Tangible Heritage of the Historical Stonework Centre in Brusno Stare in the Roztocze Area (SE Poland) as an Opportunity for the Development of Geotourism

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Abstract
The investigation relates to the human-environment relationships in the development of geotourism. The study is focused on the stonemasonry heritage of the historical Stonework Centre in Brusno Stare – a former, now non-existent village, abandoned after World War II, in SE Poland. The “stonemasonry” heritage was included into the potential Kamienny Las na Roztoczu Geopark. Preparation of these usable, sacral, sepulchral objects, as well as the quarry requires geological and historical interpretation to become cultural geosites. The aim of the present study is to highlight the importance of the interpretation of these objects based on the combination of knowledge in the fields of geology, history, and culture. This objective has been achieved by querying available literature, inventory, and assessments of geosites. The conceptual spatial-temporal model has been proposed to illustrate the holistic approach to the potential cultural geosites considered in the manuscript. The results obtained in the study indicate the scientific, educational, and geotouristic potential of the stonemasonry heritage of the ancient Stonework Centre of Brusno Stare. Popularization and promotion of these objects is needed to make them attractive cultural geosites and contribute to the development of geotourism in the Roztocze area.

Keywords Geoheritage · Stonework · Cultural geosites · Geotourism · Roztocze area

Introduction

The research issue undertaken in the study is associated with the attempts to create the Kamienny Las na Roztoczu Geopark (Krapiec et al. 2012). When the concept of geopark was being developed in 2010–2011, a detailed inventory of geosites was made. The project of the geopark was commissioned by the Ministry of the Environment (at present the Ministry of Climate). It was designed in cooperation between researchers from the AGH University of Science and Technology in Kraków, Polish Geological Institute-National Research Institute – Carpathian Branch in Kraków, Institute of Nature Conservation of the Polish Academy of Sciences in Kraków, and Maria Curie-Sklodowska University in Lublin. The spatial range of the investigations covered the central and southern parts of the Roztocze area in SE Poland (Fig. 1a). Twenty-five out of the 166 geosites inventoried by the first author of the article are related to the ancient Stonework Centre in Brusno Stare (Fig. 1b and Table 1). They include local quarries as well as utilitarian (elements of buildings) and artistic (tombstones, statues, roadside crosses) sites with stone products, mainly from the nineteenth century.

Stone objects produced in the ancient Brusno Stare Stonework Centre (Mazur 2008) are an important element of the local geoheritage. Some of stone objects (the wall with gates, a mortuary building, and historical tombstones) are part of the Greek Catholic tserkva (church) complex in Radruż village (Fig. 1b) included in the UNESCO World Heritage List in 2013 (UNESCO World Heritage List. http://whc.unesco.org/en/list/1424).
In this study, the quarries and stonework objects manufactured in Brusno Stare may become cultural geosites. The importance of these cultural geosites is evidenced by the relationship between geological resources and the use thereof by humans (e.g. Lugon and Reynard 2003; Panizza and Piacènte 2003; Pralong 2004; Reynard et al. 2009; Zgłobicki et al. 2015).

When included in the geotourism offer, they can expand knowledge about the ancient Stonework Centre in Brusno Stare, contribute to promotion of its products, and consequently play a role in protection of the local geoheritage through a combination of geoconservation, geo-history, and geointerpretation1 (likewise the 3G’s concept after Hose 2012). This is in line of the research trend consisting in a holistic approach to geotourism (Pralong 2006; Hose 2012; Dowling 2013; Gordon 2012, 2018; Telecka 2017).

The main objective of the study is supported by specific aims: (1) characterization of geological resources promoting the development of the ancient Stonework Centre in Brusno Stare, (2) presentation of the history of the Stonework Centre, (3) characterization of the traits and forms of stonework products from Brusno Stare, and (4) quantitative assessment of inventoried cultural geosites.

The tasks addressed in the study will contribute to popularization of the stonemasonry heritage. Simultaneously, through the consolidation of the public memory of the ancient Stonework Centre, they may prompt actions for preservation and conservation of its heritage.

**Methods**

Primary and secondary data sources were used to achieve the study goals. The primary sources included 25 geosite inventory cards. The secondary data sources comprised publications related to geotourism, geoheritage, and historical geosites, as well as publications on the history and function of the ancient Brusno Stare Stonework Centre.

