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# MUTUAL IMPACTS OF GEOCACHING AND NATURAL ENVIRONMENT

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## Abstract

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Rising popularity of geocaching is linked to increased risk of negative impacts on natural environment. Based on that, this paper intends to present possible approach of how to evaluate these impacts in the Landscape protected area Moravian Karst (Czech Republic) and in the Vrátna dolina valley (National park Malá Fatra, Slovak Republic). Recreation along with nature conservation has been solved in these areas in the log-run and geocaching has been steadily extending offer of recreational activities. Therefore, it seems desirable to examine how geocaching affects environment and simultaneously how topography or land cover influences availability or difficulty of caches. 57 caches (i.e. one third of the total) has been analyzed in the Moravian Karst and 11 caches in the Vrátna dolina valley. To assess impacts, own classification of indicators has been suggested, such as cache attendance, environment attractiveness or visually detected impacts of geocaching on natural environment. Our study revealed the major risk lies primarily in geo-highways which – with respect to soil type, land cover and intensity of cache attendance – grow rather fast. Despite the local nature of detected impacts, an increased attention shall be devoted to environment care and specifically to regulation of attendance.

Keywords: geocaching, tourism, nature conservation, management of protected areas, impacts on natural environment

## INTRODUCTION

### Principles of geocaching

With 6 million players around the world geocaching has received wide attention during last years. The game is an outdoor activity that is based on seeking objects hidden in containers (called caches) using GPS-enabled device. Geographical coordinates, locating the position of the box, are provided after registering on the official website of the game – www.geocaching.com. Each cache is listed on the official website along with information regarding the terrain difficulty, the difficulty of find, size and type of cache, place information and why cache has been placed here.

Based on its nature, the geocaching is positioned between recreational tourism and a sport discipline. If we consider geocaching as a form of tourism, it corresponds to the soft and alternative forms of tourism. Therefore, geocaching stands for not only motive or form, it stands for a supporting stimulus, an auxiliary activity and a tool of tourism (Holešínská and Vystoupil, 2012). The number of caches rises each year, actual state is indicated in the Tab. I

I: *Number of caches in selected countries in year 2014*

| Country | Number of caches |
|---|---|
| USA | 1,009,951 |
| Germany | 328,275 |
| UK | 176,101 |
| France | 109,388 |
| Sweden | 87,081 |
| **Czech Republic** | 39,878 |
| Austria | 37,598 |
| Netherland | 29,878 |
| Switzerland | 24,244 |
| Poland | 17,193 |
| Slovakia | 10,483 |

Source: www.geocaching.com, author

## Position of geocaching in the framework of discipline and expertise

Geocaching offers a wide range of possibilities to be examined – from information technologies over sociological and psychological studies to uses and applications in pedagogy or regional development. Vast majority of papers presents basic game principles and rules of the game (e.g. Taylor *et al.*, 2010, Dyer, 2004). Sherman (2004) describes development and popularity of geocaching from its origin. Gillin (2010) considers geocaching as a tool for social relationships. Kovář (2013) analyses rules of geocaching in terms of historic conservation and archeology. In this sense, he argues that when following rules, geocaching may be regarded as non-damaging activity (Kovář, 2013).

Zecha (2012) focuses on possible ways of how geocaching is to be optimally used in the ecological education. Ihamäki (2007) strives to describe the forms of interaction within the international game and, in addition, describes how to use geocaching as a new educational approach in schools. Similarly, Donadelli (2009) proposes ways of how to use geocaching as an outdoor activity in primary schools. Furthermore, he tries to evoke a team spirit in students, teach them orientation in environment and form a bond towards environmental education (Donadelli, 2009). Further practical examples as for the use of geocaching in education are provided by Hellgren *et al.* (2014), Zecha (2012) or Albach (2015). Spencer (2015) describes uses of geocaching as a propagation tool of library at the Macquarie University. In this regard, a riddle is placed into a book or magazine. Finally, Gnafaki (2011) explores geocaching in the area of mobile technology applications, which thanks to GPS device, Wi-Fi or maps received a wide acceptance among mobile application users.

