Carpathian Journal of Earth and Environmental Sciences, August 2016, Vol. 11, No 2, p. 485 - 496

SUSTAINABLE TOURISM DEVELOPMENT IN A SELECTED AREA OF THE LOW TATRAS NATIONAL PARK – LANDSCAPE PLANNING VERSUS URBAN PLANNING

Jana ŠPULEROVA[1], Tatiana HRNČIAROVA[1], Veronika PISCOVA[2], Miriam VLACHOVIČOVA[1], Henrik KALIVODA[1], Róbert KANKA[1], Marta DOBROVODSKA[1], Pavol KENDERESSY[1], Viktória MIKLÓSOVA[1], Monika DRÁBOVA[1] & Ingrid BELČÁKOVA[3]

[1]Institute of Landscape Ecology of the Slovak Academy of Sciences, P.O.Box 254, Štefanikova 3, 814 99 Bratislava, Slovakia, E-mail: jana.spulerova@savba.sk, tatiana.hrnciarova@savba.sk, miriam.vlachovicova@savba.sk, henrik.kalivoda@savba.sk, robert.kanka@savba.sk, marta.dobrovodska@savba.sk, viktoria.miklosova@savba.sk, monika.drabova@savba.sk

[2]Institute of Landscape Ecology of the Slovak Academy of Sciences, branch Nitra, Akademicka 2, P. O. BOX 22, 949 01 Nitra, Slovakia, E-mail: veronika.piscova@savba.sk

[3]Institute of Landscape and Garden Architecture, Faculty of Architecture, Slovak University of Technology in Bratislava, Nám. slobody 19, 812 45 Bratislava, Slovakia, E-mail: belcakova@fa.stuba.sk

Abstract: The Low Tatras National Park, situated in Central Slovakia, has excellent conditions for many sports activities, including ski resorts and natural tourist attractions. This study aims to comprehensively evaluate the impact of tourism development on the environment in the selected study area – Demänovská Valley – and prepare a proposal for sustainable development of this mountain resort. The study is based on an assessment of the current state and the natural condition of the environment, and reflects the current conditions of the protected area and development plans in the area which have already been approved or are in the process of being approved. Continued expansion of the ski resorts and the requirements of new buildings create pressures on the environment and protected areas. The result of our study is an assessment of the natural and anthropogenic risks in the study area and a proposal for optimal land use.

Key words: protected area and natural resources, landscape ecological regionalization, tourism development

1. INTRODUCTION

The attractive natural values of mountain areas stimulate the human desire to behold the beauty of nature, resulting in development to accommodate tourism and recreational needs (Neuvonen et al., 2010). Tourists are drawn to natural areas by attractions which depend, in the long term, on the conservation of natural amenities; and tourism itself generates adverse environmental impacts (e.g., high levels of noise; air and water pollution; changing views and landscapes due to the building of high-rise hotels and large-scale urbanization) (do Valle et al., 2012). The expansion of human activities causes increasing disruption of the environment, threatening ecosystem sustainability and biodiversity conservation in the mountain regions. An integrated ecotourism approach, and increased emphasis on activities which respect natural and cultural values, could provide benefits for environmental, economic and social concerns together (Yilmaz et al., 2013). Mountain areas provide a common set of ecosystem services for society, including soil stability, water quantity and quality, forage quality and quantity, conservation of botanical diversity, aesthetics and recreation (Lamarque et al., 2011). Positive examples of attempts to conserve nature and preserve traditional living spaces whilst promoting tourism can be found around the world (Cousins, 2007; Kienast et al., 2015; Stadel et al., 1996; Tyrväinen et al., 2014). In contrast, conflicts

particularly arise between nature conservation and tourism development in cases of construction booms in natural wilderness areas where development plans are lacking and tourism is not regulated. Tourism has a number of negative social and environmental consequences once it grows beyond the capacity of the environment. Sustainable tourism planning requires an in-depth analysis of existing resources and an understanding of local communities' attitudes towards development and its consequences (Kostopoulou & Kyritsis, 2003).

Demänovská Valley, one of the largest tourism resorts in the Low Tatras National Park (Slovakia), is a protected area due to its natural values, which however are increasingly under threat by tourism-related development. If we want to preserve its values, the growing development trends in the Demänovská Valley urgently require the implementation of innovative policies and actions to ensure sustainable tourism development. The aim of our environmental impact assessment is a comprehensive assessment of the impact of tourism development and urban planning in the study area on the environment, with an emphasis on maintaining the significant natural landscape values.

2. METHODS

This study is based on an assessment of the current state of the environment in the study area and reflects the current status of natural resources, environmental conditions, nature protection limits, and development plans in the area which have already been approved or are in the process of being approved under current legislation (Fig. 1). Several types of environmental conditions and activities have been analyzed and evaluated: (1) Physical conditions – geological structure, landform, drainage, soils, climate, hydrological and hydro-geological regimes, habitats, etc.; (2) Landscape structure and landscape scene – landscape elements, landscape mosaics, landscape characteristics, visual amenity and scene; (3) Current spatial protection limits and measures – nature protection areas, areas of water and forest resources, ecological networks; (4) Planned tourism-related development activities and land use (pressures) – proposed changes in land use, withdrawal of land for construction, architectural proposals and development plans of the territory.

Using synthesis, the environmental conditions of the study area and the spatial distribution of the current and proposed land use helped us determine the appropriateness or inadequacy of the planned activities and identify various conflicts of interest in the landscape. The method of multi-criteria analysis and multi-criteria impact assessment (Table 1) was selected for the assessment of proposed activities as the best alternative out of a set of several options (Belcakova, 2012; Fischer et al., 2015; Fischer & Jha Thakur, 2008). In our case study, this methodological approach enabled the analysis of multiple possible courses of action and land use options and helped to identify the most suitable management solution for sustainable tourism development in the study area. The impact of proposed activity was evaluated in five categories on the basis of its origin and intensity: very negative (--), negative (-), neutral (0), positive (+) and very positive (++). The result is a partition of the study area into landscape complexes, identification of conflicts of interest and a proposal of measures for environmentally friendly land use in a manner compatible with the needs of regional tourism development. The synthesis of positive measures and plan of rural development activities were done using ArcGIS 10.1 tools.

