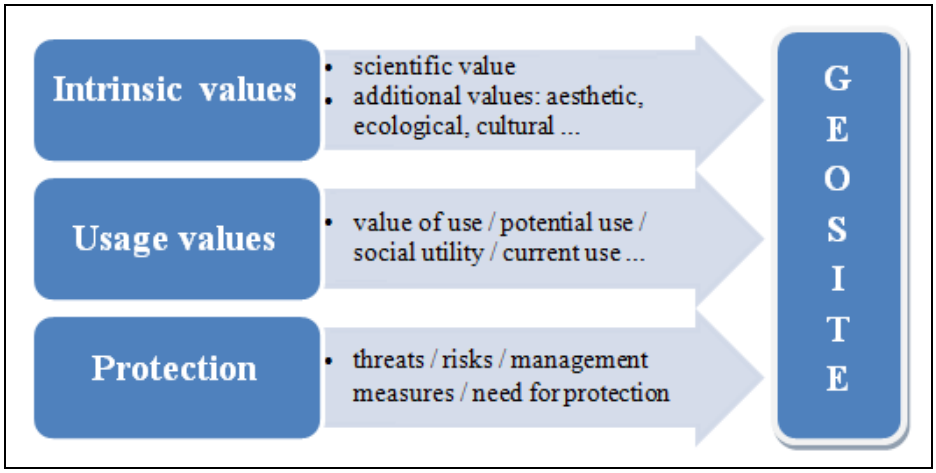

Fig. 3. Value coordinates in geosites evaluation

Regardless of the area, the context, and the objectives of the research, all methods evaluate the scientific value of an object/ site that derives from its status as a witness of Earth's history (provides information on geology or geomorphology of the site, past climatic and environmental conditions), evolution / development of life (plants and animals), of human history, respectively of human society.

Reynard (2005) proposes the distinction between the scientific value, *the central value* which bases an object or geographic location/site as a geosite and the other values (aesthetic, ecological, cultural or economic) which come in addition to the central value. Grecu and Iosif (2014a) consider the scientific value as a *primordial value* for a geosite, which may have a significance/interest in sciences (geology, geomorphology, biology, history, technology etc.). The scientific value *can not be null* (in this case, the site is not considered geosite), unlike other values that may have little or no representation (Reynard et al., 2007).

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4 Designated as: *global value* at Reynard et al., 2007; *total value* at Coratza and Giusti, 2005, at Serrano and González-Trueba, 2005, by Pereira et al. 2007, at Comanescu et al., 2012 and others; *the value or merit* of geosite at Bruschi and Cendrero, 2005.

5 Instinct values are considered to be the values/qualities of the natural elements (Sharples, 2002) or only those belonging to Earth sciences (Perret, 2014).

The identification of sites with a high scientific potential and quantification of their value it's achieved by various criteria. For example, we have detailed the criteria for assessing the scientific value of geosites used in studies conducted in different European countries (Table 1).

Table 1

Criteria assigned to assess the scientific value of geosites

Coratza and Giusti, 2005 (Italy)	**Serrano and González-Trueba, 2005 (Spain)**	**Reynard et al., 2007 (Switzerland)**	**Pereira and Pereira, 2010 (Portugal)**	**Grecu, Comănescu and collaborators 2009-2016 (Romania)**
• The value for scientific research • The educational value • Rarity • Surface area (% of total area) • Grade of conservation • Visibility • Value added (ecological, historical, cultural, economical)	• Genesis • Morfology • Dynamics • Timeline • Litology • Geological structure	• Integrity • Representativeness • Rarity • Paleographical value	• Integrity • Representativeness • Rarity • Number of intersting geomorphological features (diversity) • Other geological features with patrimonial value • Scientific knowledge in specialized publications	• Integrity • Representativeness • Rarity • Pale-ontological interest • The ecological interest • Education Geo-history

As it can be seen, there are some common criteria: integrity, representativeness, rarity. These are considered by Grandgirard (1999)[6] to be discriminatory criteria because they allow the evaluation of the value of a geographic place from the point of view of the Earth sciences and clearly distinguish it from the other places in the studied territory.