## Impact of geocaching on natural environment

The impact of geocaching cannot be generalized ambiguously. Frankly speaking, any form of imprudent movement of tourists or visitors may be regarded as environment damaging. Accordingly, we may argue that negative impacts correspond to a common tourism (Holešínská a Vystoupil, 2012).

The most negative impacts of geocaching involve soil and flora damaging by trampling down, causing decreased soil porosity, which in turn leads to further damages on plants and tree roots. Tourists likewise enlarge mountain pavements and in areas of strongly attended caches they may produce visible pathways denoted as geo-highways (Vítek, 2007).

In addition, Holešínská a Vystoupil (2012) argue that disturbing of animals (which are then distracted from reproduction), intentional damaging of vegetation by collection of fruits, or taking minerals or digging into rocks may equally contribute to negative impacts on natural environment.

Environmentalists frequently point out that the cache itself constitutes a foreign element being of plastic nature and thus to be considered as rubbish.

1: *Soil erosion on geo-highway in the national park Malá Fatra*

The advantage of geocaching lies in simplicity of negative impacts detection as we are able to determine precisely how intensively the cache has been attended based on information provided when registering the cache. Fig. 1 shows then the soil erosion due to 435 registered cache visits in years 2011–2014.

The work "Environmental Impacts of Human Activity Associated with Geocaching" explores GPS with respect to tourism, covers recreational ecology and impacts of geocaching on natural environment as well. It describes likewise a wide spectrum of participants of all age groups who perform geocaching. Author describes the practice of placing caches onto open spaces outside touristic tracks and often into ecologically sensitive areas (Patubo, 2010).

Administration of National park and Landscape protected area Šumava capitalized on a potential of geocaching to attract tourists into the region. They created a container (cache) titled *"Lýkožrout smrkový (bark-beetle) 2009"* where a player is provided with an information about this insect. It is a mystery cache having several phases and once a player reaches the last one, s/he is rewarded with a small wooden figurine. Beside these examples, there are many other applications of geocaching in the Czech Republic often used as tools for a development of tourism and regulation of visits.

## THE AREAS OF INTEREST

### Lanscape protected area (LPA) Moravian Karst

Moravian Karst was declared as protected landscape area in year 1956 and currently covers/spreads over 92 km$^2$. The major part of Moravian Karst constitutes mostly broad-leaved woods. There are 11nature reserves, 4 national nature reserves and 2 national nature monuments. The Moravian Karst belongs to one of the most visited karst areas in the Czech Republic. Visitors may admire developed forms of surface and underground karst, unique plant and animal societies, cultural and technical monuments proving existence of a human being for more than 100000 years. At the beginning of year 2015 there was 145 caches found in here.

2: *Localization of Landscape protected area Moravian Karst within Czech Republic*

### Vrátna dolina valley, National park Malá Fatra

National park Malá Fatra is situated in the southwest of the Western Carpathians. Area of the national park itself covers the whole orographic part of the Krivanská Malá Fatra. Regarding the extraordinary natural value of this area, it was re-categorized in 1988 from the protected landscape area to the national park. In the park there are 14 national nature reserves, 9 nature reserves, 5 nature monuments and 1 protected landscape element. There was 47 caches situated in the national park in autumn 2014. Vrátna dolina valley belongs to one of the most important centers of tourism in the Malá Fatra.

3: *Localization of National park Malá Fatra within Slovak Republic*

## MATERIALS AND METHODS

Participants (geocachers/cachers) are self-monitored in the framework of geocaching. Global internet database constitutes an important part of the whole game with information about both caches and players. Thus, a researcher may utilize database information about given area to determine exact number of players trying to find a cache since its establishment. Indicators relevant to the analysis of potential impacts on natural environment were selected as follows: difficulty of find, terrain difficulty, cache attendance (successful, unsuccessful, total) and its distribution over the year, date of cache establishment, size and attractiveness of cache (see Table II for a detailed information on selected indicators).

