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Case study

Analysing the possible impact of landslides and avalanches on cultural heritage in Upper Svaneti, Georgia

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ABSTRACT

In this paper, the threat posed to cultural heritage by landslides and avalanches is analysed for two communities (Ushguli and Mulakhi) in the Upper Svaneti region in Georgia. The vulnerability of 60 cultural heritage objects has been evaluated through a conservation calculation based on an existing methodology using a State of Conservation Index (SCIx), which served as an input in a Spatial Multicriteria Evaluation (SMCE). Factors that are considered important for the occurrence of landslides (slope, landcover, lithology and drainage density) and snow avalanches (slope, insolation, slope curvature and landcover) have been used to generate a susceptibility map. A qualitative risk assessment was carried out by combining susceptible areas and cultural heritage objects. As there were very limited historical data available on the occurrence of landslides and snow avalanches, a combination of local and expert knowledge has been used to extract information on both cultural heritage and natural hazards. Existing management plans were also analysed to evaluate how natural hazards could be incorporated. Finally, some recommendations are given related to the analysis of the impact of natural hazards on cultural heritage in Georgia.

1. Research aims

The main purpose of this study is to assess the possible impact of landslides and snow avalanches on cultural heritage sites in two communities (Ushguli and Mulakhi) in the Upper Svaneti region in Georgia. The general approach adopted is based on previous studies for the assessment of the state of conservation of cultural heritage and on Spatial Multicriteria Evaluation (SMCE) and Participatory GIS techniques for the hazard susceptibility areas.

For the present study, this adapted approach was chosen because it allows non-experts in the field of cultural heritage to perform an objective survey on the state of conservation of cultural heritage objects in a data scarce environment. Moreover, the results of the survey can be integrated into a GIS to eventually deliver priorities of intervention based on the vulnerability of the cultural heritage assets to natural hazards. This study aims also to evaluate the prospects of integrating hazard risk aspects of these cultural heritage sites into management plans.

2. Experimental

2.1. Introduction

The preservation of cultural heritage is very important as it represents the legacy of human beings on the planet as well as evidence of their activities in different living conditions and environments [1]. Although cultural heritage is vanishing at a global scale, especially in developing countries there is an increased awareness of the need for preservation as it provides important resources for culture, tourism and the economy [2,3].

The threat to cultural heritage posed by natural hazards is reported in various studies [1,3–9]. Landslides may also represent an important threat to cultural heritage [10], for example in Moscow (Russia), Slovakia, Machu Picchu in Peru, and Umbria in Italy [1]. It is emphasised that the only way forward is to incorporate cultural heritage into disaster mitigation and management approaches [11]. Governmental agencies, cultural heritage and disaster management professionals should work together in order to achieve effective preparedness and mitigation strategies [11]. Moreover, knowing the state of conservation of the cultural heritage features is important information in order to assess their vulnerability in a natural hazard risk assessment context [1,12].

There are relatively few studies concerning approaches for the assessment of the state of conservation of built structures within a cultural heritage context. Existing studies mainly

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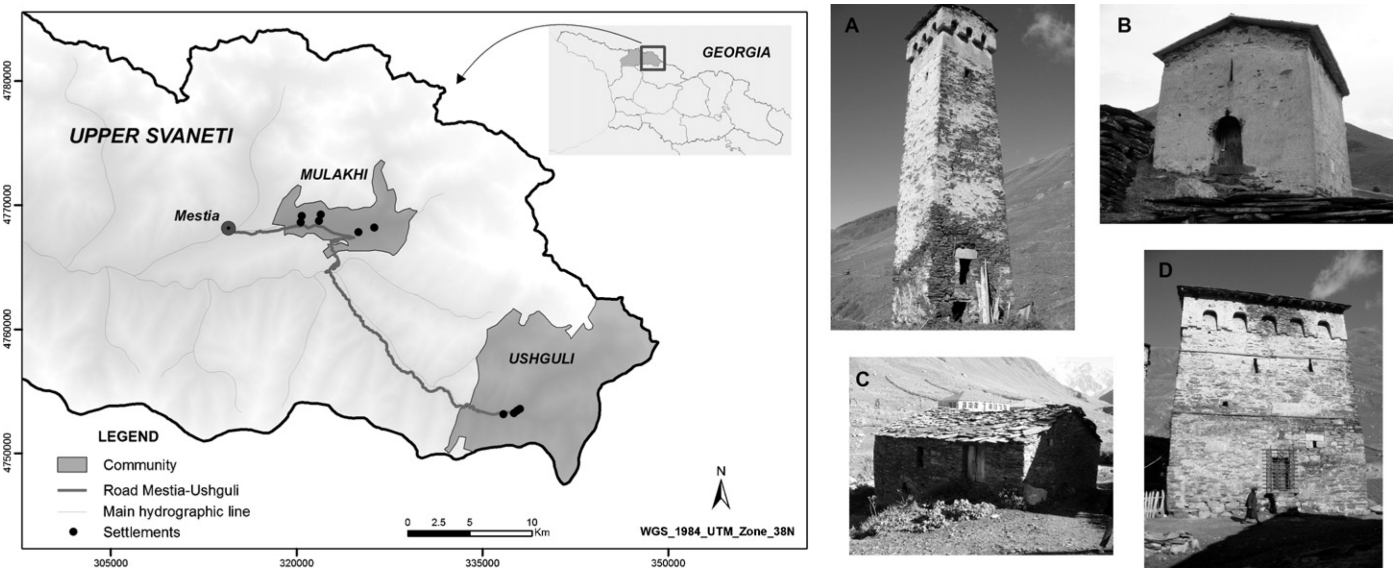

