Geo-caching for wheelchair users: A pilot study in Luhačovské Zálesí (Czech Republic)

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Abstract

An optional leisure activity in the countryside for wheelchair users is subject to discussion b in this article. Geo-caching is a leisure activity on the borders between tourism and sport, which appeals to a growing proportion of peoples globally. It can become a prospective part of social tourism as a leisure activity for persons with disabilities: this paper devotes attention to wheelchair users. In this research project we analysed how terrain difficulty and its markings reflect on the availability of caches to be gained by wheelchair users. The aim of the field survey was to verify if the caches indicated by the difficulty of the terrain (terrain level: 1 and 1.5) can be considered available for disabled people. The availability of the caches was also assessed based on the presence (aid) of an assistant. We found that access to most of the easily available caches contains small but critical constraints for wheelchair users – from path bumps to the very cache locations which are unreachable for wheelchair users. Therefore, we have proposed a set of recommendations and pictograms to make geo-caching more available for persons using wheelchairs and to expand their opportunities for active outdoor leisure activity. The results will be used to design access to natural sites for wheelchair users.

Keywords: disabled people, leisure time activities, sustainable tourism, accessibility, road surface, Czech Republic

1. Introduction

Geo-caching is a leisure activity on the borders between tourism and sport. The basic principle of the game is to search for hidden containers (caches) using GPS devices, and then to share such experiences from their search with others via the Internet. The main benefits of geo-caching include possible education of players in various fields and this way of spending leisure time is of high quality. This game has a positive effect on tourism as well, and tourism is an important factor in regional development. According to Geo-caching.com, geo-caching was created in 2000 and currently it has approximately 3 million active players and 2.8 million caches worldwide.

The popularity of this activity is also confirmed by the constant growth in the number of the caches hidden in the world and in the Czech Republic. This game is currently very popular in the Czech Republic. It has gained thousands of active players there since its start and, with respect to the number of its caches, the Czech Republic ranks among the first ten countries in the world. The caches in the Czech Republic rank among the most visited and Czech geo-cachers are some of the most active.

The word geo-caching consists of the words "geo" for "Earth" and "cache", which is the term used for hidden stocks, as well as data stored in the computer (Peters, 2009). The basic idea consists in locating the hidden containers, which are called 'geo-caches', and then sharing the experience with other players (geo-cachers) at the official website, Geo-caching.com. Geo-caching is played by people of all age groups, with strong perceptions of the player community and sensitivity to the environment. Geo-caching is not defined against the other forms of tourism. It is not a substitute, it is complementary. Geo-caching as a complement can be done nearly everywhere. It is a supportive stimulus, additional leisure activity, and a tool of tourism. As the Czech people are fond of tourism and hiking and go hiking even without geo-caching, it is considered a "value-added" (Bittnerová, 2012).

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The main objective of the European Disability Strategy 2010–2020 (adopted 15 November 2010) is to empower people with disabilities so as to enable them to enjoy their full rights, create a barrier-free Europe for all, and comply with the international commitments made at the United Nations Convention on the Rights of Persons with Disabilities (Pagán, 2012). The relationship between disability and tourism can be analysed within the broader literature on ''social tourism'', which is concerned with barriers and other issues affecting participation (Pagán, 2012).

Outdoor recreational activities include a lot of constraints for disabled people. A tourism/leisure constraint refers to various factors which preclude or reduce an individual's frequency, rate, or enjoyment as a participant in such activities (Lee et al., 2012). Table 1 presents the basic division of constraints for disabled persons within tourism, hiking and leisure activities.

The authors of this paper have dealt with issues of access to landscape for wheelchair users in the long term, at the national and international levels. This paper presents a pilot survey of options and the current status of placing and marking caches in the landscape, as well as in built-up areas. Any search for caches is not limited in age or sex and is usually affordable. In our opinion, however, it is vital to provide information about the options of cache finding and the limiting factors that can make caches inaccessible for wheelchair users. The output is a methodology that should be used by those who place the caches, as well as cache reviewers, who check and approve of individual caches. The designs show instructions for cache hiders for the wheelchair users that go alone to find a cache, as well as the options of cache marking for wheelchair users who will need assistance. Sometimes only a little is needed for a cache to be accessible also for wheelchair users. As regards the information in Table 1, the authors would like to provide information to help to eliminate one of the constraints mentioned – architectural constraints and ecological constraints. The literature review deals with social tourism and links to the issue of disabled persons. Attention is focused on the description of geo-caching as such, as well as the issue of the survey target group, i.e. wheelchair users. Also, a description of the current status of cache hiding in the terrain in relation to the survey target group is presented.

The main aim of the research is to analyse how the terrain level and its markings reflect on the availability of caches to be gained by wheelchair users. It was necessary to examine the current condition, number and accessibility of caches within the selected area – the micro-region of Luhačovské Zálesí – and to determine whether the caches, in particular in the easiest category, are available; if they are not, what are the critical limits of accessibility?. Based on these findings, we aim to suggest how these restrictions can be avoided during the hiding of the caches, and to define the spatial parameters of geo-caching for people using wheelchairs.

Luhačovské Zálesí was chosen as the pilot site for the survey because the caches there are located both in the urban environment and the landscape. The aim was to evaluate sites both inside and outside of the cities.

We based this survey on the current marking of caches:

- the assessment of terrain difficulty and
- the difficulty of finding the cache.

The paper also deals with the issue of so-called virtual caches. The recommendations proposed for placing caches in the terrain (in the municipalities and in the landscape) should help wheelchair users, who often choose not to go seeking caches due to various constraints and obstacles in the terrain, to obtain information. Everybody that would want to place a cache accessible for wheelchair users in the terrain would have to meet some parameters and the cache would be marked with a recommended symbol at the web site. The caches would be marked either as accessible independently (without assistance), or those accessible with assistance.

After discussions with wheelchair users and their families, and especially the staff of the League of Wheelchair Users, this topic was evaluated as important. They welcome each initiative that is aimed to provide better information on leisure activities for wheelchair users or specific proposals to improve the options of leisure activities.