During the field inventory events, each geosite was documented in terms of its location (geographical information system, GIS; town, commune), genesis, physical traits (size, surface area, geological/historical age, lithology, and rock...
structure), and current status (form of ownership, protection status, preservation state, accessibility for visitors, location relative to existing infrastructure). Additionally, photographic documentation was collected for each of the 25 inventoried cultural geosites.

The method proposed by Brilha (2016) was used for the quantitative assessment of the cultural geosites in the Roztocze area. This is a specific method to quantify the values, creating an integrated proposal for the quantitative assessment of all types of geosites. The quantification process was based on 37 criteria (7 criteria were used for scientific value, 12 for education values, 13 for touristic values, 5 for degradation risk) with numerical parameters ranging from 1 to 4 (Brilha 2016). The final value for each cultural geosite derives from the weighted sum of each criterion, with a maximum score of 400 points. Each criterion has a specific weight for the scientific value (SV), potential educational use (PEU), potential touristic use (PTU), and degradation risk (DR). Based on the numerical result, the values and the degradation risk of the cultural geosites were classified into one of four classes: very low, low, moderate, and high (Tables 1 and 2).

Additionally, a conceptual spatial-temporal model illustrating the holistic approach to unique cultural geosites was proposed. Cartographic methods were employed as well to demonstrate geographic position of the studied area, the geospatial distribution of the analysed geosites in relation to geological settings, and the range of influence of the ancient Stonework Centre in Brusno Stare (Fig. 1).

| No. | Name of geosite                                                                 | Type of object               | Scientific Value | Potential Educational Use | Potential Touristic Use | Degradation Risk |
|-----|--------------------------------------------------------------------------------|------------------------------|------------------|---------------------------|-------------------------|------------------|
| 1   | Miocene organic limestone in the quarry on Brusno Hill                          | Quarry                      | 185              | 235                       | 220                     | 165              |
| 2   | Remains of a farm stone fence in Huta Lubycka                                   | Usable                      | 50               | 95                        | 155                     | 85               |
| 3   | Remains of stone residential and farm buildings (fence walls, cellars, walls) of the Greek Catholic church complex on Monaster Hill |                             | 55               | 95                        | 155                     | 85               |
| 4   | Stone fence around the Greek Catholic church in Wola Wielka                      |                             | 60               | 135                       | 185                     | 130              |
| 5   | Ruins of the Greek Catholic church complex and gravestones in the cemetery in Dziewieczierz-Moczary | Sacral                      | 60               | 125                       | 185                     | 130              |
| 6   | Ruins of the Greek Catholic church and gravestones in Huta Rozaniecka            |                             | 60               | 125                       | 185                     | 130              |
| 7   | Ruins of the Greek Catholic church and gravestones in Kniazie                   |                             | 60               | 105                       | 165                     | 100              |
| 8   | Limestone wall and tombstones in the Greek Catholic church complex in Radruż      |                             | 130              | 145                       | 185                     | 130              |
| 9   | Limestone gravestones at the Greek Catholic church in Belżec                    |                             | 50               | 120                       | 180                     | 125              |
| 10  | Limestone gravestones at the Greek Catholic church in Wola Wielka               |                             | 60               | 125                       | 185                     | 130              |
| 11  | Limestone Jordan Chapel in Dziewieczierz-Moczary                                |                             | 60               | 95                        | 155                     | 85               |
| 12  | Limestone gravestones in the cemetery in Belżec                                 | Sepulchral                   | 50               | 130                       | 190                     | 140              |
| 13  | Limestone gravestones in the cemetery in Horyniec-Zdrój                         |                             | 55               | 125                       | 185                     | 130              |
| 14  | Limestone gravestones in the cemetery in Kniazie                                 |                             | 55               | 105                       | 165                     | 100              |
| 15  | limestone gravestones in the cemetery in Łubycza Królewska                     |                             | 60               | 125                       | 185                     | 130              |
| 16  | Limestone gravestones in the cemetery in Lówcza                                 |                             | 55               | 105                       | 165                     | 100              |
| 17  | Limestone gravestones in the cemetery in Narol                                  |                             | 50               | 125                       | 185                     | 130              |
| 18  | Limestone gravestones in the cemetery in Prusie                                  |                             | 55               | 125                       | 185                     | 130              |
| 19  | Limestone gravestones in the Greek Catholic cemetery in Radruż                   |                             | 60               | 115                       | 175                     | 115              |
| 20  | Limestone gravestones in the cemetery in Siedliska                               |                             | 55               | 125                       | 185                     | 130              |
| 21  | Limestone gravestones in the cemetery in Stara Huta                              |                             | 50               | 95                        | 155                     | 85               |
| 22  | Limestone gravestones in the Greek Catholic cemetery in Brusno Stare            |                             | 60               | 95                        | 155                     | 85               |
| 23  | Limestone gravestones in the cemetery in Werchrata                              |                             | 60               | 125                       | 185                     | 130              |
| 24  | Limestone Poniński chapel in the cemetery in Horyniec-Zdrój                     |                             | 55               | 125                       | 185                     | 130              |
| 25  | Temple of the Sun in Nowiny Horynieckie                                          | Place of worship             | 80               | 115                       | 155                     | 85               |
Table 2. Classification of scientific (SV), educational (PEU), touristic (PTU) values, and degradation risk (DR) into four classes: very low, low, moderate, and high.