Fig. 1. Location of the study area and examples of heritage objects. A. Tower. B. Church. C. Machubi. D. Fortified dwelling.

concentrate on the assessment of ordinary buildings from an architectural/engineering perspective. Documented working procedures are often quite complex and require considerable expertise and expensive equipment [13,14]. A much more straightforward approach was adopted by Canuti et al. [1] for state of conservation analysis of cultural heritage objects in Machu Picchu (Peru), in relation to their vulnerability to landslides. Using this approach a damage value is defined for each type of element at risk based on an in situ survey catalogue. This methodology is considered efficient in remote environments and when only limited resources are available as it does not require expensive devices and complex procedures. Consequently, it can be considered suitable for application in developing countries.

The state of conservation assessment performed in this study is inspired by the work of Lazzari et al. [12], including some elements of Canuti et al. [1]. Lazzari et al. [12] collected typological characteristics of individual buildings through a field survey using a predesigned questionnaire, which formed the basis for a GIS-based analysis to detect priorities for intervention for structural recovery and management of surveyed buildings in relation to geomorphologic and anthropogenic risk. The vulnerability of the historical buildings was evaluated through a decay index calculation.

2.2. Study area

Georgia is a country of ancient culture, and its precious cultural heritage includes, among others, residential, religious and military architectonic structures spread all over the country. Svaneti is one of the oldest provinces of Georgia, which was spared from the upheavals in bordering regions, due to its isolation located in the high part of the Caucasus Mountains. Therefore many important architectural monuments are preserved in this region, such as prominent churches and residential/defensive architecture, in the form of towers, and fortified dwellings, many of which also date back to the Middle Ages [15]. The study area is located within the Upper Svaneti region (Fig. 1). It comprises the communities of Ushguli and Mulakhi. Ushguli community is located at an altitude of about 2100 m.a.s.l. in the south-eastern part of Upper Svaneti and includes four settlements: Murkmeli, Chazhashi, Chvibiani and Zhibiani. To preserve both the cultural and scenic value of cultural heritage objects in an exceptional mountain landscape the village Chazhashi was included in the UNESCO World Heritage List in 1996 [16]. Mulakhi community (1700 m.a.s.l.) is located in the centre-eastern part of Upper Svaneti, and consists of eleven villages. For practical reasons, in this study six of those eleven villages were considered: Artskheli, Lakhiri, Zhamushi, Chvabiani, Zhabeshi and Murshkeli.

Tourism comprises one of the main economic activities in the study area mainly motivated by the rich cultural and landscape heritage. The cultural heritage objects are classified as towers, fortified dwellings, machubis and medieval churches (Fig. 1 and Table 1). The climate in the area is characterized by high precipitation, long cold winters and relatively short cool summers. Geomorphologic ally, the study area is dominated by fluvio-glacial landforms where glaciers have developed U-shaped valleys with steep slopes. In the higher parts of these valleys (above 3000 m.a.s.l.) and close to the still glaciated areas periglacial processes such as solifluction occur. On the valley slopes at lower altitude surficial landslides and debris flows are very common. On very steep, near to vertical slopes rock fall frequently occurs. The higher parts of the slopes, above the tree line, are also frequently affected by snow avalanches. Where the glaciers retreated denudational landforms have formed. Under the influence of glacial melt and corresponding water erosion, a number of narrow and deep gorges have formed in the landscape. Periodic debris flows and mud flows have formed numerous debris cones at the bottom of these gorges. The outlets of secondary streams in the main valleys are also often characterized by debris cones that are formed by periodic debris flows, mud flows and snow avalanches.

2.3. Data and methodology

The methodology used in this study is represented schematically in Fig. 2. It consists of three interconnected parts. The first part deals with the assessment of the state of conservation of the cultural heritage objects based on a survey and a GIS analysis. The second part deals with the multihazard assessment of the study area based on a community-based approach and SMCE. The hazard maps were combined with the weighted state of conservation analysis resulting from step 1, resulting in a qualitative risk assessment for the cultural heritage objects. The third part deals with the analysis of existing cultural heritage management plans, and to give guidance to authorities about the incorporation of hazard and risk assessment. This methodology although basic in nature is considered to

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Table 1
Cultural heritage objects in the study area. The main characteristics are given as well as the number of objects in the two communities. The number of sampled objects is indicated in brackets.