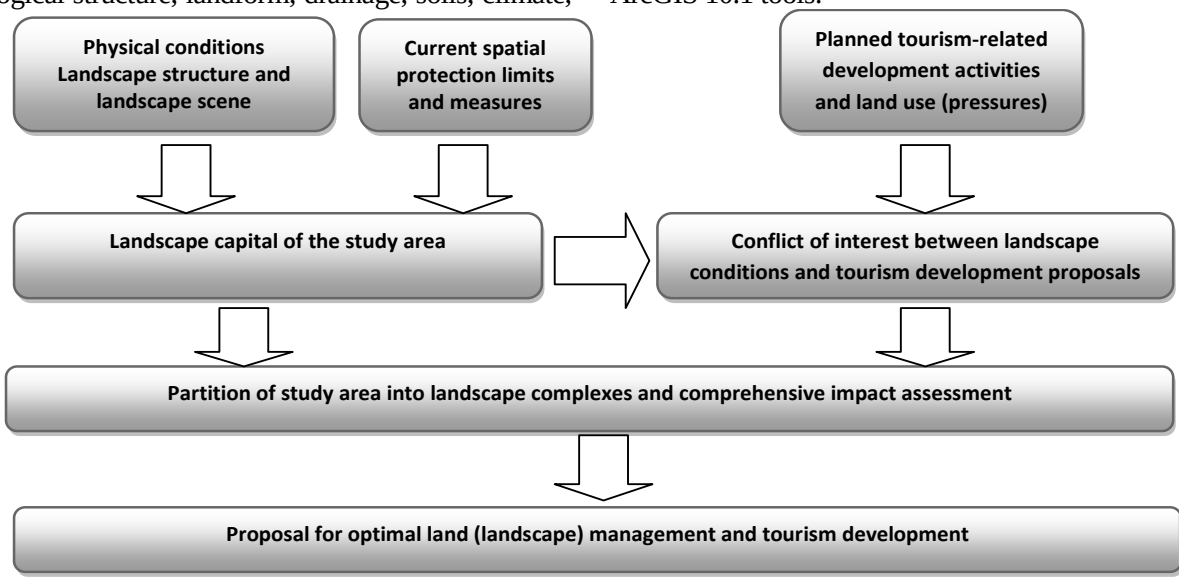

Figure 1. Methodological approach to assessment of sustainable tourism development in selected study area

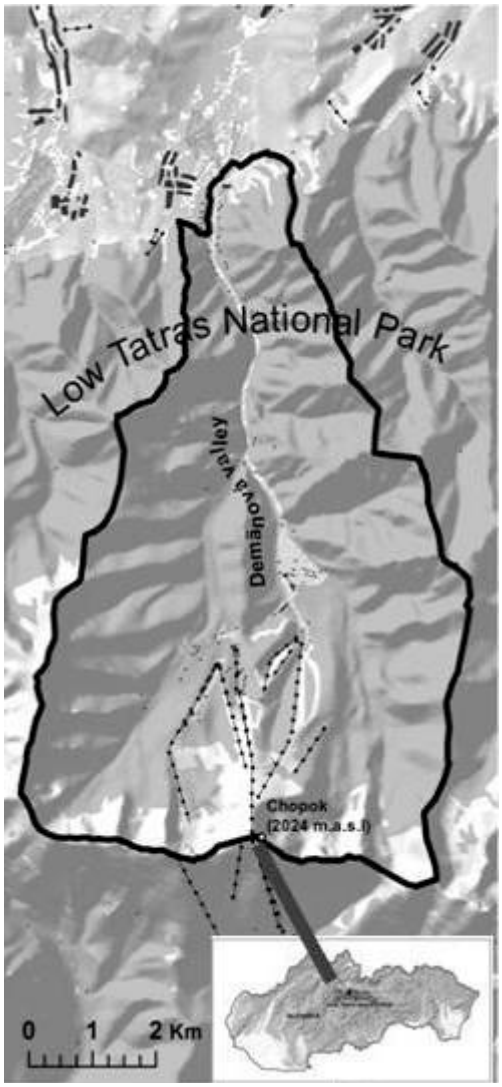

Figure 2. Location of the Demänovská Valley study area in the Low Tatras National Park, Slovakia

Table 1. Landscape parameters for multi-criteria impact assessment

Landscape parameters	**Impact indicators**
Landscape structure	
Landscape elements	Fragmentation of land use
Land use	Permanent occupation of forest and agricultural land
Landscape mosaics	Loss of valuable mosaic elements
Landscape stability	
Abiotic landscape stability	Threat to stability of landform and soils, floods
Biotic landscape stability	Threat to stability of biotopes
Ecological stability	Exceeding of landscape carrying capacity
Landscape scene	
Visual amenity	Visual amenity changes
Landscape scenery	Visual pollution
Landscape character	Devaluation of landscape character

3. THE STUDY AREA

This research is situated in the mountainous areas of the Low Tatras National Park, where conditions are favourable for many sports activities, and where are found ski resorts and natural tourist attractions such as publically-accessible caves. The subject of research is the study area of the Demänovská Valley, which belongs to the cadastral municipality of the same name (Fig. 2).

The area of the Demänovská Valley cadastral area is 4,784.83 ha, of which built-up areas occupy 52.08 ha (1.089%), agricultural land 55.87 ha (1.168%), forest land 4,634.12 ha (96.85%), water areas 17.24 ha (0.36%), and other areas 25.52 ha (0.533%). The northern border of the cadastre is formed by the Liptovská Basin (700 m a.s.l.) and the southern border is formed by the main ridge of the Low Tatras, featuring the highest elevation point in this area, Chopok peak (2,024 m a.s.l.).

The geological structure of the territory is formed of granite and schist and also by dolomite, limestone and other sedimentary rocks. The extensive Demänova karst area, and part of the Ďumbier karst area, are connected to the limestone complexes of the Low Tatras. Demänovská Valley belongs to the most important karst areas in Slovakia. Rendzinas, leptosols, cambisols, and podzolic and lithic soils are represented in the study area (VÚPOP, 2000).

The Demänovka River, with its 3 main tributaries, Priečny potok, Zadná voda and Otupnianka, flows through the territory of Demänovská Valley. The middle part of the river basin passes through the karst area. Vrbické Lake, a natural pool of glacial origin, is located there.

Positions above 1,500 m a.s.l. are characterized by a very cold climate with average temperatures in January of -7 to -8°C, and on the main ridge of about -9°C. The annual rainfall exceeds 1,400 mm in the mountainous areas and reaches 1,600 mm on the highest peak, Chopok. Snow cover lasts about 100 to 200 days, depending on precise location (Hrnčiarova ed., 2002).

The Low Tatras mountain range is among the areas with the highest number of plant species in Slovakia. The timber line extends to an altitude of 1,500–1,550 m a.s.l., with the mountain pine subalpine zone reaching an altitude of 1,800–1,850 m a.s.l., and the alpine zone above that. The composition of vegetation is affected by humans. Intensive forest management is reflected in changes in the forest structure, particularly an absolute dominance of spruce (Michalko et al., 1987). Our habitat inventory in the study area found 22 habitats of European importance (by type: river banks – 1,

shrubs – 1, alpine communities – 3, grassland – 2, wetlands – 2, habitats on rock and screes – 5 and forests – 8). The diverse habitats and varied topography have conditioned high fauna species richness, including many rare, endangered, endemic species of vertebrates (e.g. marmot, chamois) and invertebrates of cave spaces.