| Range | Values and degradation risk |
|-------|-----------------------------|
| 0–100 | Very low                   |
| 101–200| Low                         |
| 201–300| Moderate                   |
| 301–400| High                       |

Adapted from Brilha (2016)

Study Area

The ancient Stonework Centre was located in Brusno Stare village in the Roztocze area. The region is situated in south-eastern Poland and north-western Ukraine. It appears in the landscape as a distinct upland range spreading from NW to SE, between Kraśnik (Poland) and Lviv (Ukraine) (Fig. 1a). In Poland, three subregions with diverse natural features are distinguished – Western Roztocze, Central Roztocze, and Eastern Roztocze.

Brusno Stare was located in Eastern Roztocze. This area is characterized by the highest altitudes in the region – 390 m a.s.l. (Wielki Dział, Kragly Goraj Hills). The main terrain forms include flat-topped hills, tablelands, dry valleys, ravines, and karst forms (caves) associated with the physical and chemical features of rocks and sediments (see Geological Settings). For the purposes of the local stonemasonry, Miocene detrital limestones and sandstones were excavated in the quarry on Brusno Hill (Fig. 1b and c, and Table 1).

The historical context is also important from the point of view of the function of the ancient Stonework Centre in Brusno Stare village (Fig. 1b). Before World War II, the area of Eastern Roztocze was inhabited by different nationalities, e.g. Poles, Ukrainians, Jews, and Germans. They contributed to the specific traits of the cultural landscape (type of settlement network, land-use structure, sacred object scenery) (Skowrońska-Wójcik and Kociuba 2001). Aeolian formations, i.e. sands, also forming dunes, are characteristic for the depressions and valleys of central Roztocze, whereas loess covers are typical of the western part of the region.

In Eastern Roztocze, Miocene detrital limestones and sandstones were used in the ancient Brusno Stare Stonework Centre. The Miocene limestones are composed of bioclasts (fragments of algae and mollusc shells) on average accounting for 70–90% of the rock. Its characteristic trait is the variable content of quartz grains through the vertical section (up to 10%). Its chemical composition is dominated by CaCO₃ (over 90%), whereas the content of SiO₂ ranges from 10 to 30%. In terms of physical characteristics, limestones are characterized by high apparent density (about 1.9 Mg/m³), porosity (35.68%), mostly moderate and high absorbability (14.25% weight absorbability; 25.25% volumetric absorbability), poor frost resistance (12–25 cycles), and high abrasiveness, especially after extraction (Musial 1987). Owing to the two latter features, the rocks were an easy-to-handle stonework material; nevertheless, when subjected to “ageing” in natural weather conditions, the rocks became durable and resistant to external factors. They were mainly used for production of tombstones, statues, and roadside crosses.

Geological Settings

The Roztocze region located within the Trans-European Suture Zone (TESZ) was included in the study (Berthelsen 1992). Its current features are associated with the Mesozoic-Cenozoic stage of development. It was unevenly raised in the late Miocene-Pliocene as a large-scale flower structure covering the original Mesozoic-Cenozoic synclinal area (Jankowski and Margielewski 2015). This structure, which is rooted into deep substrate, creates fault zones of different rank, enclosing and dissecting the area of Roztocze.