2. Theoretical background

2.1 Social tourism and disabled people

Social tourism or 'tourism for all', which is advocated by Rollová (2010), contains the terms that were hidden in the background of social interests until recently. Social tourism focuses on making travelling accessible to people financially disadvantaged, the disabled and the elderly. Currently, this issue is given more attention, as we are aware that in many cases it can revive tourism in a number of areas and regions. Persons with disabilities constitute a group which have more complicated living conditions because of their impairments. In recent years, social tourism has become a very important topic discussed in a series of conferences organised by the United Nations (e.g. Convention on the Rights of Persons with Disabilities – CRPD), the World Tourism Organisation (e.g. UNWTO, 2016), and last but not least also the European Union authorities (e.g. European Accessibility Act, European Disability Strategy). Due to the diversity of the topic, there is no uniform definition of social tourism.

The tourism demand of disabled people in the market is increasing due to the following factors (ISTO, 2014):

i. the number of persons with disabilities;

ii. impaired people usually travel with a friend, relative or social worker;

Dimension	Constraints
Intrinsic	Lack of knowledge, health-related problems, social ineffectiveness, physical and psychological dependency
Environmental	Attitudinal constraints, architectural constraints, ecological constraints, transportation constraints, e.g. air travel, rules and regulations constraints, e.g. international air regulations
Interactive	Skill-challenge incongruities, communication barriers, e.g. language

Tab. 1: Leisure-travel barriers of disabled tourists
Source: Smith (1987) in Lee et al. (2012)

iii. the fact that the tourism market has dynamically developed;

iv. people with disabilities and older people can travel outside the main season, which makes for a more homogeneous perennial demand that all travel agencies wish to have; and

v. these clients are mostly booked to leave for a long time in advance, which is a guarantee for the tourist industry.

Page and Connell (2009) stated that social tourism can engage people who would normally not have this opportunity because of economic reasons, unavailability or inability. According to Jolin (2014), social tourism points to the available activities and programs for different population groups – the elderly, families with children, people with low income and people with disabilities – so that they have a chance to engage in them. The basic ideas of tourism for all are mainly to make tourist routes, destinations and products accessible, to take all related necessary measures that will allow all citizens to use the tourism services, regardless of any citizen's economic situation, and at the same time respecting their uniqueness and individuality (ATHENA, 2009).

Social tourism also includes leisure activities of people with disabilities and in the Czech Republic it is becoming increasingly popular. This country ranks very highly in Europe in terms of the signposting of hiking routes (www. stoplusjednicka.cz), and some places are recommended for wheelchair users (https://www.kct.cz) and (http://www. helpnet.cz). The accessibility of buildings and cities for people with disabilities is addressed by various projects, as shown by information portals (http://www.helpnet.cz). Currently, it is possible to classify 10% of the population as persons with disabilities. Adding the number of family members and assistants who accompany the disabled people, we obtain a potential 30% of the active population with special demands on travelling. (http://p12.helpnet.cz/). Such a large group of people deserves attention. Examples of projects supporting accessible tourism as such include the following: "Beskydy for all" or "Wheels on the Road" in the Czech Republic; "The landing tourism" in Bulgaria (Soldánová, 2014); and "Tourism for All UK" (TFA, 2008) and OpenBritain (OpenBritain, 2014) in the United Kingdom.

Titzl (2000) and Soldán et al. (2014) stated that social tourism helps persons with disabilities live a full and active life and join in social actions. Most of these people are forced to make a huge effort if they want to reach their desired destinations. It is very important that society is aware of people with reduced mobility and their need for inclusion in social life. According to Houserová (2005, not paged, translated from Czech): "It is necessary to accept the fact that persons with disabilities have the right to be transported and, if possible, easily and without expending all their forces". We can help them by minimising the barriers they encounter in their lives. With respect to social tourism, according to Rocca (2014), forest roads are often suitable for wheelchairs, but they must satisfy minimum requirements regarding surface, slope and obstacles. Forest roads are the object of the field work in this article. In this paper, following information from Kolářová (2012), the terms 'disabilities' and 'disabled people' are used to describe groups of people with disabilities and the research and designs are oriented to groups of people confined to wheelchairs. As Rollová (2012) states, senior citizens as well as disabled people want to travel; however, they usually do not want programs for "special clients". Products marked as Tourism for All are much more acceptable.

2.2 Wheelchair users and design considerations

Wheelchair users are people with impairments whose movement is dependent on the mechanical or power-driven wheelchair. These people are challenged with limited movement and especially architecture-inflicted barriers (Kacanu, 2001). Vágnerová (2004, p. 251, translated from Czech) says that: "Mobility impairment is the cause of restricted independence; it strengthens the dependence on other people, represents a barrier to getting lots of experience, and brings about the related restriction of socialisation or social adaptation."

It is important to provide all the people who have mobility impairment with compensation for their limited movement. Unless society is aware of this, they may become excluded from social life. Support for people in wheelchairs can help make various activities accessible and that will keep them active and prevent their social exclusion (Vítková, 2006).

Access to enclosed areas (buildings, etc.) in the Czech Republic is regulated in Decree No. 389/2009 Coll., on general technical requirements for barrier-free use of buildings. The parameters are analysed in detail in Zdařilová (2011). Figure 1 and Tables 2 and 3 present the parameters required for a wheelchair to turn.

Stronger wheelchair users can move on reinforced roads using their own forces. Potential obstacles on the roads are especially steep slopes and a disproportionate length of the route. The degree of their independence is dependent on the character of their disability. Persons in wheelchairs are
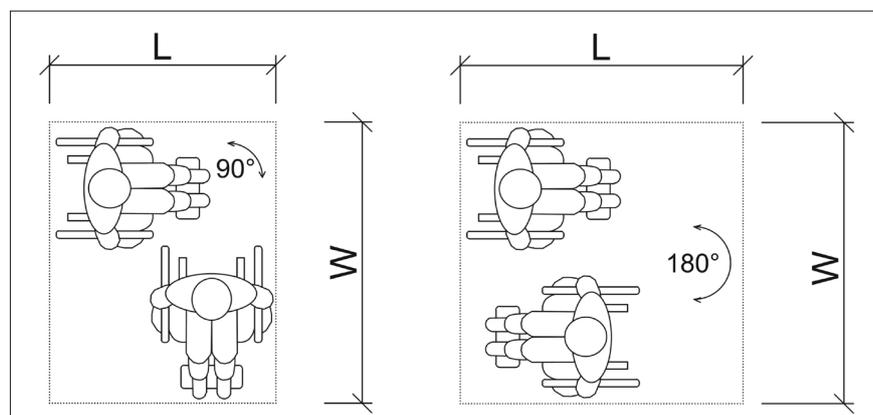