II: *Characteristics of caches and areas of interest (LPA) Moravian Karst and Vrátna Dolina valley) to be analyzed*

| Indicator to be analyzed | Lanscape protected area Moravian Karst | Vrátna dolina valley (National park Malá Fatra) |
|---|---|---|
| **Data provided by geocaching.com** | | |
| Difficulty of find | yes | |
| Terrain difficulty | yes | |
| Overall attendance | yes | yes |
| Year of establishment | yes | |
| **Fieldwork data** | | |
| Cache-to-pathway distance | yes | yes |
| Access safety | yes | yes |
| Content attractiveness | yes | yes |
| Environment attractiveness | yes | yes |
| Overall attractiveness | yes | yes |
| Visually analyzed impacts on natural environment - character | yes | yes |
| Visually analyzed impacts on natural environment - intensity | | yes |
| **Next analyses** | | |
| Placement of caches (in small-scale protected areas) | yes | |
| Placement of caches (in European important localities within NATURA 2000) | yes | |

## Indicators to be analyzed

### *1. Cache attendance*

Low attendance (less than 12 visits/month); middle attendance (13–18 visits/month); high attendance (19 and more visits/month)

### *1a. Overall cache attendace*

Low attendance (less than 500 visitors); middle attendance (501–1000 visitors); high attendance (more than 1000 visitors)

### *2. Cache-to-pathway distance*

Average distance is approximately 40 m. Caches were divided into 3 groups with respect to willingness of a player to seek cache:

1 – close caches (15 m); 2 – remote caches (15–30 m); 3 – very remote caches (50 m and more)

The cache-pathway distance plays a crucial role when making a choice about the cache. If the cache is situated less than 15 m from the pathway, the search after cache will tend to be rather straightforward and vice versa. If the cache is situated 50 m, factors such as find or terrain difficulty come into play additionally and may thus distract geo-cacher from further searching.

### *3. Access safety of cache placement*

1 – safe access; 2 – slightly dangerous access; 3 – very dangerous access

This indicator aims to denote caches with a dangerous access (usually to be found in hills).

### *4. Content attractiveness*

1 – unattractive content; 2 – attractive content; 3 – very attractive content

Content attractiveness becomes vital when geo-cacher makes a decision whether cache evoked his/her interest and whether s/he is ready to see the cache.

### *5. Environment attractiveness*

1 – unattractive location; 2 – attractive location; 3 – very attractive location

Such indicator demonstrates the cache surroundings. If the cache is placed into a very attractive environment (with a beautiful view, tourist points in its close surrounding, etc.), number 3 is assigned to the cache.

### *6. Overall attractiveness*

Overall attractiveness comprises content and environment attractiveness and was computed as a sum of these partial indicators (6 points for maximum attractiveness and 2 points for the lowest level of attractiveness).

### *7. Impact on natural environment*

Above-mentioned indicator was decided to be the most important indicator in this paper. Due to the fact that caches are situated in protected areas, it became crucial to examine the negative impacts of geocaching in a park. As indicated elsewhere, any type of imprudent activity of players may affect environment negatively.

Visible negative impacts on natural environment are:

- damages to soil – trampling, soil erosion, enlargement of mountain pavements (i.e. geo-highways)
- damages to vegetation
- damages to tree roots
- damages to rocks (abrading)

Classification of impacts intensity with respect to visually detected signs:

1 – no impact on natural environment;
2 – little impact on natural environment; 3 – strong impact on natural environment

## RESULTS

From the above mentioned indicators, results of those best characterizing mutual affects between geocaching and natural environment, are further described by means of:

1. Overall cache attendance
2. Access safety of cache placement
3. Environment attractiveness
4. Terrain difficulty
5. Negative impacts of geocaching on nature and landscape (on natural environment).

Results of examined locations are discussed individually as these were not comparable in terms of content.