Cultural heritage objects	Characteristics	Number	
		Ushguli	Mulakhi
Towers	Mostly 4–5 stories, with broad base (5 × 5 m), narrowing towards the top. Floors connected by a hole cut in the ceiling and a wooden ladder. Plain rectangular narrow windows. Walls as thick as 1 meter built of rock rubble (with large stones in lower part) and covered with lime mortar. Gable roof arranged on timber joists and covered with slate slabs. Most are in used for storage of goods	65 (17)	67 (20)
Machubi	2 storied rectangular structures of various dimensions, with wall up to 1 m made of 15–20 cm thick stones covered with lime mortar. Gable or pent roofs with slate slabs arrange in a system of "resting joists". Traditionally used as winter dwelling (first floor) and cattle shelter (ground floor). Most are now used as cattle shelter and storage shed	19 (5)	23 (7)
Fortified dwellings	3–4 stories, approximately 9 × 9 m at base, with walls and roofing similar to Machubis. Only found Ushguli. Now used as cattle shelter, storage building and even as a museum (Chazhashi village)	12 (3)	0 (0)
Medieval churches	Small (approx. 4 × 4 m) one storey-vaulted with thick walls (50 cm) of rock rubble covered with lime mortar. Some keep their original slate roof. No windows, only small slits for ventilation. Most churches are still used for worshipping	19 (5)	10 (3)

be appropriate especially because it can be carried out by non-experts in the fields of disaster and cultural heritage management in data scarce environments. Existing data on cultural heritage and natural hazards in the study area are very scarce. Consequently, most of the data was collected in the field by field mapping and interviews with local inhabitants (see below) and with two experts on cultural heritage and natural hazards in Tbilisi. The latter provided expert information about the main natural hazards occurring in the area of study and the main causes influencing their incidence as well as about cultural heritage objects as elements at risk. Field mapping was carried out in order to detect and record evidences of past hazardous events and to characterize the state of conservation of the cultural heritage objects. Mobile GIS connected to a Global Positioning System (GPS) was used to take coordinates of points of interest. In addition, sketch maps were drawn with the help of local inhabitants in order to determine historical avalanche and landslides pathways. Semi-structured interviews were conducted with twenty-nine local inhabitants in the communities of Ushguli and Mulakhi in order to obtain information about natural hazards and elements at risk. Each interview included nineteen questions

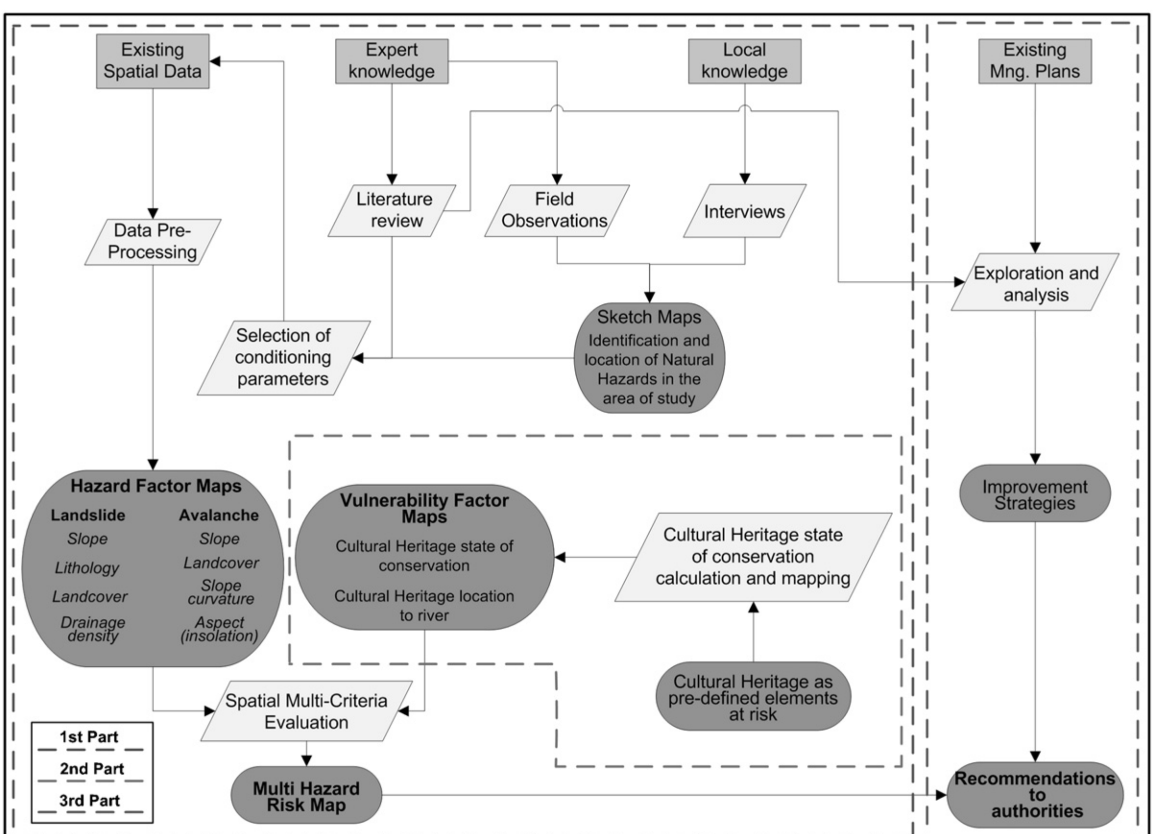

Fig. 2. Schematic flow of the overall research process. The dotted line rectangles show the three different interconnected parts that represent the methodology used.