Fig. 1: The space necessary for rotation – supplementary material for Tables 2 and 3
Source: Zdařilová (2011)

Wheelchair type	L – length [mm]	W – width [mm]
mechanical	1,300	1,450
power-driven	1,500	1,600
with assistance	1,200–1,800	1,500–1,800
the minimum value stipulated in Decree No. 398/2009 Coll.	1,200	1,500

Tab. 2: The space necessary for 90° rotation
Source: Zdařilová (2011)

Wheelchair type	L – length [mm]	W – width [mm]
mechanical	1,900	1,500
power-driven	2,200	1,600
with assistance	1,600–2,000	1,500–1,800
the minimum value stipulated in Decree No. 398/2009 Coll.	1,500	1,500

Tab. 3: The space necessary for 180° rotation
Source: Zdařilová (2011)

classified in groups and subgroups – most often we encounter a classification based on the cause, i.e. why these persons need the wheelchair (Bendová, 2007):

- wheelchair users with severe physical disabilities present from birth; and
- wheelchair users whose disabilities occurred during a person's lifetime, due to an accident or illness.

Making landscapes accessible by designing tourist routes, allowing mainly wheelchair users an independent, safe, easy and smooth motion and their passing with other pedestrians or even bicycles in a natural environment, has been discussed for example by Loučková and Fialová (2010), and Jakubis and Jakubisová (2012). Junek and Fialová (2012) state that there are many among us who like a quiet corner of nature – to climb rocky peaks, descend into valleys or breathe on the banks of roaring torrents. There are also people, however, who, due to their medical condition, are unable to do so and we have somehow overlooked to give them the opportunity (Junek et al., 2012). In addition, Janeczko et al. (2016) indicate that preferences of wheelchair users regarding recreational routes and activities vary due to locational conditions. Hence, there is a need for such field work not only for different regions but also at the national level.

The trails shared by cyclists and pedestrians should have a width of ≥ 3.00 m. If the intensity of traffic on the trail exceeds 180 pedestrians/hour and 150 cyclists/hour, the trail should be extended to 4.00 m, or the traffic of cyclists and pedestrians will be separated. At an intensity of ≤ 50 cyclists/hour and 100 pedestrians/hour, the width of the trail can be reduced to 2.00 m, or in cramped conditions to 1.75 m (Kotásková and Hrůza, 2013).

2.3 Geo-caching

Ihamäki (2013) describes the implementation of geo-caching for the case of educational programs in schools. Based on a specific example, the author points out the positive aspects of geo-caching. By geo-caching, children can improve their skills in language, critical thinking, information technology and geography. Ceeová (2008) stated that geo-caching should be included in the practical exercises of geography, because it combines the use of modern technology, work with a map, movement in the terrain and a game – all together in an appropriate way. Donadelli (2014) in his work "Outdoor learning and geo-caching", showed some exact steps for incorporating geo-caching into teaching. In any case, it is necessary to have a clear goal – what the teacher wants to pass to students, find a safe environment for the game, think of interesting tasks that will motivate students, and create teams so that the game is interesting for all students. Zecha (2012) focused on the connection of geo-caching with ecological education and the possible ways to use this combination. This work, for example, answers the questions how an appropriate cache should look and what features the route designed for environmental education should have.

Some studies have addressed computational aspects, others refer the use of the activity as a pedagogic tool, but very few have dealt with motivational or geographical issues related to geo-caching (Mendes et al., 2013). Weber and Haug (2012) described possible conflicts of geo-caching with the environment. From the perspective of applied geography, for example, the involvement of geo-caching in urban and regional development strategies can be examined and solutions to potential conflicts can be researched. Further, they mentioned that geo-caching players are active both virtually – when searching for information about caches – and physically – when searching for hidden containers. The physical presence provides the social importance of the game. Zeng (2011) drew attention to the fact that, unlike other similar games, in geo-caching you must confirm your presence in the logbook. Only then can the players be acknowledged to have found the cache. Also, Zeng pointed to the importance of physical presence and the possible satisfaction of a desire to leave virtual travelling, which according to this author is becoming the most common form of travel at present, as well as a major benefit in the possibility that players create their own experience.

According to Formánková and Vágner (2012, p. 12, translated from Czech): "geo-caching can be used by tourist agencies or other tourism actors as a marketing tool to attract a different customer segment or bring tourists to areas with low traffic". The main advantages of the game are the relatively low costs and the wide range of uses: companies

and government agencies in the USA use the game to attract tourists to specific areas and to make various social events even more interesting. (Gillin, 2010).

According to O'Hara (2008), the main components of this game include the movement of participants in the area and their involvement in the game, either physically or virtually. In the course of the game, interaction between the participants occurs. One of the main themes of geo-caching is discovering new places. O'Hara states that the caches are hidden in interesting places surrounded by natural treasures. Geo-caching brings players to locations they would not see otherwise. Willis (2010) claimed that geo-caching is not a mere activity carried out in the area, but the game participant is forced to interact with the environment. This cooperation then motivates them to think about the environment in which they are moving. Even though they know the specified cache coordinates in advance, they can only find an approximate location. To discover the cache, the players need to use their imagination and experience. They are often forced to overcome a series of physical and geographical barriers.

Geo-caching can be classified as a local, short-term unorganised and individual type of tourism. There are cases, however, when groups of geo-cachers set out for several day-long trips (often abroad) to find caches. Geo-cachers also use bicycles and cars, so it is not totally appropriate to call geo-caching a form of hiking (Holešínská, 2012).

The Czech Republic is tenth in the world in terms of the number of caches, and sixth among European states for the year 2015. As of October 31, 2015, 46,333 (active caches were registered in the Czech Republic. When the already disabled and archived caches are added, over 69,000 caches have been created in the Czech Republic since the beginning of the game (http://project-gc.com/Profile/ProfileStats).

Geo-caching is a form of soft tourism, which combines staying in the countryside with getting informed about the places visited. Some cachers use bicycles and cars but most of them make long foot trips. Caches in the landscape

allow the cachers to perceive natural values and processes more intensively. These types of caches serve as virtual educational trails and information boards. Geo-caching uses modern technologies and thus spreads information among young tourists who are not interested in information boards (Vítek, 2007).