The formations exposed on the Roztocze surface are dominated by Late Cretaceous carbonate and carbonate-siliceous rocks (93–65 million years ago). They are characterized by variable thickness ranging from 600 to 900 m in the western part of Roztocze region to 1400 m in the south (Gutowski et al. 2005). The Cretaceous rocks are covered by heavily eroded shallow water sediments of Paleogene (Eocene, 55–34 million years ago) and Neogene (Miocene, 8–12 million years ago) seas (Fig. 1b). The oldest formations, i.e. Eocene sands and sandstones, are characteristic for the eastern part, whereas the younger Miocene limestones and coquina beds, as well as sands and sandstones, are typical for the southwestern part of the region (Wysoka et al. 2007). Pleistocene deposits are present only on hills (residual moraine covers of Mindel and Riss glaciations) and in deep valleys (sands, gravels, and clays with a thickness of over 30 m) (Brzezińska-Wójcik and Kociuba 2001).
Ensuring the and a source of income. Stonework skills were passed from farmers, and the stone craft was their additional occupation to the demand for statues and roadside crosses (Kawałko eighteenth century), the enfranchisement of the peasantry, and al grounds out of development areas (initiated at the end of the nineteenth and twentieth centuries increased at the turn of the nineteenth and twentieth centuries). The first group is represented by remains of stone residential and farm buildings (fence walls, cellars, wells) (Table 1 and Fig. 2b), which were produced in the nineteenth century. Nowadays, they are dispersed across the area and exhibit different states of preservation.

Another group comprises sacral and secular buildings or their fragments. These include ruins of a Basilian Monastery on Monster Hill near Werchrata dated to the end of the sev-enteenth century, foundations of the church and belfry in Wola Wielka village from 1775, ruins of St. Paraskevi Greek Catholic stone churches in Kniazie village (with a belfry and stone posts in the fence) from 1806, ruins of St. Nicolaus Greek Catholic church in Huta Różaniecka from 1835.
Fig. 2 Cultural geosites associated with the Stonework Centre in Brusno Stare. (a) View of the quarry of Miocene detrital limestones on Brusno Hill (geosite no 1). (b) Stone fence around the Greek Catholic church in Wola Wielka (geosite no 4). (c) Ruins of the Greek Catholic Church and gravestones in the cemetery in Huta Rozaniecka (geosite no 6). (d) Ruins of the Greek Catholic church of Elevation of the Holy Cross in Dzwiecięrz-Moczary (geosite no 5). (e) Stone wall at the gate around the Greek Catholic church in Radruz (Wooden Tserkvas of the Carpathian Region in Poland and Ukraine – UNESCO World Heritage List. http://whc.unesco.org/en/list/1424) (geosite no 8). (f) Limestone gravestones in the cemetery in Lubycza Krolewska (geosite no 15). (g) Limestone gravestones in the cemetery in Werchruta (geosite no 23). (h) Examples of nineteenth century crosses decorated with bas-reliefs of Christ and with relief images of Christ and two Marias in the cemetery in Radruz (geosite no 19). Photograph a, e, and h by Ewa Skowronek and b, c, d, f, and g by Teresa Brzezinska-Wojcik.
(Table 1 and Figs. 1a and 2c), ruins of the Greek Catholic church of elevation of the Holy Cross in Dziewięcierz-Moczary village from 1838 (Fig. 2d), and Poniński’s tomb chapel in Horyniec-Zdrój village. The stone fences of sacral buildings, such as those in Łowcza and Wola Wielka villages (Fig. 2b), Radruż village (Fig. 2c), and Dziewięcierz-Moczary (Table 1 and Fig. 1b) are characteristic of the area’s heritage. The rocks excavated in the area of Brusno Stare were also used to build drives and country roads, e.g. from Jarosław to Belżeć in 1861–1863 (Kawalko 1995) in Galicia, i.e. a historical and geographical region between Central and Eastern Europe.

Arts and crafts have become the hallmark of Brusno Stare. They are primarily sepulchral works, mainly sacral sculptures, associated with the Greek Catholic and Roman Catholic rites. Additionally, there are examples of artistic tombstone work commissioned by the former German evangelical minority and matzevah stones in Jewish cemeteries.