If, in a first phase, the researches aimed to inventory and the evaluatopn of geosites only in terms of their scientific value from the point of view of the

[6] In Grangirard's view (1997a, 1997b, 1999) any geographically natural object is unique and can be considered as a geosite. From this approach perspective, are evaluated as geosites only those portions of the geosphere that are of particular importance for understanding the geo(morphological) evolution of the Earth. Panizza și Piacente (1993, 2004, 2008) extend this restrictive definition (name given by Reynard, 2004b) and considers geosite any site witch, due to its perception by, has a certain value. In this new acceptance, the value of a geographical place can have different origins: ecological, aesthetic, historical, socio-cultural or economical.

Earth's sciences, insisting strictly on the geological and/or geomorphological value of the sites (Strasser et al., 1995; Grangirard, 1997, 1999), the interest of the specialists gradually turned to the added values that a geographic place can hold, which are called by Reynard (2004b, 2005) *additional values*. In this category are included values that derive from the particular significance, in ecological, aesthetic, cultural / historical, socio-economic terms, acquired by certain parts of the geosphere through perception or exploitation of man. The significance of these values may be as precious as scientific value (Reynard et al., 2006) in the context in which they represent the identity or emotional load of a site that may be lost in the event of damage to/ destruction of the site (Perret, 2014). Additional values (aesthetic, ecological, cultural, economic) are considered in some methods as independent values or are included in the assessment of the scientific value of geosites. Their evaluation is carried out individually, each value being evaluated on the basis of well-defined criteria (in the methods of Reynard et al, 2007; Serrano and González-Trueba, 2005; Pereira et al., 2007) or summary, by less defined criteria (in the methods of Coratza and Giusti, 2005; Bruschi and Cendrero, 2005). The visible differences between these methods also appear from the point of view of the criteria used, the scoring scale (scores/marks on the indicators).

Giusti and Calvet (2010) consider that the additional values derive from *the quality* of the relief as the natural, cultural and economic resource relief and they propose a differentiation in *societal values* and *cultural values*. According to the two specialists, the societal values refer to the geosite characteristics relevant to the environment, education, economy, society (ecological value, educational, economic, social) and cultural values combine all other aspects of aesthetic, historical, identity, cultural, political, religious etc.

At the value of a geosite (global value/ total value), *use / management* values are also considered, accompanied by a special attention to *protection*.

Most studies focus on geosite valuation in a touristic and recreational context, the different values (scenic, scientific, cultural, economic) contributing to the overall *tourist value* that expresses the touristic potential of a geosite, along with the *value of exploitation* (Pralong 2005, 2006).

Also the researches made by Serrano and González-Trueba (2005) on geosites in Spain introduce in the assessment *the value of use*, quantified on the basis of criteria including protection aspects: accessibility, fragility, vulnerability, intensity of use, risk of degradation, state conservation, impact, visibility, acceptable change limits. Bruschi and Cendrero (2005) separately

evaluate different criteria for both *the potential use/ social utility*[7] of a geosite and *the potential risks and protection measures*[8].

The same research vision is recalled in the methods proposed by Portuguese geomorphologists. So, in geosite assessment, besides the intrinsic values (scientific, ecological, aesthetic, cultural), the *potential for use* (by criteria: accessibility, visibility, use of other natural or cultural values) and *the need for protection* (by criteria: degree of deterioration , level of protection)[9], or *the management value* given by the *use value* and the *protection value*[10] is evaluated, the criteria used being the same.