There is a risk associated with geo-caching as a tourist activity, however: a negative impact on nature and the landscape. Many caches, for example, are hidden in places located in protected areas. This impact is currently vividly discussed in the literature, especially the spaces around caches, which are most impacted by the search for them. Therefore, visitor rates must be closely followed and, if possible, controlled (Patubo, 2010).

2.4 Geo-caching in the Czech Republic as a form of leisure activity for persons with disabilities

The Czech encyclopaedia of geo-caching (wiki.geo-caching.cz) states that the number of stars on the scale of the terrain represents the number of limbs needed to find the cache. The description of terrain level 1 is "I can jump there with one leg, also a wheelchair user can get it easily". Apparently, caches with terrain level 1 are the most easily available ones. Their hiding and seeking, however, is not very popular for most of the geo-caching community. These caches are located in places accessible for the general public, and therefore they are often the target of people who do not know geo-caching and who sometimes even in ignorance steal or destroy the container. The cache hiders need to check the containers constantly and see whether they are in place and intact. This is very discouraging for the cache authors with respect to hiding the caches in terrain level 1. Characteristics of difficulty can be found in Table 4 and the characteristics of the terrain for the distribution of caches are presented in Table 5. Figure 2 shows the number of caches based on the level of difficulty and terrain in the Czech Republic as of December 31, 2015. From Figure 2 the most frequent caches are those marked as terrain level 1.5 and 2; however, these are inaccessible
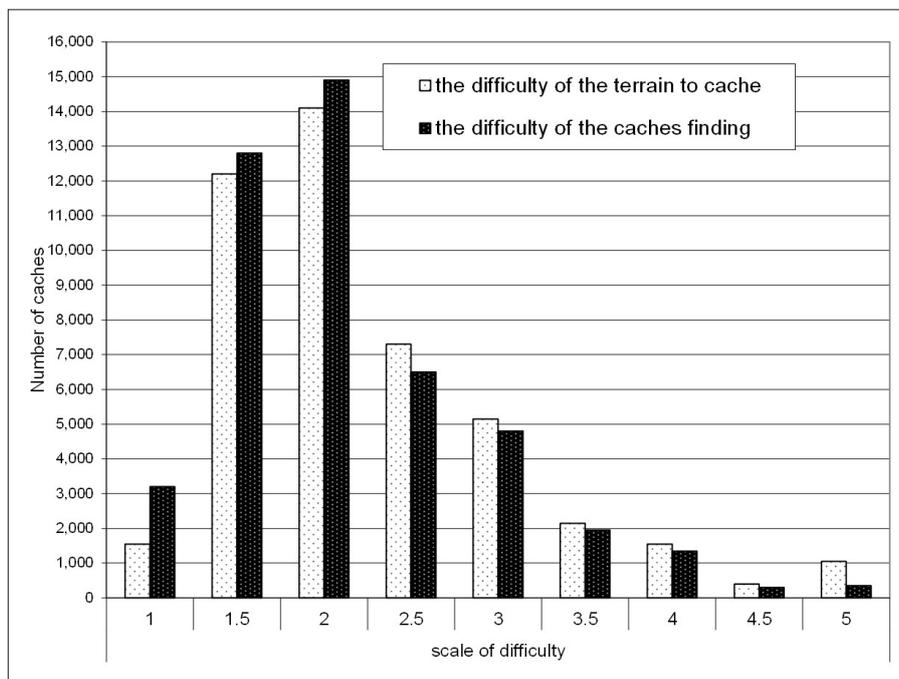
Fig. 2: The number of caches in the Czech Republic by the level of difficulty and terrain as of October 31, 2015
Source: authors, based on project-gc.com

Difficulty	Difficulty characteristics
Level 1	Caches easy to find, thanks to the description and clues. In some cases, it is possible to find the cache even without a GPS device, after a thorough study of the cache listing. Recommended for beginners. Hidden in a solitary tree roots, at small sacral buildings in a meadow, etc. No multi-caches or mystery caches are included.
Level 2	Simple traditional and multi-caches with the usual hiding (trees, stumps in the forest, well accessible thickets).
Level 3	More complex multi-caches, where the cacher proceeds from one hidden place to another and collects the information necessary to find the final coordinates. These caches require thorough preparation before the search. Difficult calculations are included that can be very challenging. Most of these caches have interesting hiding places.
Level 4	Very time consuming. Difficult mystery caches and very long multi-caches. Involve complex puzzles and their hiding places can be very challenging even for experienced players.
Level 5	This category includes the most difficult mystery-cache with great time demands and difficult puzzles. Caches are designed for truly experienced players. Not everyone can find such a cache.

Tab. 4: Cache classification by difficulty
Source: authors, based on Geowiki.cz

Terrain	Terrain characteristics
Level 1	Roads, reinforced paths, sidewalks, marked hiking trails, but also dirt roads. The paths where everybody without distinction can move, mothers with children as well as people in wheelchairs or cachers with roller skates.
Level 2	Not reinforced roads in any terrain. Simple field or forest terrain outside roads. Children and their grandparents can manage.
Level 3	More difficult terrain with no roads; steep hills, skipping over streams, thickets, nettles. Terrain manageable for most people, but with possible minor complications (abrasions, heavy breathing).
Level 4	Terrain for sporty people. Includes very steep slopes, wetlands and marshes, wading streams, rivers (streams that can be skipped over are included within terrain level 3). This designation is recommended for all caches which are 2 metres above ground, and it is necessary to climb up the tree/wall.
Level 5	Very difficult terrain; requires special equipment. For very fit sporty people. Includes rappelling, diving, swimming against the current, etc.

Tab. 5: Cache classification by terrain
Source: authors, based on Geowiki.cz

for wheelchair users. Caches with difficulty and terrain levels marked with three or more stars are designed for experienced cache-hunters, who play the game on a regular basis and have several years of experience.