The field inventory reveals that the sixteenth-century crosses in Prusie village (Table 1 and Fig. 1b) are the oldest artefacts of artistic stonework. Their shape resembles the Maltese cross. They were manufactured in this form until the first half of the nineteenth century. Similar crosses can be found in the cemeteries in Brusno Nowe, Dziewięcierz-Moczary, Horyniec, Huta Różaniecka (Fig. 2d), Kniazie, Lubyca Królewská (Fig. 2f), Łowcza, Plazów, Siedliska, Werchrata (Fig. 2g), and Wola Wielka and in cemeteries at Greek Catholic churches, e.g. in Belżeć and Radruż villages, or cemetery remnants in Brusno Stare (Table 1 and Fig. 1b). Crosses with a widened vertical beam decorated with bas-reliefs depicting Christ appeared in the first half of the nineteenth century. The crosses have trefoil-shaped or bevelled arm edges. They can be found in all the aforementioned cemeteries. At the end of the nineteenth century, crosses were made of a single block of limestone; they were placed on pillars with bas-relief images of Christ or Christ with two Marias (Fig. 2h), and their arms were straight, trefoil-shaped, and bevelled. Such gravestones can be found in all Greek Catholic cemeteries in Eastern Roztocze, besides the one in Prusie village.

At the beginning of the twentieth century, another type of tombstones appeared, i.e. a cross on a pedestal resembling a pole. Pedestals in the form of stone mounds and crosses resembling wood with bark-shaped carving were introduced as well. Such tombstones can be found in the cemeteries in Radruż, Werchrata, Brusno Nowe, Lubycza Królewská, Łowcza, Horyniec, Belżeć, and Kniazie (Table 1 and Fig. 1b).

A separate group was represented by Jewish matzevah stones, i.e. grave stelae, which became popular in the eighteenth century. Most of them are a collective work of Christian stonemasons from Brusno Stare and Jewish craftsmen, i.e. the authors of Hebrew inscriptions (Reinfuss 1989). In the nineteenth century, the matzevah stones became more richly ornamented. Motifs connected with the rich symbolism of Jewish culture such as lions, birds, crowns, palms in the gesture of blessings, and candlesticks were used (Mazur 2008).

A well-preserved group are the evangelical tombstones in the cemetery in Brusno Nowe, originating from the 1820s and 1840s. Besides the typical crosses, there are also stelae (Mazur 2008).

There are also tombstones and monuments made during World War I, for instance, the crosses from 1917 with German inscriptions on the site of the former Basilian Monastery on the Monaster Hill and the monument commemorating Polish soldiers fallen in the battles in 1918–1919 in Horyniec-Zdrój.

The rich stonework assortment from Brusno Stare also comprises numerous stone crosses as well as sculptures of saints and chapels, which were commonly located at roads and crossroads. They were erected as an expression of gratitude for regained health or abolition of serfdom, for example, in the Łowcza and Radruż villages, and at murder, suicide, and defeat sites. There are also penitential and grave figures (Kawalko 1995; Mazur 2008) as well as shrines associated with rites such as the Feast of Epiphany in Dziewięcierz-Moczary village.

It is important to cherish the memory of the outstanding stonemasons from Brusno Stare – for instance, one of the most famous craftsmen, Grzegorz Kuźniewicz (1871–1948), called the “Artist”. He made many tombstones and monuments in the Polish part of Roztocze and in the USA (1907–1912) (Kawalko 1995).

The diversity of Brusno Stare stonework was also influenced by the presence of Jews. They owned or rented large quarries (e.g. before World War I, the quarries were rented by Szmaja Bienstock and Józef Reichbach in Brusno Stare and Azriel Klingberg in Radruż). Additionally, they produced matzevah tombstones (e.g. in the first decade of the twentieth century, Jankiel Bienstock and Jan Grabowiec) or made millstones (e.g. at the beginning of the twentieth century, Szmaja Bienstock and Józef Reichbach, cf. Olszewski (1912)).

This report confirms the view that the stonemasonry heritage in Eastern Roztocze is a testimony to the multicultural character of the region. Despite the severe damage left by World War II, the state of preservation of Brusno Stare heritage at the beginning of the twenty-first century can be regarded as satisfactory.