Numerous studies have also been carried out in Romania, at the Faculty of Geography of the University of Bucharest, within the research project ,,Inventoring, Evaluation and Mapping of Geomorphosites. Case studies: the Dobrodjea Plateau and the Southern Carpathians". *The management and utilization value* is taken into account when assessing *the total value* of the geomorphological geosites (geomorphosites) in the Ponoare protected area, for which the following criteria are proposed: conservation degree, site protection, vulnerability/ natural hazards, intensity of use, use of value aesthetic, cultural and economic relations, the relationship with planning policies (Comănescu et al., 2012). The methodology developed by Comănescu and his collaborators is based on the specialized scientific literature, but with adaptations imposed by the geographic specificities of the spaces for which the inventory and evaluation of the geomorphosites was made. A particular criterion is the one that takes into account *the relationship between geomorphic geosites and hazards* (Grecu 2017). Geomorphological processes/hazards create geomorphosites, which, by further modeling, can generate other geosites on another evolutionary/dynamic scale or can destroy the geosite. In this case, with the palaeogeographic method, both the initial geosite and the dynamic stages can be determined until the geosite is destroyed, especially in the river geosites (Fig. 4), such as meanders, waterfalls etc. (Grecu 2017, 2018, Grecu, Iosif 2016).

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7 Criteria for assessing the potential for use: the activities that can be carried out, the observation conditions, the accessibility, the extension, the proximity of the infrastructure, the socio-economic condition / conditions of the region.

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9 Pereira et. al., 2007.

10 Pereira et. al., 2007.

Fig. 4. Geosit fluvial – Meanders cashed – San Juan River, Goosenecks State Park, Utah, USA (Malavoi, Bravard 2010)

Analyzing the values and criteria proposed for the assessment of geosites in different European methods, Perret (2014)[11] advances the idea that geosites can be defined as well-known and visited sites with various arrangements, as well as less known, arranged or frequented sites, because all these sites have a set of intrinsic values. Both categories of sites can be equally useful for valuing heritage and, as a result, Perret considers that use and protection values should be perceived rather as site features and not as values in itself, as the relevant assessment criteria highlight useful aspects for management on the valorisation and protection of these sites.

In line with this geographic reality well-perceived by Perret, the most recent methodological developments (Perret and Reynard, 2014, Reynard et al., 2014, 2016, Clivaz and Reynard, 2017) intent to evaluate *the intrinsic value of geosites* and related *features use and management*, which take into account the protection of sites (highlighted by the state of protection, damage and threats) along with their promotion (assessed by visiting conditions – accessibility, security, context, tourist infrastructures – through facilities and interests).

4. Particular analyzes and results. Inventory and assessment of geosites in Southern Dobrudja

The notion of geosite has a double acception, which determines that research involves different values and criteria, and there *is no unique method of research*. The methodological differences also concern the spatial context of research, in terms of enlargement (national/regional/local research) and its geographic reality (different characteristics in geological, geomorphological, ecological, socio-cultural and economic

[11] He analyzed the geosite assessment methods proposed by: Serrano and Gonzalez-T., 2005; Reynard et al. 2007; Zouros 2007; Bruschi and Cendrero 2005; Pereira et al. 2007; Pereira et al. 2010; Reynard et al. 2012.

context of the studied space). Based on Serrano and González-Trueba (2005), territorial and cultural relations are much stronger when the geosite's assessment is carried out on a regional scale than on a national scale.

The territory of South Dobrudja presents a mosaic of sites of great diversity, generated by how the relief was formed and evolved, how it allowed and favored the development of other natural environmental components, and last but not least the way in which man exploited his natural characteristics in order to satisfy his needs of existence, material and spiritual living[12]. As a result, it requires a detailed scientific study in a more comprehensive optics focusing on the entire value potential resulting from the combination of natural features with anthropogenic intervention and the existence of geosites.

By building our research on a transversal and integrated approach to the relief, and referring to the sites that define the geographic personality of the study region, we propose an evaluation method inspired by the established methods, but designed to highlight the specificity of the South Dobrudja Plateau and to allow us to make a complete inventory of geosites.