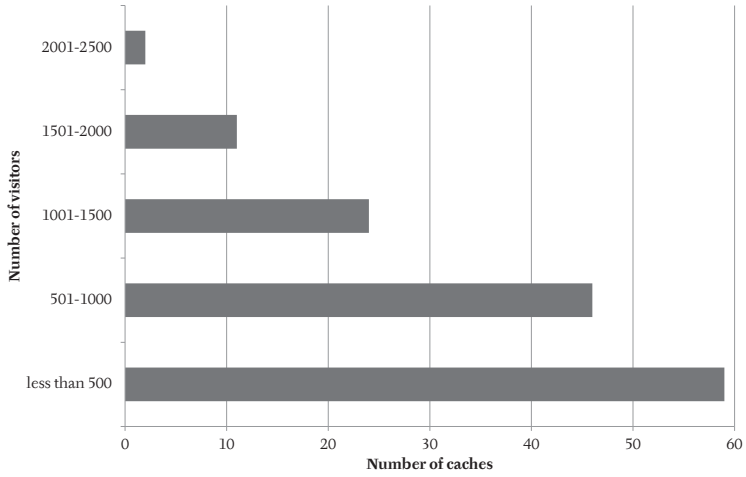
Counts of caches located in small-scale protected areas are given for the Landscape protected area Moravian Karst. Results for the Moravian Karst are provided collectively, for the National park Malá Fatra due to the lower number of caches more into detail.

### Lanscape protected area Moravian Karst

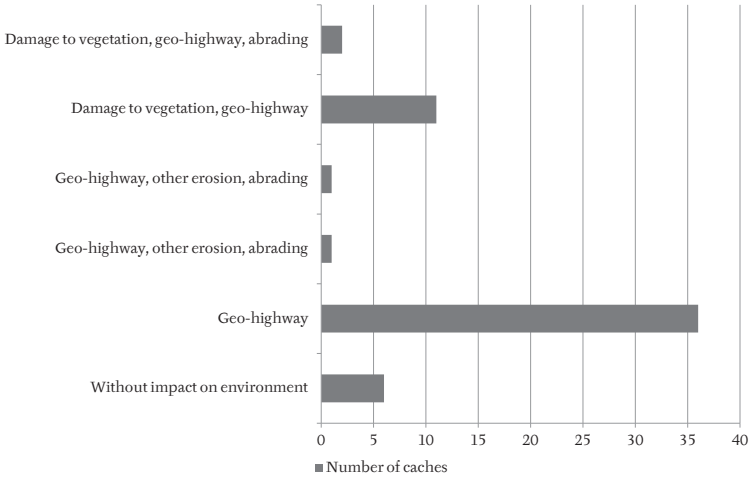
#### *Overall cache attendance*

Cache attendance is dependent on both seasonality and weather. The attendance tends to be higher in the spring and summer and lower within autumn and winter. The year of cache establishment is equally important (caches established in year 2014 or 2015 will have logically lower rate of attendance than caches established earlier).

Figure 4 represents attendance of all caches in the Moravian Karst. The highest attendance of checked catches was recorded among caches with 501 to 1000 visits, that is, 23 caches out of total 57 visited caches.




4: *Total attendance of all caches in the Landscape protected area Moravian Karst on the date 28.2.2015*




5: *Negative impacts on nature and landscape among analyzed caches in the Landscape protected area Moravian Karst on the date 30.4.2015*

### *Access safety of cache placement and terrain difficulty*

Brněnská pohodová cache is situated in a very dangerous terrain (in abandoned limestone quarry). This cache is placed on the rock requiring helmet and rock-climbing equipment.

Slightly dangerous access was recorded in a set of 16 caches (e.g. cave entrances, small rock-climbing or climbing steep slope of the quarry). In sum 70 % of caches are located in a safe terrain with no life endangering factors.

Terrain difficulty (with 9 levels of difficulty ranging from 1 to 5 where each size of a level amounts to 0,5) seems to be the decisive factor when comes to players' motivation whether to search after cache or not.

Caches with terrain difficulty 1,5–3 are dominant in this area whereas very dangerous caches are rather rare here. Out of the 145 caches, 21 caches show terrain difficulty 3,5–5.

### *Environment attractiveness*

32 caches out of 57 are located in an attractive environment and 18 caches are situated in a very attractive environment. Less attractive environment is characteristic for caches near to busy roadways making the search fast and rather straightforward, however, at the same time due its unattractive location discouraging from further search.

### *Impacts of geocaching on nature and landscape*

The following is an outline of activities with a negative impact within this area: geo-highways, damages to vegetation and rocks and soil erosion. 6 caches did not exhibit any signs of damage due to the fact that were placed near to roads and therefore protected from trampling or other ways of how to negatively affect vegetation.