**Results**

The inventoried cultural geosites are located in Eastern Roztocze, approximately 20 km away from the Stonework Centre in Brusno Stare (Fig. 1b).

The final values for the scientific value (SV), potential educational use (PEU), potential touristic use (PTU), and
degradation risk (DR) were calculated (Table 1). Next, the results were classified into one of four classes: very low, low, moderate, and high (Table 2).

The assessment indicates that:

- At present, the scientific value of almost all planned geosites is very low, with the exception of two localities (the quarry on Brusno Hill and the elements of the Greek Catholic church complex in Radruż), which were assigned a low value.
- In accordance with the adopted evaluation criteria, a vast majority of the geosites exhibit a low value for potential educational use, except for the quarry on Brusno Hill, which was assigned a moderate potential value. Five of the listed objects (2, 3, 11, 21, and 22, see Table 1) had the lowest scores.
- Except for the quarry, all inventoried geosites were assigned a low value for potential touristic use.
- Low and the lowest values for degradation risk were assigned to as many as 16 and 9 of the 25 geosites, respectively.

It therefore seems necessary to develop appropriate criteria for a more comprehensive assessment of the cultural geosites. It can be assumed that the degree of attractiveness of the designed geosites analysed in the study would significantly increase if the assessment included cultural features, e.g. their connection with the history of the region and the local modes of production activities (e.g. crafts/industry), the material heritage (monuments), and the immaterial heritage (tradition, folklore), as well as the specific features of the local community (national and religious diversity). Such attempts have already been made, as evidenced by investigations conducted by Dmytrowski and Kicińska (2011) as well as Łabęcka and Terpiłowski (2017).

**Discussion**

The example of the use of the stonemasonry heritage of Brusno Stare described in this paper represents the increasingly popular trend of creating cultural geosites (Nita and Mygat-Piątek 2014; Mero et al. 2018). Among the current list of world geoparks, only some were created exclusively based on geosites with unique natural resources (UNESCO Global Geoparks List. http://www.unesco.org/new/en/natural-sciences/environment/earth-sciences/unesco-global-geoparks/list-of-unesco-global-geoparks/). In a majority of geoparks, elements of nature and culture are combined, thus creating a sense of place, as underlined by Hose (2012) and Dowling (2013). Areas created in this way serve geotourism as defined by the National Geographic Council (after Mero et al. 2018).

This concept was taken into account in the project of the Kamienny Las na Roztoczu Geopark. The inventory indicated a complex of thematically related objects associated with the Stonework Centre in Brusno Stare, whose uniqueness and potential promote the development of geotourism.

The evaluation of the cultural geosites revealed their low geological and tourist attractiveness as well as scientific value, in contrast to data presented by Sá dos Santos et al. (2016) or Mero et al. (2018). This may result from the relatively poor knowledge of Eastern Roztocze and its tourist resources. An important factor that would facilitate their more effective use in tourism is the education of the residents and tourists in the area covering the natural and historical assets of the area.

The study emphasizes the importance of the holistic approach and proper interpretation of cultural geosites combining knowledge of geology, history, and culture. The stonemasonry heritage in Brusno Stare incorporates memories of the village and crafts that functioned and were recognizable in SE Poland in the past but do not exist at present (Fig. 3).

In the past, the residents used the easily processable local detrital limestones to specialize in stonemasonry and, hence, the ancient Stonework Centre in Brusno Stare became famous for the craft (Fig. 3a). This changed during and after World War II when the village ceased to exist. The absence of man led to the loss of the continuity and significance of all elements associated with the previous human presence (Fig. 3b). The place has fallen into oblivion and, consequently, the sense of place has been lost. Currently, the interest in the area’s unique
heritage is a motivation for acquiring knowledge about local craftsmen and their products, which consequently ensures the proper interpretation of the place. Such actions bring together the preserved elements of the former human-environment relationships and provide awareness of their real importance. They should be the basis for creation of cultural geosites (Fig. 3c). These activities are part of geoeconomics, shaping geotourists’ attitudes in terms of proper interpretation and protection of geosites, which was emphasized by Gordon (2018). As demonstrated by the analyzed example, the display of only geological resources at some geosites, without the cultural context, may lead to loss of the sense of place.