The staging of the research is adapted according to the methodologies proposed by Grecu (2014a, 2014b) and Comănescu et al. (2009, 2011a, 2011b, 2012, 2013) and it includes the following steps:

1. *stage of documentation* – of primary importance for any research; includes three specific steps/ actions:

- **a.** bibliographic documentation (study of the reference bibliography for highlighting the geological, geomorphological, ecological, cultural and economic particularities of the study region);
- **b.** cartographic documentation (studying geological, geomorphological, topographic maps, including satellite imagery);
- **c.** field documentation which allows us to make concrete observations and analyzes from the point of view of the objective reality existing on the field.

2. *stage of geosites inventory* is prior to the assessment and is concretized through three basic actions:

- **a.** identifying potential geosites and locating them on the topographic map;
- **b.** selection of geosites – considering the list of geosites to be evaluated; the most representative geosites for the studied area are considered in terms of their interest/ importance for science in *lato sensu*[13] (geology, geomorphology, hydrology, biology, history, architecture, technology);
- **c.** geosite characterization – by completing the inventory sheet.

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[12] South Dobrudja is recognized as an ancient habitation space, multiethnic and multicultural space.

[13] Studying geosites explores the links between Earth sciences and society. History, architecture, or technology, we consider social sciences and, together with geo-sciences, demonstrate the multiple functionality of relief (perceived as a natural, cultural and economic resource, Reynard, 2005), the polisemy and its tripartite architectural dimension

3. *the geosite assessment stage* (quantitative/numerical assessment);

4. *the stage of synthesis* comprising comparative analyzes, correlation statistical analyzes, hierarchies

5. proposals for valorisation of geosites from a scientific and economic perspective (tourism).

We propose an inventory sheet inspired by the work of several researchers (Reynard, 2006; Reynard et al., 2007; Kozlik, 2006; Pralong, 2004, 2005, 2006; Comănescu et al. 2009, 2011, 2012; Cocean, 2011, 2012; Iosif, 2014) and adapted to the needs of our research.

This Geosite Inventory File consists of three parts/sections: I – *General Data*, II – *Evaluation of Intrinsic Values*, III – *Assessment of Socio-Tourist Use*. If general data are informative/descriptive, the evaluation data is of analytical nature.

The characterization of geosites takes into account the category, the degree of complexity, the spatial extension. In order to characterize *the complexity of geosites* we take into consideration the categories proposed by Grandgirard (1997a): *simple/isolated* geosites (eg Cernavoda fossil areas – Figure 5, Movila Banului, Aliman, Credința, Lake Gâldău), *complex geosites* (eg Marine Dune from Agigea, Marine Area Costinesti – 23 August – Fig. 6, Techirghiol Lake), *system geosites* (eg Canaralele – Fig. 7, Marine Area Vama Veche – May 2).

Fig. 5. The Cernavodă Fossil Point

Fig. 6. Marine Area Costinești – 23 August

Fig. 7. Canaraua Fetii

Regarding the spatial extension of geosites, Reynard states that ,,there is no standard size [...], no minimum or maximum size" (Reynard, 2004b, p. 125). From the literature we consulted, we note that, after their *spatial extension*, geosites can be *punctual*, with a small area, under 1 ha (eg Limanu Cave/La Icoane, Sarcofage Cave, Movile Cave – Fig. 8), *linear* (eg Canaraua Fetii, Valu lui Traian, Anghel Saligny's Bridge – Fig. 9, Danube-Black Sea Canal), *areas* (eg Fântâniţa-Murfatlar Forest, Agigea Marine Dune, Techirghiol Lake).

Fig. 8. The Movile Cave

Fig. 9. The *Anghel Saligny's Bridge*

To significantly reduce subjectivity we opt for the second stage of the investigation for a numerical assessment. The proposed evaluation values and criteria are taken from the assessment methodologies established in the literature, with adaptations imposed by the geographical (natural, socio-economic) particularities of the studied region.

The final value of each geosite is given by its intrinsic values and its utility on the line of social and tourist valorisation.

We present below the values and criteria used for the assessment of geosites in South Dobrudja:

Scientific value. This value allows us to highlight the scientific qualities of the site that promotes it as a geosite. The scientific interest of a geosite lies in its natural features (geo (morpho)logical, biological, hydrological, pedological), as well as in the distinctive scientific note of a historical and technological nature resulting from the exploitation of that geographic place by man (Table 2).