Second and more serious group involves caches with merely one negative impact – geo-highways (taking into account along with soil trampling). This group is likewise most numerous group covering 36 caches out of 57 investigated caches.

However, more negative impacts on nature and landscape were monitored among 15 caches. As these are positioned a long way from the road network and thus more surrounded by natural environment such as rocks, vegetation, etc.

### *Distribution of caches in the small-scale protected areas*

In sum 39 caches are situated in the small-scale protected area in the Landscape protected area Moravian Karst, out of which 17 caches are part of the national nature reserve, 3 caches of the national nature monument and 19 of the nature reserve.

## National park Malá Fatra

### *Overall cache attendance*

Overall cache attendance in Vrátna dolina valley usually falls within a range 250 – 990 geocachers per cache and is characterized by a high success rate of found caches. As such caches are mostly placed on the same tourist path, it might be interesting to examine whether and how the cache attendance differ at its origin (usually on valley level) and finish (usually on the ridge).

### *Access safety of cache placement and terrain difficulty*

Caches with a very dangerous access (labeled as '3' according to our methodology) amounted to three caches and caches with a slightly dangerous access (labeled as '2') added up to only one cache (Malé Noclahy). Remaining caches may be denoted as more or less safe.

Proposed indicator might be very valuable in describing geocacher's own cache (in listing) by assigning stars based on its safety.

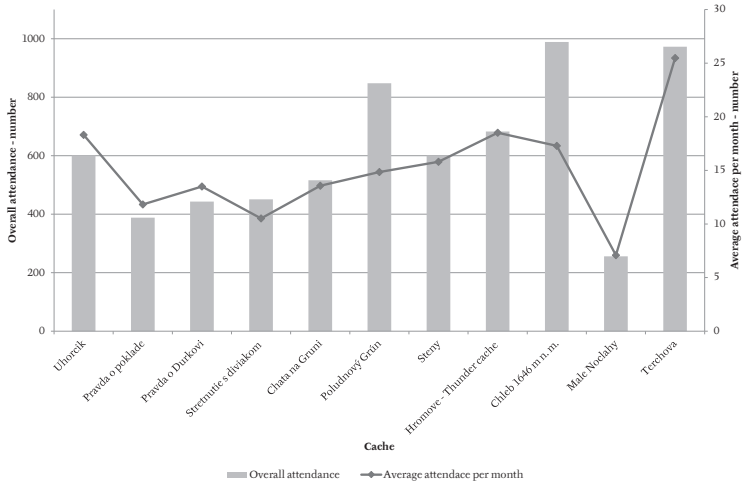
### *Environment attractiveness*

Altogether 2 caches were found in unattractive environment. Cache 'Uhorcik' has been situated on a densely visited track, its placement though did not encourage players to search further. In its surrounding one could find only a hillside evoking dangerous rather than interesting place. 7 caches were found in a very attractive environment, nevertheless, that is given by attractiveness of area of interest.

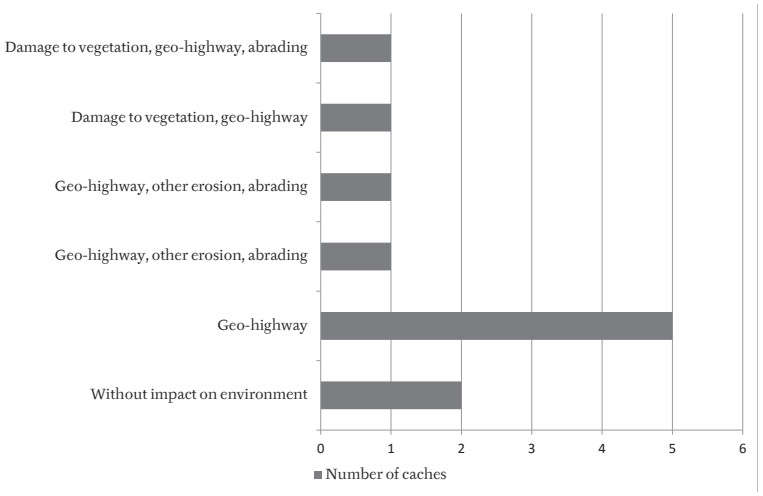
### *Impacts of geocaching on nature and landscape*

Immediate surrounding of 9 caches exhibited several manifestations of attendance. Despite this fact, however, the overall intensity of impacts among 7 caches may be classified as low. Only 2 caches were heavily affected (wide geo-highway) and no visible damages were observed on 2 caches.