STATE OF CONSERVATION INDEX - Building No. 4 (Ushguli)							
	Score	Level of decay 1	2	3	4		
Roof (Decay due to lack of maintenance DLM)	(x6)	X				=	6
Decay due to misuse (DM)	(x3)			X		=	9
Decay for masonry moisture/biological degradation (DMBD)	(x3)				X	=	12
Structural damages (SD) (cracks, partial collapses, sinking, tilting)	(x6)		X			=	12
Number of floors (f)	4						
$\sum coef$	22					WEIGHTED TOTAL SCORE (Wt)	39
						STATE OF CONSERVATION INDEX ($SCIx$)	1.77

Level of decay				State of conservation valuation		
1	2	3	4	to 0,89	RUIN	
Very Heavy	Heavy	Moderate	Low	0,90 - 1,83	VERY BAD	X
				1,84 - 2,22	BAD	
				2,23 - 2,82	MODERATE	
				2,83 - 3,51	GOOD	
				3,52 - 4,00	VERY GOOD	

The state of conservation index is obtained dividing the weighted total score (Wt) by the sum of the coefficients ($\sum coef$) and number of floors (f)

Fig. 3. Example of State of Conservation Index (SCIx) calculation.

divided in three sections related to hazard general information, hazard exposure information and hazard perception. The information extracted from the interviews and sketch maps was used to identify and locate natural hazards and elements at risk as well as to define the conditioning parameters serving as input in the Spatial Multicriteria Analysis in the multihazard risk index analysis.

In order to assess the state of conservation of individual cultural heritage features in the field, a survey sheet was designed based on previous studies [1,12]. The survey sheet has two major parts: the first part aims to gather general information about the cultural objects such as its typology, number of floors, presence of restoration works, human use and topographic position. The second part focuses on the level of damage of the objects on a scale from "Very Heavy" to "Low". The parameters assessed include cracks, partial collapses, sinking, tilting, roof damage, humidity degradation and biological degradation. Due to the rather simple building structure of the objects assessed, these parameters are considered appropriate to perform a basic state of conservation assessment [12]. In Ushguli, a total number of 30 cultural heritage objects were surveyed in the four villages included in the community, covering 26% of the total. In Mulakhi community, also 30 cultural heritage objects were surveyed in six of the eleven villages included in the community, covering 30% of the total. Based on Lazzari et al. [12], a State of Conservation Index (SCIx) was calculated for each individual cultural heritage object assessed. Four major decay/damage classes were considered:

- building decay due to damaged roof [17];
- building decay due to misuse (e.g. as animal shelter) [18,19];
- building decay due to moisture effects and biological degradation [1,12,19];
- observed structural damage, such as cracks, partial collapse, sinking and tilting [1,12].

The next step in the calculation was to assign weights to each one of the above decay/damage classes. The weights were given based on the level of decay varying from "Very Heavy" to "Low" (1 to 4) and these were multiplied by an amplifying factor based on literature sources [1,12,19], expert opinion, and the results from the data gathered through the survey sheets (Fig. 3). As shown in Fig. 3, the *SCIx* was obtained dividing the weighted total score (*Wt*) by the sum of coefficients ($\sum coef$) determined by the sum of the score plus the number of floors (*f*):

$$SCIx = Wt/\sum coef \quad \text{where} \quad \sum coef = 18 + 4 \tag{1}$$

The number of floors is added to the summation of scores considering the height of the object as an aggravating factor in the state of conservation of the building. Moreover, the number of floors was also considered related to the maintenance of the roof (easiness/uneasiness of access). The quantitative evaluation of the state of conservation of the cultural heritage object ranges from 0 to 4 and was classified into six groups, corresponding to a qualitative scale ranging from "Ruin" to "Very Good" (Fig. 3).

A mobile GIS configuration (a pocket computer with ESRI's ArcPad 7 software) connected to a GPS receiver was used to take coordinates of each one of the cultural heritage objects examined. The GPS points recorded were transferred into ArcGis10 and the attribute table was filled with attributes such as survey sheet-id, village name, community name, type of feature, and SCIx. The results were used as input in the Spatial Multicriteria Analysis.