Table 2

Definition of specific criteria for assessing scientific value

CRITERION	EVALUATION
Integrity ($V_{ști}$)	This criterion takes into account the state of conservation of the features that promote the site as geosite (after Reynard 2006)
Representativeness ($V_{ști_2}$)	This criterion follows the representative character of the site in relation to the study space (based on Reynard, 2006).

Rarity ($V_{ști_3}$)	This criterion refers to the rarity of the object relative to the reference region of the study and is evaluated by reference to the number of similar sites present in the study region. It is based on the existing literature.
Reference model for geo-sciences / biology / history / technology ($V_{ști_4}$)	This criterion takes into account the site's reference value for the progress of science: • allows restoration of past environmental and climatic conditions; • marks an evolution of biology at gender level, plant/ animal species, life cycle, reproduction etc. (Fig. 10); • is a crucial testimony to the reconstitution of the past of humanity and societies; • is a crucial moment in the evolution of methods, materials processing (Fig. 11-12).

Fig. 10. Ferula mikraskythiana – popularly called ,,aerel dobrogean"[14]
(foto Mátis *et al.*, 2017)

Fig. 11. Hobo-type bridge
From Agigea[15]

Fig. 12. Mosque Esmahan Sultan
from Mangalia[16]

[14] The plant was discovered in the Dumbrăveni forest by biologist Mátis and represents a new species for science, being part of the Apiaceae family, the genus Ferula (Mátis et al., 2017); it is a species that has a limited population, only 172 plants and it is located in the Dumbrăveni forest.

[15] It's the first hoban bridge built on a national road in Romania; the construction system is represented by 10 hoban (bundles made of 40 parallel wires, 5 mm in diameter, protected by metal sheaths) which support the bridge's structure;

[16] It represents the oldest Muslim cult site in Romania, in operation today; built in 1525, has walls made up of pieces of stone carved in place by stonemason craftsmen, joined by steel castings poured into the holes made directly into the stone.

Aesthetic value. Reynard (2006) argues that the beauty of a site is relative and depends on the subjectivity of the observer. This subjectivism arises from the fact that the appreciation of beauty is, as a rule, of emotional nature. The proposed criteria for evaluating this intrinsic value (Table 3) are to minimize possible subjectivism by an aesthetic appreciation of a cognitive and practical nature.

Table 3

Definition of specific criteria for assessing aesthetic value

CRITERION	EVALUATION
Vizibility ($Vest_1$)	This criterion allows the evaluation of geosite observation conditions, the existence of natural (vegetation) or anthropic (design/construction) obstacles (processing by Pereira P. and Pereira D., 2010). The highest score is obtained by the visible object from all visual angles (after Coratza and Giusti, 2005).
The color contrast between the site and the surrounding environment ($Vest_2$)	This criterion takes into account the difference in color between the studied object and the environment. The higher the color contrast, the higher the value (after Pralong, 2006).
Vertical development / degradation and spatial structure ($Vest_3$)	This criterion takes into account the height of the object relative to the surrounding space and other similar objects. Consider the monotonous or grandiose aspect (given by the height of the object) and the contribution to the structure of the space. It is based on the existing literature.

Ecological value. This intrinsic value highlights the particular flora, faunistic species, the importance of the site for its diversity and its ecological dynamics based on evaluation criteria (Table 4).

Cultural value. Panizza and Piacente support the idea that cultural value is related to the use of human relief and geological objects as resources, cultural assets being inserted into the physical framework (Panizza and Piacente, 2004). Considering the relationship *the relief = geomorphologic context = support of cultural value*, we consider that cultural value highlights the potential and interest that a site has in terms of archaeological/historical, religious, architectural as a result of its anthropic exploitation/arrangement. Sites with these valences (archaeological/ historical, religious, ethnographic) provide the link between *the past* they testify and *the future* represented by their valorisation /use on the basis of criteria (Table 5).