3. Methodology

3.1 Survey design

A field survey was conducted in the case study territory – the micro-region Luhačovské Zálesí (Czech Republic). This location was chosen with respect to its proximity to the Luhačovice spa town. Luhačovice is the largest Moravian spa with a long tradition of spa treatments for respiratory, digestive disorders, diabetes and musculoskeletal problems. The town is famous for its natural mineral springs, favourable climatic conditions and pleasant environment, which combines beautiful nature and typical architecture (http://www.luhacovice.cz/24834-lazenstvi). The possibility of treating diseases of the musculoskeletal system in the area was an important aspect for making research in the field of accessibility of caches. We focused on a target group of people with reduced mobility – people in wheelchairs.

The aim of the field survey was to verify if all the caches indicated by the difficulty of the terrain (terrain level) 1 and 1.5 can be considered available for disabled people. The availability of the caches was also assessed based on the presence (aid) of an assistant. In the course of the research, all caches with the difficulty selected were found

(total number of caches 21, as of October 31, 2015 – that is about 18% from all the caches in the study area: see general information about the caches below), and photographs were taken of the caches and access to them. Inappropriate situations were identified on the basis of the critical limits excluding wheelchair users. For example, these included terrain barriers (kerbs, large cracks in road surfaces, bumpy roads, etc.) or caches located outside the defined range. The accessibility of individual caches was assessed using the methodology of the Prague Wheelchair Organization; this methodology is also used for the rules of cache hiding for the disabled. A cache hiding place is marked by a circle in the photographs, bold arrows and ellipses show obstacles on the way to the cache.

The terrain survey was conducted in summer 2016. No wheelchair user participated in the pilot survey to check the existing caches. The caches were identified (found) and their surroundings were visually searched. A tape measure and a retractable tape measure were used to measure the distances, sizes and heights of obstacles, and specific troublesome sections were photographed. The primary factor taken into account was whether a person sitting in a wheelchair can find and get the cache without assistance.

Geo-caching offers rating scales for the difficulty of both seeking the cache and the route. As easily accessible caches are often stolen or destroyed, their occurrence is not very frequent. Based on the field survey and the information from the discussion forum at the website on geo-caching

(https://www.geocaching.com), measures and general recommendations were proposed for people who hide caches. The proposals focus on the accessibility parameters that need to be adhered to with regard to the movement of people in wheelchairs. The parameter proposals and recommendations were subject to consultation with the staff of the League of Wheelchair Users in Brno.

3.1 Area under study

The micro-region Luhačovské Zálesí was founded in 1999. It is located in the south-east part of the Czech Republic and is in the Zlín region. It consists of 24 municipalities. The area of the micro-region is 248.54 km^2 with a population over 25,000 inhabitants, which gives an average population density of 105 inhabitants per km^2 (the micro-region has a rural character). The largest municipalities by population are Luhačovice and Slavičín. Approximately 55% of the total population of the micro-region live in these two towns (http://www.luhacovskezalesi.cz/mikroregion/), see Figure 3.

There were 119 caches in the micro-region as of December 31, 2015. Most caches are located in Pozlovice (32 caches), the number is so high thanks to the series of mystery caches (25 caches) which are placed around Luhačovská přehrada Reservoir. The second ranked municipality as regards the number of caches is Luhačovice. There are 25 caches in total. The most caches per square kilometre are to be found in Pozlovice. The second ranked density is in the smallest village in the area, Podhradí, with a total of 4 caches. The lowest values are found in Slavičín, which is primarily due to it being the largest area, but also the fact that there are only 4 caches. There are 7 municipalities with no caches at all in the micro-region.
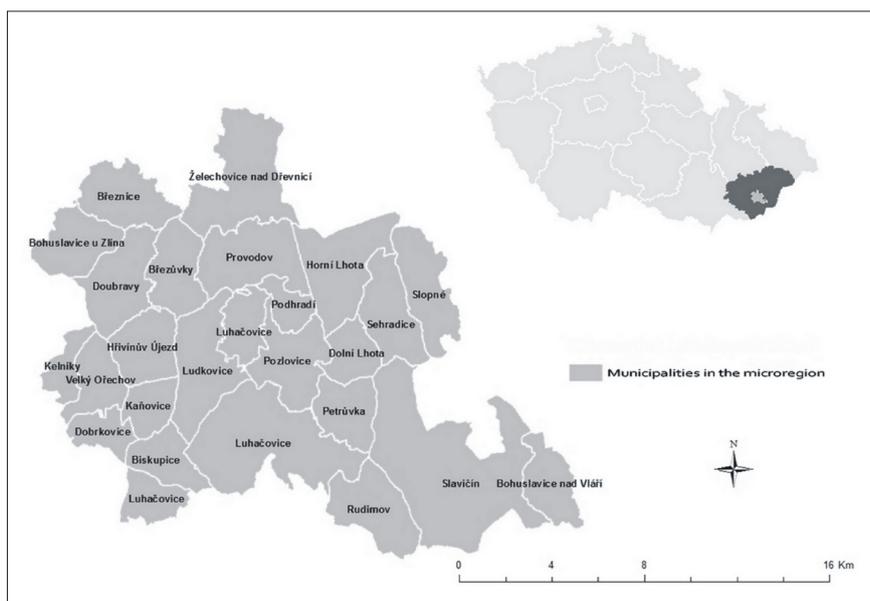

Fig. 3: The location of the Luhačovské Záhoří microregion
Source: authors, based on ArcČR 500
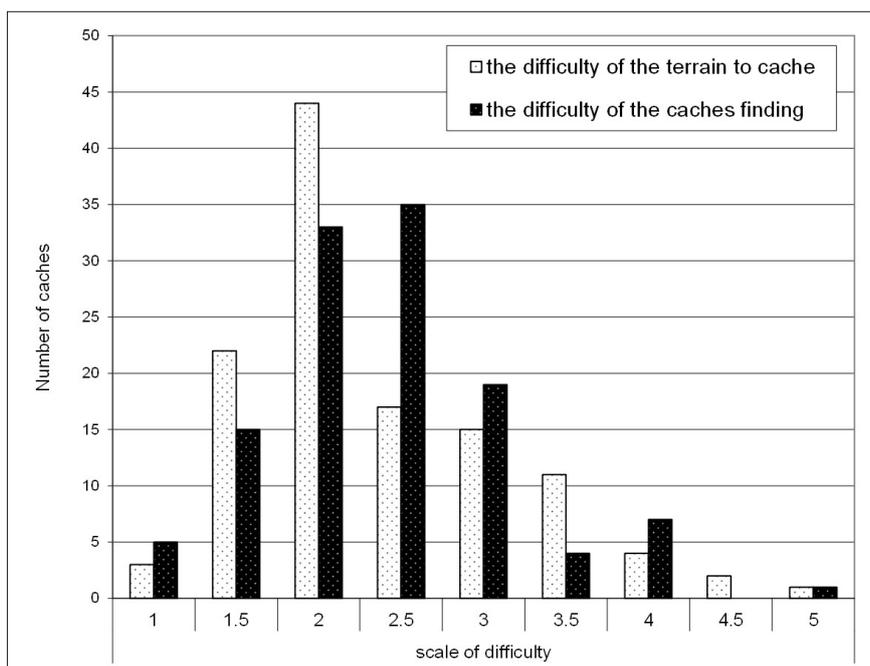
Fig. 4: Representation of caches by level of difficulty and terrain in the micro-region Luhačovské Zálesí as of October 31, 2015. Source: authors, based on geo-caching.com