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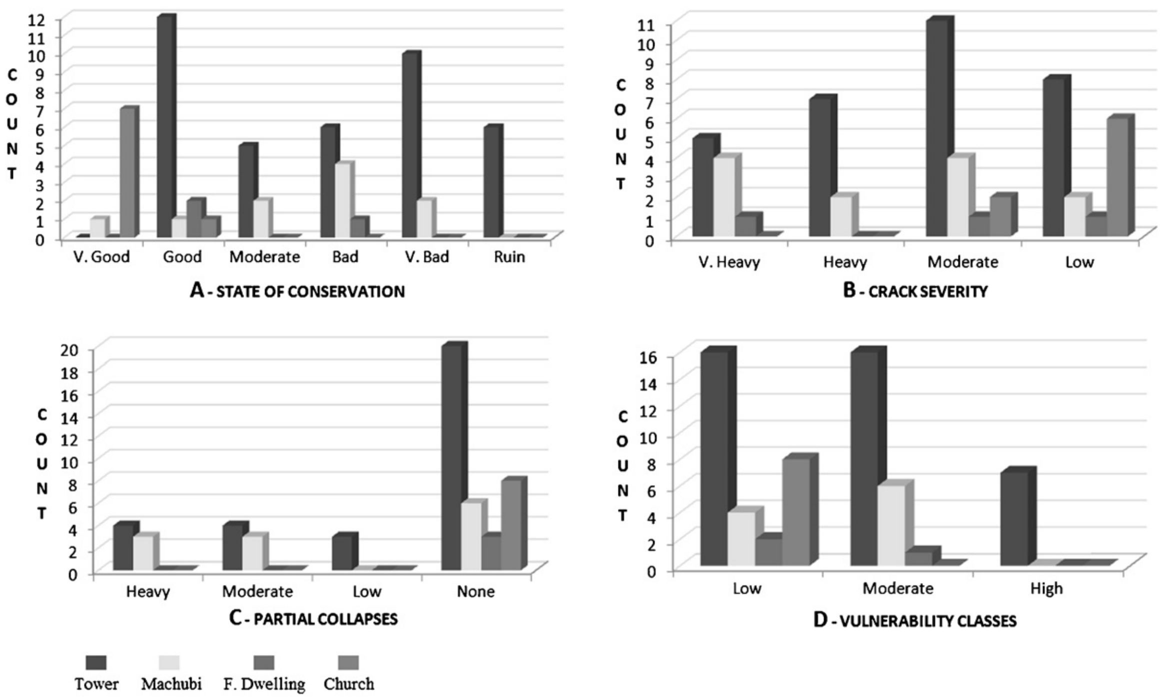

Fig. 4. Summary of the state of conservation and damage assessment. A. frequency of cultural heritage objects according to their type and the state of conservation. B. Number of objects with severity of cracks. C. Number of objects with respect to the overall damage. D. Number of objects in the various vulnerability classes.

A semi-quantitative multihazard risk index analysis was performed focusing on landslides and snow avalanches as these were the main natural hazards identified from the interviews. Many methods exist for mass movement susceptibility, hazard and risk assessment [20]. The methods for susceptibility assessment can be subdivided into heuristic, statistical and deterministic methods [20]. Deterministic methods require detailed information on soil characteristics (e.g. soil depth, hydrological and geotechnical parameters), which are not available for the study area. As the very limited landslide inventory did not allow for a statistical analysis of landslide susceptibility, it was decided to use a heuristic approach based on SMCE. SMCE is based on the selection of indicator maps, the standardization of these into a range of 0 to 1, the application of a weighting approach, the integration of the weighted indicator map into a composite index map, and the classification of this map into several classes. SMCE for landslide susceptibility assessment has been applied among others by [21] and [22]. A hazard susceptibility analysis was performed for landslides and avalanches in the communities of Ushguli and Mulakhi. The methodology followed is the same for each community and hazard type, only varying the conditioning factors used for landslides and avalanches. For landslide susceptibility assessment the following factors were considered: slope gradient, lithology, landcover and drainage density [22]. For snow avalanche susceptibility the following factors were used: slope gradient, slope aspect, slope curvature and landcover [23]. Those factors are considered relevant bearing in mind data availability, the area of study and the scope of this work.

A vulnerability analysis of the cultural heritage objects was performed for Ushguli and Mulakhi, based on the state of conservation, and the objects were classified in three vulnerability classes: high, moderate and low vulnerability. The susceptibility maps and vulnerability maps were combined in a qualitative multihazard risk assessment. Three different risk maps were produced: a landslide risk map, a snow avalanche risk map, and a combination of the two as a multihazard risk map. The final maps were reclassified in three levels of risk: high, moderate and low.

2.4. Results

2.4.1. Damage assessment and state of conservation

In this study 60 cultural heritage objects were assessed, 30 in each community. Of those, six towers were assessed as completely ruined by causes that could not be established. For the remaining 54 objects a damage assessment was carried out considering the method described in Section 3. The results are shown in Fig. 4.

More than 40% of the objects show heavy roof damage or have no roof at all. These objects all show an overall state of conservation ranging from "bad" to "ruin". The churches are the best conserved, and all eight of the assessed churches have been provided with new roofs recently, to protect the precious icons, murals and paintings. All of the assessed objects show cracks, which are serious in more than one third of the objects, including 12 of the 31 towers. About one third of the towers and half of the machubis have partial collapsed, with different degree of severity. Five of the 31 assessed towers, show some degree of tilting. More than half of the objects are located on flat (< 5°) or slightly sloping (6–20°) terrain, the other half on moderate slopes (21–40°), except for three of the towers which are located on a steep (> 40°) slope.