Table 4

Definition of specific criteria for assessing ecological value

CRITERION	EVALUATION
The ecological interest ($Veco_1$)	This criterion takes into account the importance of the site in the development of unique or particular ecosystems, the presence of particular flora and/ or fauna species, ecological diversity is based on existing literature.
Protection and conservation ($Veco_2$)	This criterion highlights the legal status of site protection for ecological reasons, the official recognition of its ecological value. It is based on the existing literature.

Table 5

Definition of specific criteria for assessing cultural value

CRITERION	EVALUATION
The archaeological and historical importance ($Vcult_1$)	This criterion defines the existence and importance of archaeological vestiges, historical edifices present in the evaluated site. For the archaeological vestiges is also taken into consideration the importance derived from the literature (processing after Pralong, 2006)[17].
The religious importance ($Vcult_2$)	This criterion allows the assessment of geosite's role in the spiritual life of man. It is to be seen whether the site represents/ shelters a religious settlement (religious buildings, places of worship with a special value for the multiethnic valency of the studied region).
The architectural importance ($Vcult_3$)	This criterion is whether the site represents/shelters an architectural edifice/construction with architectural elements of interest[18].

The geosites sum up a scientific, social and educational capital that requires promotion and valorisation, which ,,contributes significantly to the increase of the power of regional identity" (Coratza, 2004, p. 221). In view of some proposals for promotion and valorisation of geosites in South Dobrudja, we are also looking at the second aspect of the evaluation aimed at analyzing the characteristics related to **the usefulness** of these geographic places holding intrinsic values. We propose to approach the utility of geosites from five perspectives: **scientific valorisation, educational value** and **tourism valorisation**. In order to ensure the relevance of future proposals for promotion and valorisation, we considered it necessary to consider besides the three dimensions of utility and aspects regarding **the conditions for visiting** and **the protection** of the sites. In order to ensure the relevance of future proposals for promotion and valorisation, we have decided that it is necessary to consider besides the three dimensions of utility and aspects regarding **the conditions of visiting** and **the protection** of the sites.

By evaluating the **scientific valorisation** it analyzes how the scientific importance of a site is (re) known at the level of the society, that is to say *the social validation* of the scientific value through *the transfer of knowledge* between the scientific community and the civil society (Table 6).

[17] A model site for the organization of material and spiritual life, a model site for the functioning of settlements, which highlights special public utilities for that period, will receive the maximum score;

[18] The site that represents /shelters an architectural edifice of national interest will meet the maximum score.

Table 6

Definition of specific criteria for assessing scientific use

CRITERION	EVALUATION
Knowledge and recognition of the scientific importance of the site (Vf. șt.$_1$)	This criterion allows the assessment of (re)knowledge of geosite's role in society by including and integrating its scientific significance in: international/national papers/studies/articles; regional development plans/strategies (Region SE)/county/local (at the level of administrative-territorial unit) or by the existence of a site management plan/rehabilitation and restoration plan.
The site's contribution to education and training (Vf. șt.$_2$)	This criterion is intended to include scientific information in learning contents at different levels of education.

Educational value is given by the usefulness of a site because it has, as a result of human perception, a formative-informative value/significance, meaning it can play a role when in the transmission of knowledge with effects in the formation and development of cognitive, affective-attitudinal acquisitions. We support this approach based on the presence of educational value, in an explicit or implicit manner, in most methods of geosites investigation. The argumentative aspects are:

- sites of particular or special interest are sites ,,defined on the basis of scientific, educational and recreational interest" (Rivas et al., 1997, quoted by Reynard, 2005);
- for Coratza and Giusti (2005), Zouros (2007) or Pereira et al. (2007) the educational value contributes to the evaluation of the scientific quality (value) of a geomorphosite;
- Serrano and González-Trueba (2005) consider geomorphosites as an educational resource and introduce educational elements in assessing the cultural value of a geomorphosite;
- Reynard (2006; Reynard et al., 2007) includes the educational value in the synthesis of the evaluation, along with the global value, risks/threats and management measures, and considers that this criterion evaluates ,,the importance of the subject for education and training".