Using the difficulty of finding a cache, the most frequent in the micro-region are caches at levels 1.5 and 2. From the perspective of the difficulty of the route leading to the cache, the highest number of caches are in terrain level 2 and 2.5 (see Fig. 4). Similar to the national comparison, caches of difficulties 1, 4.5 and 5 for both indicators have very low values (source: geocaching.com).

4. Results

Based on the literature and expert consultations with members of the League of Wheelchair Users in Brno, we formulated rules for hiding caches intended for people in wheelchairs. The rules are divided into two main categories:

1. independently accessible caches; and

2. caches accessible with assistance.

As even the path to the destination is demanding and a more complex categorisation could be slightly discouraging, we chose this two-level division. The levels only differ in terms of the difficulty of the terrain, which can be more challenging in the case of caches with assistance. The very getting to the cache is, in both cases, (unaccompanied cache and cache with assistance), dependent on the person in the wheelchair.

The proposed rules are described so that they are understandable to the general public, easy to use, and quick to apply in practice. The figures that are an integral part of the rules should serve for simplification and an easier understanding of the "barrier-free" access to the caches. At the present time, there is no unified methodology to map hiking trails for people with disabilities in the Czech Republic. The colour coding of the proposed pictograms was created after consultations with members of the League of Wheelchair Users in Brno, based on the methodology for building access evaluation, which is being prepared in cooperation with other organisations by the Prague Wheelchair Organization (www.presbariery.cz), because this methodology should become recognised everywhere in the Czech Republic in the future. The goal is not to create new markings, which could be misleading for persons with disabilities, but instead to link markings which will be used for both the tourist and urban routes suitable for persons in wheelchairs. The route description includes the height as well as cross gradients, which would be checked by the so-called reviewer (volunteer) in each area, who would assess and approve the caches established in the area.

4.1 Recommendations for different types of caches

A – Independently accessible caches:

This category is designed for less experienced wheelchair users, wheelchair users without assistance, hand bikes and power-driven wheelchairs. The pictogram to indicate this cache and the route is shown in Figure 5.

Description of the route: The route to an independently accessible cache must lead on a technically (concrete, tar, paving) or naturally reinforced and levelled surface, which does not change even in rainy weather. Along the route, there may not be clefts over 20 mm (drainage grooves, train crossings, etc.). The route gradient for the entire length of route has a maximum of 6%, in a section of 9 m a maximum of 8%, at a cross gradient a maximum of 2%. Due to the size of wheelchairs, it is necessary to allow sufficient width for the path. The minimum path width should be 1,500 mm, and there is a possible short-term narrowing to a minimum

of 900 mm. For two wheelchairs to pass each other, a minimum width of 2,000 mm is suitable. The route should not contain any obstacles higher than 20 mm, such as roots, kerbs, holes, gravel, etc. Any obstacles reaching over 20 mm should be pointed out by the authors in the cache description. Tables 2 and 3 and Figure 1 show that it is necessary to allow adequate space for wheelchair turning.

Cache placement: When placing the cache, it is necessary to remember that people in wheelchairs have a limited horizon and reduced vertical reach. The reach of an "experienced" wheelchair user to the side is 400 mm, or up to 600 mm when leaning; the reach forward is 650 mm. The cache should be placed at a minimum of 200 mm above the ground, preferably at a height of 400–1,000 mm above the ground, with a maximum of 1,400 mm so that it is reachable from the wheelchair. Additionally, the placement height should also consider whether the person in a wheelchair will need to reach to the side or forward and also from which distance, or how close they will be. The so-called deadlock for wheelchair users is shown in Figure 6. The cache should not be placed in a corner – in a right-angled triangle with dimensions 450 × 450 × 630 mm.

B – Caches accessible with assistance:

This category is appropriate for very proficient wheelchair users, power-driven wheelchairs and wheelchair users with assistance. The pictogram to indicate this cache and the route is shown in Figure 7.

Description of the route: The route to the cache accessible with assistance must be located on technically (concrete, tar, paving) or naturally reinforced and levelled surface, which may be slightly waterlogged or muddy in rainy weather. Along the route, there may not be clefts over 20 mm (drainage grooves, train crossings, etc.). Routes can climb for their entire lengths by a maximum of 8%, in a section of 9 m by a maximum of 8–12.5%. The cross gradient can reach 7% to a maximum of 4% of longitudinal gradient. The cross gradient can be a maximum of 4% when the longitudinal slope is 4–12.5%. The path width should be at least 1,200 mm, but short direct narrows can be a minimum of 900 mm. The route should not contain any obstacles,

Fig. 5: Marking of a cache accessible without assistance (independently accessible caches)
Source: authors' elaboration
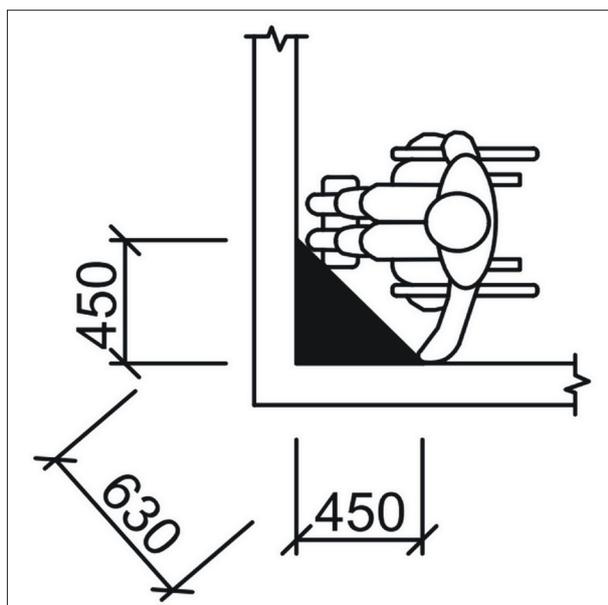
Fig. 6: Wheelchair user's deadlock
Source: authors based on ligavozic.cz

Fig. 7: Marking of a cache accessible with assistance
Source: authors' elaboration

such as roots, kerbs, holes, gravel, etc. If there is an obstacle on the route which can be avoided by taking a path with the above-mentioned parameters, the cache author will provide this information in the cache description. Likewise, the author will point out obstacles greater than 50 mm.