Evidences of different levels of humidity and biological degradation are found in all types of objects. Nearly 90% of the assessed objects present low to moderate levels of both humidity and biological degradation. Less than 10% of the objects show no signs at all. The highest level of humidity is found in two machubis; the highest level of biological degradation is encountered in one tower, one machubi and one church. Overall, half of the objects assessed are not used for any purpose. One third of the objects (mainly towers and machubis) are used as animal shelter and for agricultural storage. All churches are used as worship places and one object

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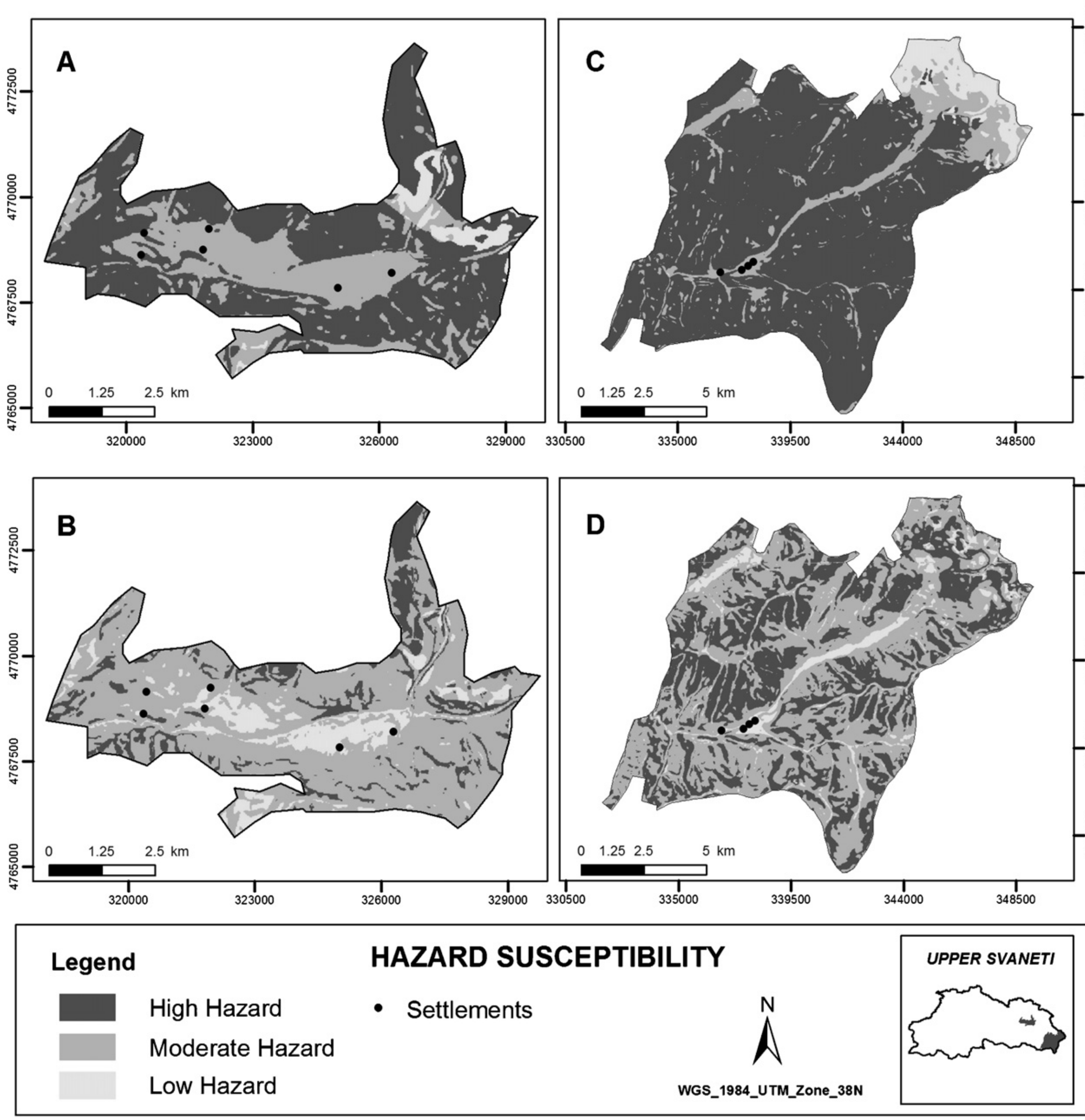

Fig. 5. Hazard susceptibility in the study area. Mulakhi: Landslide (A) and avalanche (B). Ushguli: Landslide (C) and avalanche (D).

(fortified dwelling in Ushguli) as a museum. In slightly more than half of the objects (mostly towers and churches) evidence of restoration works could be observed.

2.4.2. Landslide and avalanche risk assessment

The susceptibility maps for landslides and snow avalanches are shown in Fig. 5, whereas Table 2 shows the percentage of the total area with low, moderate and high hazard susceptibility. In Ushguli community vulnerability was calculated based on the state of conservation of cultural heritage objects and on the location of the objects in relation to the Enguri River. Nineteen out of 30 objects show low vulnerability and only three objects have a high level of vulnerability due to their advanced state of deterioration. Two of those high vulnerability objects are located at the downstream right side of the river in Murkmeli village directly under steep slopes. The absence of the river as a natural barrier against landslides and snow avalanches adds an additional degree of vulnerability to these objects. The overall vulnerability of the cultural heritage objects in Ushguli is quite favourable as many of these objects (especially in Chazhashi village) have benefited in the last years of recovery and maintenance works. In Mulakhi community 12 out of 30 objects have low vulnerability whereas four are highly vulnerable. Overall churches are the cultural heritage objects that are less vulnerable. For each community two maps were produced using SMCE, showing the risk of cultural heritage objects to landslides and avalanches respectively (Fig. 6).