The study area has been part of the Low Tatras National Park and its buffer zone since 1978, and is under the 2nd and 3rd levels of nature protection. The national park's area of 728 km² and its buffer zone of 1,102 km² make it the largest national park in Slovakia. The territory of the Demänovská Valley study area contains one National Nature Reserve (Demänovská Valley), and two National Natural Sights (Demänovská caves and Vrbické Lake). The caves of the Demänovská Valley were included in the list of wetlands of international importance under the Ramsar Convention on Wetlands (Ramsar, 1971) in 2006 under the number 1,647.

The area is also part of the European nature conservation network Natura 2000, containing the Special Protection Area Ďumbier Mountains (SKUEV0302) and the Site of Community Importance Low Tatras (SKCHVÚ018).

The study area is situated in the Protected Water Management Area of the Low Tatras' eastern part as a protected area of natural accumulation of water and is also in the protection zone of water resources with several levels of protection – the 1st, 2nd and 3rd degrees of protection and water protection zone of 2nd degree with reinforced protective measures due to occurrence of active springs. The Demänovka with its tributaries has been declared to be an important watercourse.

Forest land currently occupies 4 635.47 ha, of which 3,995.83 ha is covered by forests and 639.64 ha by non-forest area. By forest category, commercial forests make up 2.96 ha, special-purpose forests 660.97 ha and protected forest 3,261.90 ha.

Tourism development in the Low Tatras can be dated to the 1920's, when the Demänovská caves were discovered and made accessible to the public. However, most of the development came after 1948, when the cableways to the peak of Chopok were built on the northern and southern sides of the mountain. The two largest tourist centres were built close to the base station of the cableway in the 1960's: the Trangoška/Srdiečko/Kosodrevina centre on the south side and Demänovská Valley/Jasná on the north side. The most popular forms of tourism in the study area are hiking, in summer, and skiing, in winter. Tourism is particularly associated with a visit to the caves, which are the most visited caves in Slovakia. The ski resort offers 46 km of snow-covered ski slopes of varying difficulty, of which 92 ha are situated on Chopok North and 60 ha on Chopok South, along with 12 freeride zones. There are 30 cable cars in operation, and lifts with a transport capacity of more than 30,000 persons per hour. The number of visitors to the winter resorts Chopok North and Chopok South was reported as from 4,000 to 9,000 per day in the years 2012 – 2014. Demänovská Valley has more than 70 accommodation facilities.

In recent years, new forms of recreation and sporting activities such as mountain biking, hang gliding, alpine skiing, ice climbing and others have developed. The focus of these activities tends to be the central part of the national park which is accessible by cable car.

There are two important documents laying out tourist development plans in the area: the Spatial Plan of the Demänovská Valley village adopted in 2008, and its update Amendments No. 1 to Spatial Plan adopted 2013. These documents outline allocation of land for the following: (1) New ski slopes will link the three ski resorts Lúčky, Záhradky and Jasná, and will require about 21.86 ha of land; (2) Plans for construction of tourism and recreation facilities include construction in the vicinity of Tri Studničky and Lúčky, with a planned range of land of 29.15 ha, and construction and expansion of housing and facilities on five other sites covering an area of 17.75 ha, 8.82 ha of which agricultural land and 8.93 ha forest land; (3) 33 other facilities to be built on forest land, including tourism services, public facilities, personal mountain transport facilities, sports areas, technical infrastructure and a water management facility, requiring area 528.3 ha, and (4) Proposal for permanent or temporary withdrawal of forest land for 35 other miscellaneous sites with an area of 124.93 ha of which 38.01 ha is permanent and 86.92 ha is temporary withdrawal.

The total proposed development in the Demänovská Valley cadastre will require 700.122 ha of land, of which 37.19 ha is agricultural land and 662.932 ha is forest land.

4. RESULT

4.1. Conflicts between development and the environment in Demänovská Valley

The Spatial Plan of Demänovská Valley village from 2008 and its Amendments No. 1 from 2013 focus on the maximum exploitation of the Demänovská Valley, which gives rise to environmental conflicts. Nature conservation has suffered in many ways, rare and sensitive habitats have been degraded, and there is a disruption of

ecological relationships, which may have permanent and irreversible effects on the alpine nature. Based on the pre-existing natural conditions, landscape parameters and current spatial limits of the area, and on conflicts between these and the current and proposed uses (pressures), we partited the Demänovská Valley into five landscape complexes (LC), to assist in discussing the various environmental problems (Fig. 3): LC1 – the mouth of the Demänovská Valley, containing Tri Studničky and its environs with accommodation facilities for recreation and smaller sports areas with varying vegetation; LC2 – Demänovská caves, the unique karst cave system consisting of two cave areas and Repiská, a separate resort with several cottages and sports fields; LC3 – Jasná/Záhradky, an important sports and recreation resort consisting of four local parts: Lúčky, Nižné priečne, Záhradky and Jasná with accommodation facilities of varying architectural value, and many attractions; LC4 – Chopok (western part), covering the western part of the Zadná voda valley and the side ridge of the Bôr peak, including several cottages and cableways, and LC5 – Chopok (eastern part), a relatively intact natural complex covering the eastern part of the Zadná voda valley with a side ridge of the Tanečnica peak.

Based on the multi-criteria impact assessment of proposed development projects on the environment in each individual landscape unit and consideration of the proposed urbanization activities in the different LCs and the state of the natural physical factors, landscape parameters and limits of protection of nature and natural resources, we have specified the following as the most common environmental conflicts in Demänovská Valley: (I) urbanization pressures on the natural values of the national park, (II) destruction and loss of habitat, (III) increased geodynamic risk, (IV) disruption of the hydrological regime, and (V) visual changes (Table 2).

(I) Sports tourism activities, accompanied by their significant space requirements, now constitute serious anthropogenic impacts on the natural environment and have given rise to urbanization pressures on the natural values of the national park. Urbanization plans and the construction of new ski trails and cableways conflict with the 3rd level of nature protection (LC1, LC3), and the planned construction of roads and technical infrastructure in the area, conflict with the 4th levels of nature protection (LC4). These are connected with the proposal to reduce the level of protection for LC4 and LC2 (environmental conflict labelled as C1 according to Table 2). The location of new construction in recreation areas of existing sports facilities (LC1, LC3) means intensification of development in the national park areas by new construction (C2). The new centres in areas untouched by recreation (LC2, LC3, LC4) represents development in the natural environment (C3). The realization of the planned activities will result in the permanent occupation of agricultural and forest land (C4). Inconsistencies and differences between the existing conservation boundaries of nature and water resources lead to unnecessary confusion (C5, LC2).