Cache placement: The cache placement should comply with the recommendations for the caches accessible without assistance.

C – Virtual caches for persons in wheelchairs:

It is not always easy, especially in natural terrain, to find a convenient place to hide a cache and, at the same time, choose the terrain level that could be marked with a single star. In order to make a larger quantity of caches accessible and thus to involve a wider range of disabled people, virtual caches for wheelchair users were proposed. These caches have no physical location, so that the cache author only finds a suitable terrain to the cache.

The authors of the virtual caches, as well as the physical ones intended for disabled persons, can be both a person in a wheelchair and a person without disability. This possible authorship of caches represents a strong motivation for disabled people to get involved in the game. Individual caches contain tasks, based on which the cachers receive

points and are acknowledged to have found the cache. The tasks in this case are not meant to make cache access more difficult, but rather to make otherwise inaccessible places available and motivate players to gain a greater number of caches. The authors of virtual caches choose the task assignment as a function of their own imagination, as well as the options offered by the place selected. A bonus task aims to motivate players in wheelchairs to gain more caches that are close to one place. The geo-cachers on wheelchairs can obtain a reward for finding a specific number of caches in an enterprise, whose address and name will be provided to them by the staff of the local information centre. This information can also be found on the playing card. The reward for players in wheelchairs can be, for example, a free cup of coffee. The offer will depend on the individual enterprises. For a more detailed description of the virtual caches, see Table 6.

4.2 General results: cache locations and routes

Out of all the caches at the terrain level 1 or 1.5 found in the area surveyed, some are selected as examples and described as inappropriate for wheelchair users. The cache in the area in Figure 8, for example, is partly accessible for a person in a wheelchair. There is a paved road leading to

Task	Task description
Photos	The player takes a photograph at the place of the cache coordinates. The player sends it to the cache author and requests the point for finding the cache.
Get to know the place	It is necessary to fulfil a task, which is located at the place of the cache coordinates; the task is directly linked to an important spot, building or natural monument, etc. Examples: count the number of steps to the building entrance, find the year of establishment/re-construction of the building, note the colour, number of windows, go to the information board and find out.... etc. The fulfillment of the task is consulted with the cache author, who decides whether the cacher can get the point.
Bonus	The players pick up cards at the information centre where they put down the individual caches. After finding all the locations of the virtual caches and the proper completion of the information, the players can go to the place/ service where they get a reward for the "catch".

Tab. 6: The tasks of virtual caches for the disabled
Source: authors

the cache, which can be an advantage even for persons in wheelchairs without assistance, but the surface of the tar road is broken by roots and thus finding the cache is not possible for a person in a wheelchair.

Another inaccessible cache location was identified in a container in Figure 9. The cache is fixed outside the metal rod using a magnet at a height over 1.5 m above the ground, which is unsuitable for people in a wheelchair. At the same time, the terrain surface leading to the cache location is impassable for wheelchair users (Fig. 10).

Fig. 8: The route to the cache – tar damaged by tree roots Source: authors

Fig. 9: Cache location at a height of 1.5 m above the ground. The maximum height should be 1.4 m. Source: authors
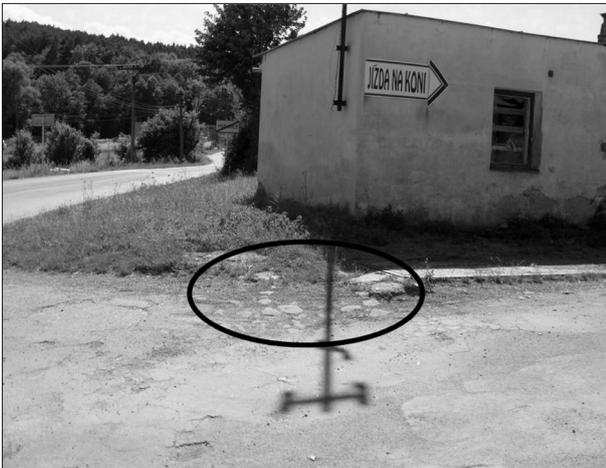
*Fig. 10: Damaged surface does not allow wheelchair users to access the cache. Source: authors*
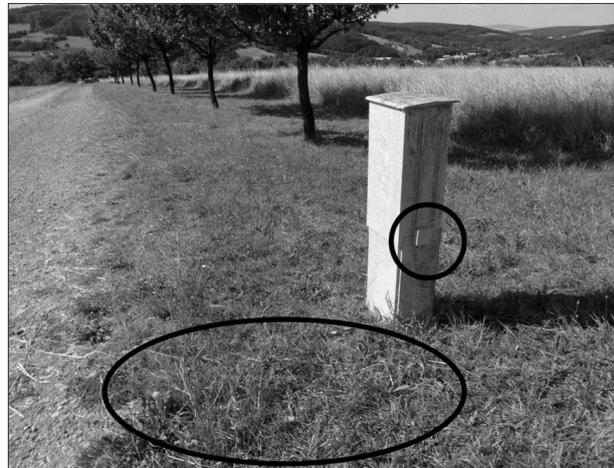
Fig. 11: Cache location at the correct height (0.4 m above the ground, the minimum height is 0.25 m); the road surface is troublesome. Source: authors

An appropriate placement for a cache is shown in Figure 11. The container at this height is reachable for a person in a wheelchair. The cover gets opened easily and it does not require any excessive force. The path to the container (Fig. 12), however, only partially meets the criteria for cache availability for people in wheelchairs. This cache could be marked as appropriate for a person in a wheelchair with assistance.