3. Integrating hazard risk into cultural heritage management plans in Upper Svaneti

Experiences in the field of cultural heritage and disaster management are still relatively scattered in developing countries. There is a need for clarification of fundamental issues including risk assessment, the possibilities and limitations of technical adaptation and retrofitting of historic buildings to withstand disasters, and the paradox of endangerment through prevention [24]. Furthermore,

Table 2
Landslide and avalanche hazard percentage area in both communities.

Community	Hazard	Area (%)		
		Low hazard	Moderate hazard	High hazard
Ushguli	Landslide	5.8	15	79.2
	Avalanche	5.8	55.9	38.2
Mulakhi	Landslide	4.9	33	62.1
	Avalanche	13	72.6	14.4

societal and even ethical issues have to be addressed in relation to potential conflicts between the urgent protection of people and the protection of cultural property [24]. The reason behind the nearly complete absence of effective risk management of cultural assets is inadequate knowledge of the assets themselves, failure to calculate the true cost of loss or damage, and the difficulty of putting a value on the nonmarket nature of many cultural heritage values [25]. More recently, the importance of the socioeconomic value of cultural heritage as a way of mitigating risk before disaster strikes has been recognised [26]. A study by the International Council on Monuments and Sites (ICOMOS) in 14 mainly industrialised countries showed that natural hazard risk analyses are generally not included into overall cultural heritage management plans [11].

A number of relevant management plans and reports, including [15,18,27], for Upper Svaneti were examined in this research. The focal point was on exploring the presence/absence of hazard risk management elements related to cultural heritage conservation. The overall conclusion is that natural hazards risk elements as possible threat to cultural heritage are not taken into consideration.

Based on literature sources [25–28] and on the knowledge acquired of the area during this study a number of guiding principles are proposed for the strengthening of management plans and the integration of hazard risk elements in Upper Svaneti:

- identification of main actors at national, regional and local level relevant for an effective cultural heritage management process;
- creation of multidisciplinary teams for the elaboration of cultural management plans, also including experts in natural hazard assessment and disaster risk management;
- give priority to the elaboration of a complete census of cultural heritage objects as well as of natural hazards inventories, since so far they are both lacking;
- promotion of the use of GIS and remote sensing technology in different phases of the management plan, such as natural hazard mapping and monitoring, and the creation of databases;
- inclusion of the landscape as a part of cultural heritage management plans;
- involvement of the local community in the management process;
- promotion of training activities in the region concerning regular maintenance of the sites (inspection and restoration techniques, use of materials for restoration) and tourism management;
- promote the importance of cultural heritage through education programs within the schools in the region;
- promote natural hazard awareness also through school education.

Examples of relevant actors include the Ministry of Culture and Monument Protection of Georgia and its National Agency for Cultural Heritage Protection; the Ministry of Environment Protection of Georgia and its Agency of Protected Areas (APA) and National Environmental Agency (NEA); the Georgian National Committee of the International Council on Monuments and sites (ICOMOS