(2) Destruction and loss of habitat is the result of increasing construction and associated landscape changes, causing direct damage to habitats and the destruction of flora and fauna (C6). These may result in irreversible changes to and loss of protected forests (LC3, LC4) and partial destruction of certain non-forest, forest and riparian vegetation habitats of European importance, for example the Acidophilus *Picea* forests of the montane to alpine levels (LC3, LC4) and the Bog Woodland and Hydrophilous Tall Herb Fringe Communities of the plains and of the montane to alpine levels (LC4), among others.

Fragmentation of habitats, loss of food and lairing opportunities, reduction of nesting opportunities for animal species of European importance, lack of an ecotone zone and corresponding creation of new forest walls vulnerable to disaster risks (LC3, LC4) threaten the overall stability of forest ecosystems (C7). Ecological instability of forests (LC3, LC4) is also caused by increased random timber harvesting (C8) due to wind or bark beetle calamity timber.

The fragmentation of land use patches leads to decreasing biodiversity (Klauco et al., 2012). By interference in wetlands within the protection zone of Vrbické Lake (LC4) and by disturbance or destruction of other surrounding habitats, especially during the spring migration (LC1, LC2), amphibians and reptiles are directly threatened (C9). Marmot, chamois, lynx and birds of prey such as eagles and grouse are among the species most vulnerable to disturbance by man (LC3). Open access to Bôr hill (LC4) would cause disruption of chamois and marmot habitats (C10). Many vulnerable and endangered species of cave fauna (LC2) are disturbed by the increased visit rate (C11). The expanding ski arena constitutes a migration barrier for large carnivore populations between the Chopok North and Chopok South areas (C12). Wooden barriers erected along the ski route on the northern slope of Chopok also have a negative effect here (LC3). Landscaping of slopes has brought alteration of the natural species composition on the ski slopes (C13) and possibly an increase of non-native and invasive species (LC3, LC4).

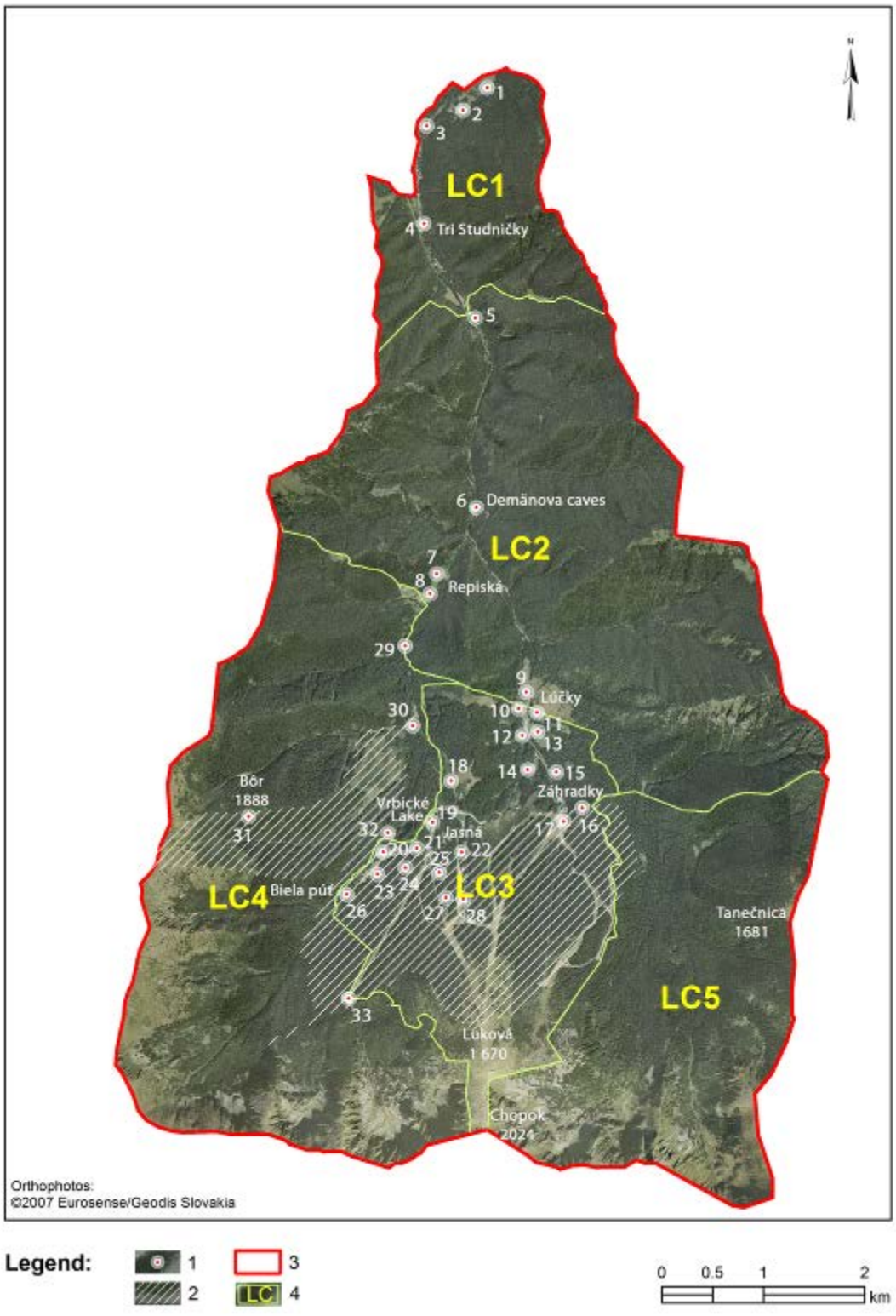

Figure 3. Environmental conflicts between nature and natural resources protection and regional development in landscape complexes of the Demänovská Valley

Legend: 1 – Schematic representation of the conflict between the natural environment and area of proposed land use changes (numbers 1–33 of proposed activity according to Table 2), 2 – Schematic representation of the conflict between the natural environment and proposed linear land use changes (proposed chairlifts, ski trails and expansion of existing ski trails), 3 – border of study area, 4 – border of landscape complexes (LC): LC1 – mouth of the Demänovská Valley, LC2 – Demänovská caves, LC3 – important sports and recreation resort of Jasná/Záhradky, LC4 – Chopok (western part), LC5 – Chopok (eastern part).