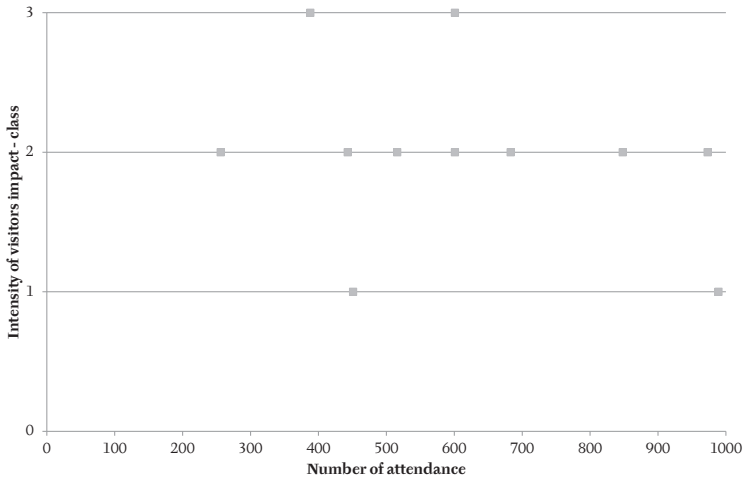
Based on this result, we may conclude that the most severe negative impact of the game within this area leads to an enlargement of mountain pavements, in particular, outside the indicated tourism pathways, and to development of geo-highways.




6: *Overall attendance and average attendance per month of individual caches in Vrátna Dolina valley (National park Malá Fatra) on the date 6.6.2014*




7: *Types of negative impacts due to cache attendance among analyzed caches in Vrátna Dolina valley (National park Malá Fatra) on the date 6.6.2014*




8: *Intensity of negative impacts on natural environment due to cache attendance in Vrátna Dolina valley (National park Malá Fatra) on the date 6.6.2014*

## DISCUSSION

Geocaching has attained considerable value in terms of its current impacts on natural environment. Despite its intensive development, however, its impacts seem negligible compared to investors or forest management intentions (particularly in the National park Malá Fatra). On the other hand, placement of caches directs participants outside the indicated pavements (to be in many instances not allowable) or towards unnecessary contacts with local predators (e.g. the brown bear). The most destructive impact on natural environment are geo-highways resulting in a soil erosion produced by trampling of a land cover. Besides visually obvious impacts on natural environment (Schneider, Lorencová, 2015), such as damages to soil surface, there are other factors not to be visible at first sight yet still of a great importance, such as disturbing of wildlife (and their reproduction). Simultaneously, one shall allow for a fact that impacts of geocaching do not tend to be of a single effect but much rather of multiple synergy effects. In terms of impacts assessment methodology, the assessment of impacts intensity seems to be the most subjective. One may consider them in terms of a local impact with a considerably higher intensity as if they were compared to impacts of other activities (of tourism or management nature, for instance)

Anyway, it is commonly desirable to take into account geocaching in specially protected areas. For authors of a management plan it is not of a great cost to find particular cache via geocaching. com, verify its existence in terrain and accordingly, propose further monitoring or regulatory measures. In addition, one may incorporate principles geocaching is based on into visitor regulations. Last but not least, administration of protected area may actively participate in regulating placement of caches into convenient locations.

## CONCLUSION

Number of caches has been rising rapidly both worldwide and in the Czech and Slovak Republic. Such development concerns specially protected areas including national parks and protected landscape areas. While impacts of geocaching on natural environment are merely of a local nature they became essential – among others due to localization of caches into small-scale protected areas. In terms of tourism, it is equally important to position caches into difficult terrain, however, by doing so, this may turn game into a dangerous activity. In this regard, geocaching shall be deemed as a tool of how to regulate cache attendance and be treated in the management plan accordingly. On the other hand, from the standpoint of monitoring of recreation activity impacts on natural environment, information provided in listings of individual caches may be helpful – cache attendance, date of establishment or difficulty.

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