Conclusions

Here, in this study there have been described and valorised several new geosites associated with the ancient Stonework Centre in Brusno Stare. The valorisation results indicate their low geological, touristic, and scientific value. It would have been higher if a holistic approach had been applied, as emphasised in studies in other areas. Therefore, the results of the study confirm the necessity of creation of cultural geosites in their full natural, historical, and cultural context (see Fig. 3). Due to the growing tourists’ interest in Eastern Roztocze (Brzezińska-Wójcik et al. 2017), taking steps for development of geotourism in this area seems advisable. The best solution would be to continue efforts to create the Kamienny Las na Roztoczu Geopark.

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References

Berthelsen A (1992) From Precambrian to Variscan Europe. In: Blundell D, Freeman R, Mueller S (eds) A continent revealed. The European Geotrailor. University Press, Cambridge, pp 153–164
Brilha J (2016) Inventory and quantitative assessment of geosites and geodiversity sites: a review. Geohoritage 8:119–134. https://doi.org/10.1007/s12371-014-0139-3
Brzezińska-Wójcik T, Kociuba W (2001) Transformation of the Roztocze segment of the Wieprz River valley (SE Poland) in the Pleistocene. Prz Geol 49(3):257–266
Brzezińska-Wójcik T, Skowronek E, Świeca A (2017) Diversity of the tourism potential and functions in the Roztocze region. Economic Problems of Tourism 40(4):65–81. https://doi.org/10.18276/eppt.2017.4.00-06
Dmytrowski P, Kicińska A (2011) Geotourism valuation of biotic objects and their significance in prospect of geopark development. Problemy Ekologii Krajobrazu 29:11–20
Dowling R (2013) Global geotourism – an emerging form of sustainable tourism. Czech Journal of Tourism 2(2):59–79. https://doi.org/10.2478/cjot-2013-0004
Gordon JE (2012) Rediscovering a sense of wonder: geotourism and cultural landscape experiences. Geohoritage 4:65–77
Gordon JE (2018) Geotourism and the cultural landscape: enhancing the visitor experience and promoting geocuration. Geosciences 8(4):1–24. https://doi.org/10.3390/geosciences8040136
Gutowsky, Popadyuk I, Olszewska B (2005) Late Jurassic–earliest cretaceous evolution of the epicontinental sedimentary basin of South-Eastern Poland and Western Ukraine. Geological Quarterly 49:16–31
Hose TA (2012) 3G’s for modern geotourism. Geohoritage 4:7–24. https://doi.org/10.1007/s12371-011-0052-y
Jankowski L, Margielewski W (2015) Tectonic position of the Roztocze region in the light of the evolution history of the Carpathian Foredeep. Biuletyn Państwowego Instytutu Geologicznego 462:7–28. https://doi.org/10.5604/08676143.1157483
Jawor G (2000) Osady prawo wołoskiego i ich mieszkańcy na Rusi Czerwonej w późnym średniowieczu. Uniwersytet Marii Curie Skłodowskiej, Lublin
Kawalko D (1995) Brusniacki ośrodek kamienniarski. Zamojski Kwartalnik Kulturalny 3(45):5–8
Krapiec M, Jankowski L, Margielewski W, Urban J, Krapiec P (2012) The stone forest (Kamienny Las) Geopark in Roztocze and its geotouristic values. Prz Geol 60(9):468–479
Łabecka K, Terpiński S (2017) Geotourism potential of the chalk mine in Mielnik (Podlasie lowland). Annales UMCS, B 72(2):57–71
Lew S (1967) Ludowy ośrodek kamienniarski w Bruśiu powiat Lubaczów: Roszcznik Płynownia 11:193–205
Lugon R, Reynard E (2003) Pour un inventaire des géotopes du canton du Valais. Bulletin Murihiemien 121:83–97
Mazur J (2008) Kresowe dziedzictwo. Kamienniarsko brusniackie. Muzeum Kresów w Lubaczowie, Lubaczów
Mero PC, Franco GH, Briones J, Domínguez-Cuesta MJ, Berrezueta E (2018) Geotourism and local development based on geological and mining sites utilization, Zaruma-Portovelo, Ecuador. Geosciences 8(6):1–18. https://doi.org/10.3390/geosciences8060205
Musial T (1987) Miocene of Roztocze (South-Eastern Poland). Biuletyn Geologiczny 31:5–140
Nita J, Myga-Piątek U (2014) Geotourist potential of post-mining regions in Poland. Bulletin of Geography – Physical Geography Series 7: 139–156 https://doi.org/10.2478/bgeo-2014-0007
Olszewski J (ed) (1912) Skorowidz przemysłowo-handlowy Królestwa Polskiego i ich mieszkańców na Rusi Czerwonej. Lwów https://www.pbc. rzeczow.pl/dlibra/publication/2639/edition/2483/content?ref=desc
Panizza M, Piacente S (2003) Geomorfologia culturale. Pitagora, Bologna
Pralong JP (2004) Pour une mise en valeur touristique et culturelle des patrimoines de l’espace alpin: le concept de l’histoire totale. Histoire des Alpes 9:301–225
Panizza M, Piacénte S (2003) Geomorfologia culturale. Pitagora, Bologna
Reinfuss R (1989) Ludowa rzeczka. Mikolajki, Wolin
Reynard E, Regolini-Bissig G, Kozlik L, Benedetti S (2009) Assessment and promotion of cultural geomorphosites in the Trient Valley
Sá dos Santos WF, de Souza CI, Brilha JB, Leonardi G (2016) Inventory and assessment of Palaeontological sites in the Sousa Basin (Paraíba, Brazil): preliminary study to evaluate the potential of the area to become a geopark. Geoheritage 8(4):315–332. https://doi.org/10.1007/s12371-015-0165-9