Table 2. Multi-criteria impact assessment of individual proposed development projects in landscape complexes in Demänovská Valley

Landscape complex	Proposed activities	Current spatial limits					Multi-criteria impact assessment							Environmental conflicts and operational stage of tourism development activities
							Landscape structure and landscape stability					Landscape scene		
		Nature protection areas	Water resources areas	Forest resources areas	Ecological networks	Habitats	Fragmentation of [illegible]	Landscape mosaics	Abiotic environment	Biotic environment	Ecological stability	Landscape visual amenity	Landscape character	
LC1	**1B**	3N, SCI	yes	no	no	no	0	0	0	-	0	+	+	C2, C4
	2D	3N, SCI	yes	no	no	no	0	0	0	-	0	+	+	C2, C4
	3F	2N	yes	no	no	no	0	0	0	-	0	+	+	C2, C4
	4D	3N, SPA, SCI	yes	yes	yes	yes	-	0	0	-	-	0	-	C1, C2, C4, C9
LC2	**5F**	5NP, SCI, SPA, RS	yes	yes	yes	yes	--	0	--	--	--	-	0	C1, C2, C4, C6, C11, C16, C17, C21
	6F	5NP, SCI, SPA, RS	yes	yes	yes	yes	--	0	--	--	--	-	0	C1,C2, C4, C6, C11, C16, C17, C21
	7B	5NP, SCI, SPA, RS	yes	no	yes	no	-	0	--	0	-	--	0	C1, C4, C5, C16, C17, C19
	8D	5NP, SCI, SPA, RS	yes	no	yes	no	-	0	--	0	-	--	0	C1, C4, C5, C16, C17, C19
	9D	5NP, SCI, SPA, RS	yes	yes	yes	yes	--	0	--	--	--	--	0	C1, C3, C4, C5, C6, C9, C16, C17, C19
LC3	**10I**	3N	yes	yes	no	yes	--	0	--	-	-	-	-	C1, C6, C7, C8, C10, C12, C13, C19
	11D	3N	yes	yes	no	Yes	-	0	-	-	0	-	-	C1, C3, C4, C6, C17, C19
	12G	3N	yes	yes	no	yes	-	0	-	-	0	-	-	C1, C3, C4, C6, C17, C19
	13D	3N	yes	yes	no	yes	-	0	-	-	0	-	-	C1, C3, C4, C6, C17, C19
	14C	3N	yes	yes	no	yes	-	0	-	-	0	0	0	C1, C3, C4, C6, C8, C17
	15D	3N	yes	yes	no	yes	-	0	-	-	0	0	0	C1, C3, C4, C6, C17
	16D	3N	yes	yes	no	yes	-	0	-	-	0	0	0	C1, C3, C4, C6, C17
	17D	3N	yes	yes	no	yes	-	0	-	-	0	0	0	C1, C3, C4, C6, C17
	18D	3N	yes	yes	yes	yes	-	0	-	-	0	0	0	C1, C3, C4, C6, C17
	19D	3N	yes	yes	no	no	0	0	-	0	0	0	0	C1, C2, C4, C19, C20
	20D	3N	yes	yes	no	no	0	0	-	0	0	0	0	C1, C2, C4, C19
	21A	3N	yes	yes	no	no	0	0	-	0	0	-	0	C1, C2, C4, C8, C10, C20
	22D	3N	yes	yes	no	no	0	0	-	0	0	0	0	C1, C2, C4, C20, C21
	23C	3N	yes	yes	no	no	0	0	-	0	0	0	0	C1, C2, C4
	24A	3N	yes	yes	no	no	0	0	-	0	0	-	0	C1, C2, C4, C6, C20
	25D	3N	yes	yes	no	no	0	0	-	0	0	0	0	C1, C2, C4, C20
	26F	3N	yes	yes	no	no	0	0	-	0	0	0	0	C1, C2, C4
	27D	3N	yes	yes	no	no	0	0	-	0	0	0	0	C1, C2, C4, C20, C21
	28D	3N	yes	yes	no	no	0	0	-	0	0	0	0	C1, C2, C4, C20, C21
	J	3N	yes	yes	no	yes	--	-	--	--	-	-	-	C1, C6, C7, C12, C13, C14, C15, C18, C19
LC4	**29H**	3N, SCI	yes	yes	yes	yes	--	-	--	--	--	0	-	C1, C4, C6, C9, C10
	30H	3N, SCI	yes	yes	yes	yes	--	-	--	--	--	0	-	C1, C4, C6, C9, C10
	31I	3N, SPA, SCI	yes	yes	yes	yes	--	-	--	--	--	-	--	C1, C4, C6, C7, C8, C12, C14, C15, C19
	32E	5N, 4N	yes	yes	yes	yes	--	0	--	--	--	0	0	C1, C2, C4, C6, C9, C16, C17, C20
	33F	3N, SPA, SCI	yes	yes	yes	yes	--	-	--	-	-	-	-	C1, C3, C4, C6, C7, C15, C17, C19
	J	3N, SPA, SCI	yes	yes	yes	yes	--	-	--	--	--	0	-	C1, C6, C7, C8, C10, C12, C13, C14, C15, C18, C19
LC5	**J**	3N, SCI	yes	yes	yes	yes	--	-	--	--	--	0	-	C1, C6, C7, C12, C13, C14, C15, C18, C19

Legend: *Landscape complexes:* LC1 – mouth of the Demänovská Valley, LC2 – Demänovská caves, LC3 – the important sports and recreation resort of Jasná/Záhradky, LC4 – Chopok (western part), LC5 – Chopok (eastern part); *Proposed activities (with ordinal number 1–33* according *to Fig. 3):* A – hotels and apartments, B – cottage zones, C – occupation zones, D – occupation-recreation zones, E – widening of occupation-recreation zones, F – shops and services, G – sport, H – transport and technical facilities, I – personal mountain transport facilities, J – ski slopes and ski lift; *Nature protection areas:* 5N – 5th level of nature protection, 4N – 4th level of nature protection, 3N – 3rd level of nature protection, 2N – 2nd level of nature protection, SPA – Special Protection

Areas, SCI – Sites of Community Importance, RS – Ramsar Site, *Current spatial limits*: yes – present, no – no limits; *Multi-criteria impact assessment*: very negative (--), negative (-), neutral (0), positive (+) and very positive (++); *Environmental conflicts:* C1 – waiving the level of protection, C2 – intensification of development in the national park areas by new construction, C3 – development of new recreation centres in the natural environment, C4 – permanent occupation of land, C5 – inconsistencies and differences between the existing conservation boundaries, C6 – destruction of habitats, C7 – threat to the stability of forest ecosystems, C8 – increased random timber harvesting, C9 – impact on species caused by interference in wetlands, C10 – animal disturbance caused by human presence, C11 – disruption of cave fauna, C12 – migration barrier for large carnivore populations, C13 – alteration of the natural species composition, C14 – threat to soil cover on ski trails by water erosion, C15 – avalanche risk, C16 – deterioration in the quality of surface and karst water, C17 – potential changes in the hydrological regime of karst system, C18 – increased water extraction, C19 – devaluation of landscape character, C20 – loss of recreational comfort value, C21 – visual pollution.