The proposed criteria for the evaluation of educational value (Table 7) take into account the two forms of education (formal and non-formal) that contribute to the formation of personality, according to individual and social needs.

Table 7

Definition of specific criteria for assessing educational value

CRITERION	EVALUATION
The importance as a didactic tool (Ved.$_1$)	This criterion is to perceive the site as a model tool for explaining some forms of relief or processes/events/facts.
The importance as a non-formal educational resource (Ved.$_2$)	This criterion considers the quality of a site that makes it suitable for inclusion in educational itineraries (on tours or thematic/transdisciplinary visits)

Taking into account the fact that the geosites have a stock of exploitation potential and from an economic point of view, we propose the evaluation of **the tourism valorisation** of the sites designated as geosites. The criteria followed for the evaluation of the tourism valorisation refers to the (re)knowledge of the site by its quality as a tourist destination, as well as the presence of the tourist infrastructure with accommodation and public alimentation function (Table 8).

Table 8

Definition of specific criteria for assessing tourism valorization

CRITERION	EVALUATION
Knowledge and recognition of the site as a tourism objective / resource (Vf. tur.$_1$)	This criterion allows the site to be assessed in terms of its quality of tourist destination or tourist objective.
Tourist infrastructure with accommodation and public alimentation function (Vf. tur.$_2$)	This criterion is based on accommodation units and public catering facilities existing in the vicinity of the site.

If a geosite has a certain utility through its value potential, proof of this utility is also given by the aspects that concern **the visiting conditions**. A comfortable access and the security conditions during the visit contribute significantly to the added value of the site (Table 9). For the unaltered preservation of intrinsic values held by a geosite, its **protection** features are of particular importance (Table 10).

Table 9

Definition of specific criteria for assessing visiting conditions

CRITERION	EVALUATION
Accesibility (Cond.$_1$)	This criterion takes into account: the time to walk to the site; difficulty of travel: defined road/trail, slope, vegetation; the need for special equipment
Security/ safety while visiting (Cond.$_2$)	This criterion takes into account the level of site security to the extent of proper behavior.
Limitation while visiting (Cond.$_3$)	This criterion is based on the existence of legal and financial visitation restrictions[19].

Table 10

Definition of specific criteria for the evaluation of site protection

CRITERION	EVALUATION
The existing protection (Prot.$_1$)	This criterion takes into account the level of protection of the site from the perspective of the legal status, the form of ownership.
Possible threads (Prot.$_2$)	This criterion tracks the possible threats to the integrity of the site caused by natural hazards or use for tourism purposes[20].

[19] A site with total visitor restrictions, with access only to specialists, has a null score for this criterion, but as a site regulated as a heritage asset – by its intrinsic value – is given the maximum score when assessing existing protection (criterion 1);

Conclusions

Inventory and assessment of geosites is a "*bold challenge*" (Grandgirard, 1999). By opening the geomorphology to social life (Panizza and Piacente, 2004), a geographic place is studied also through the relations between the geo(morpho)logical component and spatial and temporal development with the other natural elements, but also with the archaeological, historical, spiritual elements etc. resulting from human actions/experiences. This approach is a consequence of the fact that, over time, *the formula of man-nature binomial* has changed, in essence the relationship between man and his environment has gained new connotations. Relief along with other abiotic and biotic components is an integral part of man's existential manifestations.

The analyzes made in this study reveal:

- the diversity of criteria to be considered in inventory geosites,
- selecting the criteria to be applied according to the local specificity imposed primarily by the natural environment conditions,
- the geosite's assessment is often imposed by the applicative character of the geosite, which results from the concrete utility for society; it is the case of geosites in Dobrudja where the historical social component has its mark on geosite diversity,
- the concept of geodiversity continues and develops on a different level the concept of geosite.

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[20] A site with a high exposure to natural hazards and / or damage generated by tourism use is considered to have a very high threat of degradation and receives a null score.

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