Although a cache is often marked with terrain level 1, the obstacles on the route (see Fig. 13) make it unreachable for wheelchair users. The space is too narrow for rotation, and the clear height is low. A wheelchair is also unable to get over kerbs and through narrow places on the way to the cache (see Fig. 14). The most common obstacles on the way to the

cache are these kerbs. If the road to the cache is tar, in most cases there are kerbs higher than 20 mm, which results in blocking the way to the cache for wheelchair users (Fig. 15). Another problem is damaged surfaces of the roads.

Figure 16 shows one route to a cache which could be classified as accessible with assistance; unfortunately, there is a narrow place on the way which cannot be avoided, so the cache becomes unreachable again. The minimum width for a safe wheelchair passage should be 900 mm.

The above analysis of the example images of caches shows that the authors do not evaluate the entire cache route as a complex. Naturally, it's not simple for most authors of the caches, as they can hardly imagine what options a wheelchair user has.

Fig. 12: The route to the cache – inappropriate, unpaved surface. Source: authors

Fig. 13: Cache located at the right height, but there is a low clear height. Source: authors

Fig. 14: The route to the cache – troublesome kerbs and a narrow space. Source: authors

Fig. 15: Kerbs and damaged surface on the route Source: authors

Fig. 16: The path narrowing to a width of 500 mm prevents a wheelchair user from passing. Source: authors

Fig. 17: The location of the cache under the bridge Source: authors

The cache in Figure 17 is located below a bridge, which is a part of a bike trail. Placing a cache on a bike trail makes it available for many wheelchair users; however, getting a cache under the bridge might be complicated, even for a ealthy person in rainy weather. Yet, there are many places in the surroundings of the bike trail where the cache could be hidden, for example, benches, lamps, trees along the trail, bushes, etc.

It is not simple to find suitable conditions for the placement of the caches in natural terrain. Although the authors of the caches in Figures 18, 19 and 20 assessed the terrain level as 1.5, they probably did not realise that the grass, which is found all over on the route, is impassable for wheelchairs. Furthermore, this cache is located below ground, which is too low for wheelchair users. The lowest possible location is at least 200 mm above the ground.

Fig. 18: Grassy surface on the route to the cache
Source: authors

Fig. 19: Inaccessible terrain for wheelchairs
Source: authors

Fig. 20: The location of the caches in the ground – not suitable for wheelchair users. Source: authors

These descriptions of the images of the various cache hideouts and the routes to them, show that most authors of caches marked with terrain level 1 were not aware of appropriate spatial parameters for the location of the caches, such that they are suitable for people in wheelchairs. For a physically healthy person, it is difficult to imagine what a person in a wheelchair perceives as an obstacle, what are the limits that apply for such persons, and how much effort they have to make to achieve the target.

5. Discussion and conclusions

To make geo-caching available and accessible for persons in wheelchairs it is necessary to involve not only active players of geo-caching, but also entrepreneurs, institutions and various associations. The expansion of geo-caching for persons in wheelchairs depends not only on active players who will constantly increase the number of caches, but also on the players who do not suffer from any physical disabilities. Therefore, it is important to raise citizen awareness of social tourism and its importance for service providers within tourism. Investments in making the countryside accessible for persons in wheelchairs are appropriately and effectively spent.

Rollová (2012) states that it is not totally appropriate to point out that a facility (in this case, a cache) is suitable for wheelchair users. In contrast, however, we are of the opinion that pointing out that a cache is suitable for wheelchair users either with or without assistance, possibly pointing out potential constraints on the road, can encourage more wheelchair users to set out for trips. We are convinced, with supporting evidence based on face-to-face consultation with representatives of the League of Wheelchair Users in the Czech Republic and wheelchair users themselves before and after our survey, that disabled travellers will welcome expansion of their recreational activities. For geo-caching to reach wheelchair users, it is important that the rules for setting up accessible caches are known and accepted by at least a part of the player community. Only then will such caches be really created and available, such that the number of them will be interesting enough for wheelchair users to try to find them. Besides the benefits for the cachers, it will be then useful for municipalities and regions where it can further contribute to the development of social tourism.

Taylor and Józefowicz (2012) found that a limiting factor for wheelchair users is the need to book tickets or another service in advance. In contrast, geo-caching is available immediately (either inside or outside a municipality). Also, they found that disabled persons actively seek open-air activities, and therefore geo-caching is also highly suitable.

The aim of this paper was to set limits and recommendations for proposing caches. It is possible to revise and mark the existing caches as suitable for wheelchair users – if they meet the recommended parameters. If the measures can start the elimination at least one of the constraints defined in Table 1 (Smith, 1987, in Lee et al., 2012), our aims have been met.

The field survey, which focused on caches with terrain levels 1 and 1.5, based on the methodology prepared and used by the Prague Wheelchair Organization, provided strong doubts concerning the claim that these caches are suitable for persons in wheelchairs. The analysis of the rules that help authors of newly-established caches rate the difficulty of the terrain and actually getting the cache, showed that the rules do not contain sufficient information

regarding the movement of wheelchairs in the field. The cache authors, then, lack accurate information about what limits wheelchair users have and what obstacles are impassable for them in the countryside or in the city. Based on these findings, rules for establishing caches suitable for people in wheelchairs have been formulated, using the above mentioned methodology.

These rules are divided into two sections regarding (i) independently accessible caches and (ii) caches accessible with assistance. The individual types of caches vary only in the difficulty of the terrain: the actual reach of the cache is in both cases dependent on the person in the wheelchair. It is obvious that if the cache could be reached by an assistant accompanying the wheelchair user, it would indicate that a larger number of caches would be accessible. The goal is not only to encourage persons in wheelchairs to play geo-caching, however, but to provide them with real experiences of the game. Virtual caches for disabled persons have been proposed to make a larger number of caches, in this case rather points, reachable. This type of caches does not have a physical form, but is bound by a task to a significant place. As research with a similar topic is not available, we cannot compare the proposals and their contribution with other studies. In order to develop the proposed instruments, it is necessary that society realizes that any form of attention is a way to overcome the barriers between the world of healthy people and people with disabilities.

Acknowledgements

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