(III) Increased geodynamic risk arises from the creation of new ski slopes or the expansion of existing ones. The growth of tourism infrastructure has exceeded the environmental carrying capacity, increasing the occurrence of various hazards (Gratton et al., 2015). The cutting down of trees and use of excavators, bulldozers and chainsaws give rise to permanent threats to soil cover on ski trails by water erosion and melting snow (LC3, LC4) (P14). Demänovská Valley is one of the largest areas of potential avalanche slopes within the Low Tatras, accounting for over 10% of the valley total area (Kňazovický, 1984). The exposed areas of ski slopes and calamity timber harvest (LC3, LC4, LC5) increase the risk of avalanches (C15). There are particularly dangerous ski slopes below Chopok in: Priehybska and Derešska mulda (Milan, 2006).

(IV) Disruption of the hydrological regime due to transport, artificial snowmaking, and increasing construction and numbers of visitors causes the following problems: (C16) deterioration in the quality of surface and karst water in the form of an increased amount of suspended matter in groundwater flows (LC2), production of waste and potential risk of contamination of soil and water (LC1, LC3); (C17) potential changes in the hydrological regime of the karst system (LC2) and groundwater in the catchment areas (LC3, LC4) due to construction in a water protection zone with reinforced protective measures and (C18) increased water extraction linked with building of artificial snowmaking systems (LC3).

(V) Devaluation of landscape character (C19) results in irreversible changes to and destruction of natural values (LC2, LC3, LC4). Urbanization activity causes irreversible disruption of the landscape and changing landscape perception, loss of recreation comfort value (C19) including visual changes, inconsistency of the architectural environment, increased noise due to urbanization, degraded or deteriorating housing, devastation of the environment after construction without subsequent revitalization (LC1, LC3). Visual pollution (C21) is increased by the many advertising billboards located in the Demänovská Valley cadastre (LC3).

4.2. Proposed measures for optimal management of study area

The present land use and current state of the spatial plan does not leave room for uncompromising enforcement of ecological recommendations concerning the landscape, which means that in many cases inappropriate activities from the landscape-ecological point of view have been implemented. Despite this situation, we have prepared the list of measures which can minimize conflict and to optimize land use of the study area.

Measures for integrated landscape protection

– Urban development activities in areas of the 4th and 5th nature protection level (LC4) should be eliminated and residential facilities developed only to a very limited degree in the national park. The area of LC3 should not be excluded from the national park. Urbanization activities beyond the border of LC3 should be eliminated (LC4 and LC5 should be non-intervention areas).

– Extreme natural conditions (relief, avalanche risk), the presence of habitats of European interest, and areas of water resources protection should be considered reasons to reject proposals for new buildings in the LC4.

– Expansion of built-up areas should be permitted only in those places where utilities (electricity, gas, water) are present; housing and services can always be situated in the mountain village outside the national park (LC1).

– Urbanization should be reduced in intensity and should comply with the architectural style typical for the mountain area (LC1, LC3).

– Proposals for a cableway to the top of Bôr (LC4) and for the planned construction of the FIS II slopes (LC3) should be rejected.

– Planned activities within LC3 should be regulated in order to avoid habitat fragmentation and decrease of the ecological value of the Demänovská Valley (LC3).

– The maximum carrying capacity of built-up areas, and the number of skiers the ski trails can bear, should be identified to limit congestion in the area (LC3).

– Borders of nature protection and natural resource areas should be made consistent in order to increase their protective value and resist possible urbanization pressures (LC2).
– A shuttle service should be planned during times of increased traffic, complemented by parking facilities at the mouth of Demänovská Valley (LC1, LC3).
– The network of nature trails (LC4) should be extended and tourism should be regulated (LC5).

Measures for nature and biodiversity conservation

– The natural values of the national park (LC2, LC4, LC5), and especially the valuable territories of Demänovská Valley (LC2) and Vrbické Lake (LC4), should be maintained. The water bodies formed in forest complexes are characterised by a significant degree of isolation from other aquatic environments and they are refuges of biological diversity (Spyra & Krodkiewska, 2013).
– Either restoration measures should be carried out or financial compensation paid if there is damage or disappearance of habitats of European or national interest (LC1 – LC5).
– The level of protection should be increased for areas important for the presence of chamois and marmots (LC4).
– Conditions of water management for the preservation of ichthyic fauna and cave fauna (LC2) should be adhered to.
– Autochthonous plant species should be used for new landscaping (LC1, LC3) and grassing of new ski trails (LC3), including the use of low bushes.
– The creation of an ecotone forest zone should be supported. Forest edges in contact with the ski slopes should be stabilized by trees adapted to the environmental conditions of open spaces (LC3).
– There should be a focus on the restoration and protection of protected and other forests after natural disasters (LC4, LC5).

Measures for the protection of soil and water resources and support of ecosystem services

– All activities that cause or may potentially cause damage or changes to the soil and topography should be regulated and monitored. If the protective function of the forest is impaired, the functional effect should immediately be secured by substitute biotechnical measures (LC3).
– Activation of geodynamic phenomena should be avoided by appropriate tree-felling practices (LC3).
– Leakage of pollutants into surface water and groundwater during construction and other activities (LC1, LC2, LC3) should be prevented. As regards the construction of buildings, roads, utilities, etc., the buffer zone of 50 m from the forest edge (LC3) should be respected.
– Proposals for buildings should be rejected in the area of water protection zone with reinforced protective measures (LC2), and activity which might interfere with water sources should be prohibited within 25 m of the Demänovka stream (LC1, LC3).
– A hydro-geological survey should be performed whenever changes are made to the spatial plan (LC2).
– The public sewer system (LC1) should be completed, and substandard parts of the sewage system (LC2) replaced or fixed.
– Water extraction (for artificial snow slopes or other purposes) should be monitored to ensure compliance with relevant regulations and maintenance of sufficient flow in rivers (LC3).
– Construction of ski lifts and trails in this area should be considered completed and no further construction permitted. Existing ski runs should feature appropriate technical measures against erosion. Sports activities should be regulated as to time, space and capacity (LC3).

Measures aimed at landscape perception and regional development

– The overall ecological and aesthetic value of existing facilities, recreation and tourism (LC1, LC2, LC3) should be improved.
– Alternatives should be assessed when placing buildings in the country, and the synergistic effect on the landscape should be evaluated. The carrying capacity of mountain areas, in terms of number of visitors and land use, should be respected in compliance with typical folk architecture styles and preservation of the natural landscape panoramas (LC1).
– The traditional building Nicholas Cottage should be preserved as a historical sight of the village, and the skeleton of a long-term unfinished hotel should be removed (LC4).
– The territory should be revitalized after any construction phase, as should the area around the old buildings (LC1, LC2, LC3).