Skorowidz miejscowości Rzeczpospolitej Polskiej (1924) Województwo Lwowskie, 13. Główny Urząd Statystyczny Rzeczpospolitej Polskiej, Warszawa. http://pbc.biaman.pl/dlibra/docmetadata?id=3113&from=publication

Skowronek E, Furtak T (2009) Determinants of change in the landscape of the Polish-Ukrainian borderland as exemplified by Rawa Roztocze. Journal of Borderlands Studies 24(2):106–125

Skowronek E, Krókowski R, Świeca A (2003) Transformations of cultural landscape: the case of the Polish-Ukrainian borderland. In: Palang H, Fry GLA (eds) Landscape interfaces. Cultural Heritage in Changing Landscapes. Kluwer Academic Publishers, Dordrecht, pp 71–91

Snyder T (1999) “To resolve the Ukrainian problem once and for all”: the ethnic cleansing of Ukrainians in Poland, 1943–1947. J Cold War Stud 1(2):86–120

Sulimierski F, Chlebowski B, Walewski W (eds) (1881) Słownik geograficzny Królestwa Polskiego i innych krajów słowiańskich, Tom 2. Sulimierski and Walewski, Warszawa. http://dir.icm.edu.pl/Słownik_geograficzny/Tom_II/

Sulimierski F, Chlebowski B, Walewski W (eds) (1884) Słownik geograficzny Królestwa Polskiego i innych krajów słowiańskich, Tom 5. Sulimierski, Chlebowski, and Walewski, Warszawa http://dir.icm.edu.pl/Słownik_geograficzny/Tom_V/

Telecka M (2017) Geology in the art of Easter Island: geotouristic aspect. Annales UMCS, B 72(2):73–96

UNESCO Global Geoparks list. http://www.unesco.org/new/en/natural-sciences/environment/earth-sciences/unesco-global-geoparks/list-of-unesco-global-geoparks/. Accessed 29 October 2018

UNESCO World Heritage List. http://whc.unesco.org/en/list/1424. Accessed 15 October 2019

Wesołowska M, Flaga M (2018) Demographic and social degradation in the Lublin province as a peripheral area of East Poland. Bulletin of geography. Socio-economic Series 41:7–27. https://doi.org/10.2478/bog-2018-0023

Wysocka A, Jasiobowski M, Peryt T (2007) Miocene of the Roztocze Hills. Biuletyn Państwowego Instytutu Geologicznego 422:79–96

Zglobiński W, Warowna J, Baran-Zglobińska B, Gajek G, Jezierski W (2015) Cultural tourism and geotourism. Tourist value of cultural geosites in Poland. Turystyka Kulturowa 6:51–67