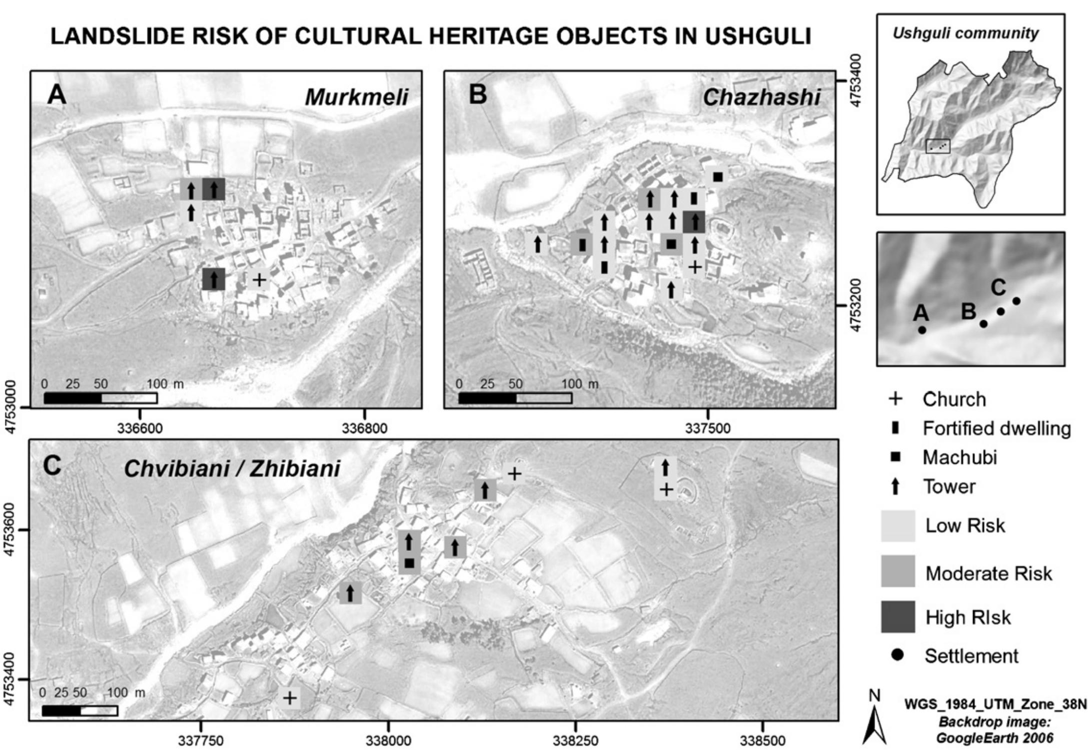

Fig. 6. Landslide risk of cultural heritage objects (example map for Ushguli).

Georgia); Georgia's Protected Areas Programme (GPAP), the Caucasus Environmental NGO Network (CENN); the Svaneti Mountain Tourism Center (SMTC); local government agencies and cultural institutions; property occupants and land users.

As is emphasised in the UNESCO World Heritage list [16] about Upper Svaneti "the unity of architecture and landscape give this region an original quality of its own". Sustainable conservation of the cultural heritage objects should, therefore, include the "exceptional example of mountain scenery with medieval-type villages and tower houses" [16]. But an equally important reason for including landscape in management planning is that, apart from its scenic value, this same landscape is also the source area of natural hazard processes that may threaten the heritage objects. Risk preparedness is recognized by ICOMOS Georgia [27] as a conservation priority for Chazhasi village.

So far the involvement of local communities in cultural heritage management seems mainly limited to carrying out restoration works to individual heritage objects. In this line their role could be extended to the construction and maintenance of protective, structural measures in the terrain (for example retaining walls, terracing of slopes, snow fences and reforestation) against landslides and avalanches. However, even more important is their active involvement in the development of non-structural measures against natural hazards. This includes community-based decision making about overgrazing control and fuelwood extraction to prevent over-exploitation and deforestation, identification of hazard prone areas, but also about controlling cattle movement in the neighbourhood of heritage objects, and about the development of infrastructure for improved access to the more isolated villages. Further development of tourism in Upper Svaneti can be of considerable economic significance for the region and its inhabitants. This makes the conservation of the cultural and landscape heritage and corresponding natural hazard risk reduction important for local communities as well. A sustained influx of tourists enables them to diversify and possibly increase their sources of income. But it also adds to the already complex interaction between people and their surroundings in the harsh conditions in this mountain environment.

Although located literally at the end of the road, in Ushguli community tourism development has contributed to a recent influx of residing families with younger children (oral communication with school headmaster). The presence of school children can be very well used to further promote the importance of cultural heritage conservation and the awareness about natural hazards and risk. Schools can act as centres for community-based risk reduction and via school children approaches for hazard mapping and vulnerability assessment can be spread to the communities surrounding the schools [29].

4. Discussion and conclusion

The results obtained from the risk assessment have been discussed with the local community and cultural heritage experts. They concluded that in this specific area many of the cultural heritage objects are not particularly affected by landslides or snow avalanches, as probably they were constructed by people that had local knowledge on potentially dangerous locations. This study did not consider other types of natural hazards, such as flooding, earthquakes or wildfires. It is important that in future studies also these hazards are considered, as Upper Svaneti is part of a zone of active tectonic activities. This study shows that most of the cultural heritage features are located in moderate to low susceptible areas for landslides and snow avalanches. The susceptibility maps, however, only considered the initiation susceptibility of landslides and snow avalanches. A separate susceptibility assessment for the run-out or travel distance for landslide and snow avalanches could not be included due to lack of data, but need to be included in future work as well. With run-out information included in the analysis the susceptibility of the area would probably change significantly. Moreover, more accurate information would be needed on the real capacity of cultural heritage structures to withstand the impact of the landslides and snow avalanches. There is at least one example of a tower withstanding the impact of a major snow avalanche event in 1987. It seems very likely that many natural events may have happened in the area since these structures were built about one millennia ago. The fact that many of these structures are still standing seems to prove that they were constructed purposely to withstand severe forces.

The approach adopted in this study allows for a basic and rapid assessment meant to be carried out for larger areas with limited resources in order to prioritise the allocation of economic budgets oriented to recovery and maintenance interventions in a more efficient way. This method gives an approximate idea of the overall state of conservation of cultural heritage sites. This method also combines state of conservation of cultural heritage objects with hazard information in a SMCE multicriteria evaluation environment, which could be easily integrated in a cultural management plan. Heritage management as a process that aims at protecting properties and places, which have historical and cultural significance, should take into account the threat posed by natural hazards. The inclusion of a section on natural hazards and disaster risk in cultural heritage conservation plans should be mandatory.

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