5. DISCUSSION AND CONCLUSION

Protected natural areas are becoming increasingly popular vacation destinations, and are facing a variety of different problems as a result (Kuttner et al., 2014). Development of recreation facilities has a significant impact on the landscape in Demänovská Valley in the form of the frequent environmental conflicts investigated here. The Jasná

ski resort is comparable in size and facilities to the alpine ski resorts, but the relatively small area of the Low Tatras National Park results in more negative consequences on the environment and the overall winsomeness of the landscape (Turecekova, 2011). Generally, downhill skiing, the machine-grading of slopes and the use of artificial snow induce major disturbances in the environment of alpine ski resorts (Roux-Fouillet et al., 2011). The dense network of tourist facilities and high traffic in summer and winter put pressure on protected areas and their natural values and in some cases contribute to accelerated erosion (Barancok & Barancokova, 2008), cause significant changes in the structure and species composition of habitats (Barancok & Barancokova, 2013; Braunisch et al., 2011; Kerbiriou et al., 2009), and disturb the ecological stability of forest ecosystems and habitats for endangered mammals (Grabinska, 2007; Izakovicova & Oszlanyi, 2009). Fragmentation of habitats and reduction of forest area have the effect of changing the local climate, and favourable conditions for winter tourism have been declining some regions over the last decades (Hoy et al., 2011; Keller et al., 2000). Avalanche risk increases with increased traffic and the building of new ski trails and forest aisles, which can act as avalanche tracks, and also with skiing under certain extreme environmental conditions. The tourism industry needs to be better regulated, and it is important to create large-area, multi-use forest buffers and corridors around protected mountain areas (Zhao et al., 2011). Nature and natural resources should be respected in terms of their functional importance in the landscape.

Another problem specific to the study area is the disruption of the hydrological regime, particularly as regards potential changes in the groundwater of karst systems, since the Demänovská Valley is one of the most significant karst sites of international importance. The study of a karst system in Romania confirmed that extensive structural features including land use activity influence the karst groundwater flow (Povara et al., 2015).

Nature conservation should ideally build on scientific recommendations as an outcome of applied conservation research and monitoring schemes which evaluate the effectiveness of environmental measures (Schindler et al., 2011). Definition of conflicts can help regional planners, national park managers and local development agencies to resolve these conflicts when they arise, balancing the needs of local communities, recreation visitors and environmental conservation. Therefore it is necessary to develop environmental management strategies, especially those related to visitor management, whose measures should be implemented in order to keep sustainable both the protected areas' natural systems and tourism development (Petric & Mandic, 2014).

Unfortunately, the current state of natural habitats in Demänovská Valley is characterized by high fragmentation. Existing tourist and recreation facilities do not allow the creation of larger multi-use forest buffers, and the drive for new construction continually exerts new pressure on forest habitats. A multi-criteria impact assessment of individual proposed development activities in landscape complexes in Demänovská Valley showed that most of the proposed activities have negative or very negative impact on landscape structure and stability and the landscape scenery. This is influenced by an anthropocentric attitude towards nature and tourism development as local authorities give greater priority to tourism development and the use of natural resources than to the environment (Xu & Fox, 2014). Due to high landscape fragmentation, our proposed measures also include of reduction of existing pressures, a halt to new construction proposals, and revitalization of the environment after disturbance, as well as support for ecosystem services of existing natural resources.

Acknowledgement

This contribution was prepared within the project "Current utilization of high mountain landscape, its impacts on change of environment, and assessment of carrying capacity of selected national parks of Slovakia", Grant No. 2/0025/13 from the Ministry of Education of the Slovak Republic and the Slovak Academy of Sciences. We are grateful to James Asher for English proofreading.

REFERENCES

Barancok, P., & Barancokova, M., 2013. *Development of Sports and Recreational Activities in the Chopok Area (nizke Tatry Mts.) and Protection of Important Landscape Elements.*, in: Fialova, J., Kubickova, H. (Eds.), Public Recreation and Landscape Protection - with Man Hand in Hand: Conference Proceedings. Mendel Univ, Dept Landscape Management, Brno, pp. 27–33.

Barancok, P. & Barancokova, M., 2008. *Evaluation of the Tourist Path Carrying Capacity in the Belianske Tatry Mts.* Ekologia (Bratislava). 27, 401–420.

Belcakova, I., 2012. *Landscape Planning Framework in the Environmental Assessment - Linkages and Mutual Benefits.* Ekologia Bratislava, 31, 1–11. doi:10.4149/ekol_2012_01_1

Braunisch, V., Patthey, P. & Arlettaz, R.L., 2011. *Spatially explicit modeling of conflict zones between wildlife and snow sports: prioritizing areas for winter refuges.* Ecological Applications. 21, 955–967. doi:10.1890/09-2167.1

Cousins, J.A., 2007. *The role of UK-based conservation tourism operators.* Tourism Management. 28, 1020–1030. doi:10.1016/j.tourman.2006.08.011

do Valle, P.O., Pintassilgo, P., Matias, A. & André, F., 2012. *Tourist attitudes towards an accommodation tax earmarked for environmental protection: A survey in the Algarve.* Tourism Management. 33, 1408–1416. doi:10.1016/j.tourman.2012.01.003

Fischer, T.B., Jha-Thakur, U., Hayes, S., Gazzola, P., Belcakova, I. & Aschemann, R., 2015. *Environmental impact assessment and strategic environemtal assessment research in the UK.* Journal of Environtal Assessment Policy and Management. V. 17, 1550016. doi:10.1142/S1464333215500167

Fischer, T. & Jha Thakur, U., 2008. *EA Lecturers' Handbook and Curriculum for EA related Master Programmes.* ROAD Bratislava, Bratislava. 196pp.

Grabinska, B., 2007. *The distribution of protected and endangered mammals Versus land use, type of habitat and protected areas of Poland: A geographical approach.* Polish Journal of Ecology. 55, 605–613.

Gratton, M., Morin, S., Germain, D., Voiculescu, M. & Ianas, A., 2015. *Tourism and natural hazards in Balea Glacial area valley, Faragas massif, Romanian Carpathians.* Carpathian Journal of Earth and Environmetal Sciences. V. 10, no. 2, 19–32.

Hoy, A., Haensel, S. & Matschullat, J., 2011. *How can winter tourism adapt to climate change in Saxony's mountains?* Reg. Environ. Change 11, 459–469. doi:10.1007/s10113-010-0155-z

Hrnčiarova, T. (Ed.), 2002. *Landscape Atlas of the Slovak Republic*, 1st ed. Ministry of Environment of the Slovak Republic, Slovak Environmental Agency, Bratislava, Banska Bystrica.

Izakovicova, Z. & Oszlanyi, J., 2009. *Sustainable Landscape Management of the Tatry Biosphere Reserve of Unesco.* Ekol. Bratisl. 28, 333–345. doi:10.4149/ekol_2009_04_333

Keller, F., Kienast, F. & Beniston, M., 2000. *Evidence of response of vegetation to environmental change on high-elevation sites in the Swiss Alps.* Reg. Environ. Change 1, 70–77. doi:10.1007/PL00011535

Kerbiriou, C., Le Viol, I., Robert, A., Porcher, E., Gourmelon, F. & Julliard, R., 2009. *Tourism in protected areas can threaten wild populations: from individual response to population viability* of the chough Pyrrhocorax pyrrhocorax. Journal of Applied Ecology. 46, 657–665. doi:10.1111/j.1365-2664.2009.01646.x

Kienast, F., Frick, J., van Strien, M.J. & Hunziker, M., 2015. *The Swiss Landscape Monitoring Program – A comprehensive indicator set to measure landscape change.* Ecological Modelling, V. 295, 136–150. doi:10.1016/j.ecolmodel.2014.08.008

Klauco, M., Weis, K., Stankov, U., Arsenovic, D. & Markovic, V., 2012. *Ecological Significance of Land-Cover Based on Interpretation of Human-Tourism Impact. a Case from Two Different Protected Areas (slovakia and Serbia).* Carpathian Journal of Earth and Environmental Sciences. V. 7, no. 3, 231–246.

Kňazovický, L., 1984. *Danger of mountains. Get to know - to protect. (In Slovak*: *Nebezpečenstvo hôr. Poznať – chrániť).* Slovenský ústredný výbor ČSZTV, Bratislava.

Kostopoulou, S. & Kyritsis, I., 2003. *Local people's perceptions of sustainable tourism development in protected mountain areas: the case of Mount Olympus, Greece*. In: Beriatoss, E., Brebbia, C.A., Coccossis, H., Kungolos, A. (Eds.), Sustainable Planning and Development. Wit Press, Southampton, pp. 47–58.

Kuttner, M., Schneidergruber, A. & Wrbka, T., 2014. *Do landscape patterns reflect ecosystem service provision? - A comparison between protected and unprotected areas throughout the Lake Neusiedl region.* Eco Mont- Journal on Protected Mountain Areas Research. V. 6, n. 2, 13–20. doi:10.1553/ecomont-6-2s13

Lamarque, P., Tappeiner, U., Turner, C., Steinbacher, M., Bardgett, R.D., Szukics, U., Schermer, M. & Lavorel, S., 2011. S*takeholder perceptions of grassland ecosystem services in relation to knowledge on soil fertility and biodiversity.* Regional Environmental Change, 11, 791–804. doi:10.1007/s10113-011-0214-0

Michalko, J., Berta, J. & Magic, D., 1987. *Geobotanical map of CSSR*. VEDA. Bratislava.

Milan, L., 2006. *Avalanches in mountain ranges of Slovakia. (In Slovak: Lavíny v horstvách Slovenska).* VEDA vydavatel'stvo Slovenskej akadémie vied, Bratislava.

Neuvonen, M., Pouta, E., Puustinen, J. & Sievänen, T., 2010. *Visits to national parks: Effects of park characteristics and spatial demand.* Journal of Nature Conservation. 18, 224–229. doi:10.1016/j.jnc.2009.10.003

Petric, L. & Mandic, A., 2014. V*isitor Management Tools for Protected Areas Focused on Sustainable Tourism Development: The Croatian Experience.* Environmental engeneering and management journal. 13, 1483–1495.

Povara, I., Conovici, M., Munteanu, C.-M., Marin, C. & Ionita, E.D., 2015. *Karst systems within the Southern Carpathians structure (Romania).* Carpathian Journal of Earth and Environmental Sciences. V. 10, no. 2, 5–17.

Ramsar, 1971. *Convention on Wetlands of International Importance especially as Waterfowl Habitat.*

Ramsar, Iran, 2.2.1971 as amended by the Protocol of 3.12.1982 and the Amendments of 28.5.1987.

Roux-Fouillet, P., Wipf, S. & Rixen, C., 2011. *Long-term impacts of ski piste management on alpine vegetation and soils.* J. Appl. Ecol. 48, 906–915. doi:10.1111/j.1365-2664.2011.01964.x

Schindler, S., Curado, N., Nikolov, S.C., Kret, E., Cárcamo, B., Catsadorakis, G., Poirazidis, K., Wrbka, T. & Kati, V., 2011. *From research to implementation: Nature conservation in the Eastern Rhodopes mountains (Greece and Bulgaria), European Green Belt.* J. Nat. Conserv. 19, 193–201. doi:10.1016/j.jnc.2011.01.001

Spyra, A. & Krodkiewska, M., 2013. *The Significance of Woodland Ponds in the Conservation of Rare Species: A Case Study of Placobdella Costata (f. Muller) (hirudinida: Glossiphoniidae).* Pol. J. Ecol. 61, 613–619.

Stadel, C., Slupetzky, H. & Kremser, H., 1996. *Nature conservation, traditional living space, or tourist attraction? The Hohe Tauern National Park, Austria*. Mt. Res. Dev. 16, 1–16. doi:10.2307/3673891

Turecekova, S., 2011. *Skiing and its influence on specific environment components on The ski centre Chopok-south example (NP Low Tatra*), in: Fialova, J. (Ed.), Public Recreation and Landscape Protection - Hand in Hand? Conference Proceeding. Mendel University Brno, Mendel University Brno, pp. 122–124.

Tyrväinen, L., Uusitalo, M., Silvennoinen, H. & Hasu, E., 2014. *Erratum to "Towards sustainable growth in nature-based tourism destinations: Clients' views of land use options in Finnish Lapland"* [Landsc. Urban Plan. 122 (2014) 1–15]. Landsc. Urban Plan. 130, 206. doi:10.1016/j.landurbplan.2014.07.008

VÚPOP, 2000. *Morphogenetic soil classification system of Slovakia (In Slovak: Morfogenetický klasifikačný systém pôd Slovenska. Bazálna referenčná taxonómia.).* Výskumný ústav pôdoznalectva a ochrany pôdy. (Societas pedologica slovaca), Bratislava.

Xu, F. & Fox, D., 2014. *Modelling attitudes to nature, tourism and sustainable development in national parks: A survey of visitors in China and the UK.* Tour. Manag. 45, 142–158. doi:10.1016/j.tourman.2014.03.005

Yilmaz, O., Mansuroglu, S. & Yilmaz, R., 2013. *Swot Analysis of Ecotourism as a Tool for Sustainable Development: A Case Research in North-West Black Sea Coastal Zone of Turkey.* J. Environ. Prot. Ecol. 14, 786–798.

Zhao, J., Li, Y., Wang, D. & Xu, D., 2011. *Tourism-induced deforestation outside Changbai Mountain Biosphere Reserve, northeast China.* Ann. For. Sci. 68, 935–941. doi:10.1007/s13595-011-0099-6

Received at: 30. 03. 2015
Revised at: 22. 03. 2016
Accepted for publication at: 22. 04.2016
Published online at: 12. 05. 2016