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CONTENTS

EMPIRICAL RESEARCH OF MODERN RURALITY: TRANSGRESSION, HETEROGENEITY, MULTILOCALITY, MULTIFUNCTIONALITY EDITORIAL

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The theme issue aims at investigating some of the methodological and epistemological challenges concerning the empirical research of modern rurality that has been emerging in Europe and elsewhere after the post-productivist transition (Ilbery 1998). As a complex organizational concept that permeates the economic and social structure of the countryside in the post-industrialized world, modern rurality is a source of narratives produced by different players, both local and global (Cecchi 2001). Modern rural areas characterized by the interconnection and interrelation of urban and rural as well as the transgression of the boundary between urban and rural, are therefore heterogeneous, multifunctional spaces characterized by ever increasing intercultural encounters, cultural transmission, as well as changes in travel and mobility patterns.

The concept of rurality as multifaceted, complex, fluid and dynamic requires epistemological and methodological revisiting. 'Rural renaissance' (Ivanko et al. 2009), as is the resurgence of rural areas in the studies of the 1990s commonly referred to, implies the emergence of new disciplinary, conceptual and methodological approaches to rural research in order to analyze the contemporary rural condition. A 'global countryside' (Woods 2007) requires adopting diverse theoretical perspectives covering post-modernist oriented human geography, theory of practice and power, theory of social space, actor-network theory, feminism and the like. Likewise, there has been a methodological revolution in rural studies in recent years introduced by the cultural and spatial turn; the basic questionnaire techniques give way to qualitative methods borrowed from anthropology such as participant observation, and semi-structured interviews (Woods 2012: 3). Novel interdisciplinary collaborative tendencies, such as the 'ethnography as/of collaboration' (Marcus 2009), help to bridge seemingly different perspectives, which enable intense methodological reflection within the research process and enhance further theoretical developments. To understand the dynamic nature of rural development, iterative ethnographic research (O'Reilly 2005; Burawoy 2003) consisting of systematic revisits to research sites has been employed in order to grasp the plurality of experiences of the diverse actors in modern rurality. Other research strategies such as multi-sited ethnography (Marcus 1995) help scholars to follow the emergence of hybrid rural place filled up with changing social and power relations.

This theme issue challenges the assumed characteristics of the rural as stable, homogenous space with rigid social stratification and specific spatial configurations, and rural people as passive populations who occupy peripheral position within existing political, economic and cultural structures. Instead, it aims to show the complex and dynamic ways in which rural space is perceived, conceived and live. Rurality emerges as hybrid, fluid and dynamic space, which is continuously materially and culturally restructured. Rural space is a process produced by different practices and often competing interests, which involves ambiguous interrelations between different actors, practices and ideas (Kay et al. 2012). Our aim is to show how the transformation processes have affected local community.

What are the issues at play in rural contexts? The theme issue presents papers that deal with some of the key challenges for the study of rural places and people in the twenty-first century. They include issues of spatial and social relations in modern rurality; the re-making of a post-productivist countryside (Halfacree 1997), illustrated by the resilience of rural communities to urbanizing pressures; issues concerning global mobility patterns to rural space as well as transnational amenity migration; problems associated with the reduction of traditional farming systems and their replacement by rural tourism; problems of population recomposition; issues of interdisciplinary and comparative research. The authors of the articles seek to indicate challenges and outline possibilities that are there for scholars dealing with rural studies from the social science perspectives: how we do rural research in the twenty-first century, with whom we do it, and when and where we do it (Hannerz 2010).

Hana Horáková's text in this volume discusses some of the epistemological and methodological challenges concerning multilocal research in four rural areas in Czechia that have recently embarked upon a project of international tourism. Based on the perspective of modern rurality as an unbounded and fluid concept she argues that classic modes of doing fieldwork should be replaced by those that better correspond to the new conceptions of the rural as a social representation. The illustrative example of such a research strategy is multi-sited ethnography that proves

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to be a legitimate proposition for contemporary research of rural development through tourism (Horáková 2014).

Dana Fialová and Jiří Vágner look into the processes of reconceptualization of the territorial identities in selected rural areas of Czechia with a high concentration of second home users. Their research results show that (1) the differences between second homes and primary residences seem to be more blurred than in the past, and (2) the second home owners and users are additional significant agents with a considerable influence especially on social life in the increasingly multifunctional rural space and local community (Fialová, Vágner 2014).

Andrea Boscoboinik investigates methodological challenges of anthropological research in the Swiss canton of Valais which has recently undergone profound changes in agricultural policies and as such has become an arena of conflicting political, economic and ecological interests. She shows that carrying out research in this setting becomes sensitive and politicized. To overcome the difficulties arising from a sensitive context, interdisciplinarity and multilocality, enabling comparison of various rural contexts, are crucial to achieve relevant results (Boscoboinik 2014).

Montserrat Soronellas-Masdeu et al. analyze the impact of international female immigration to the Catalan rural areas, namely to the communities experiencing problems in depopulation and masculinization. They highlight the issue of population recomposition which is the result of refeminization of these communities. They point to the ways these female immigrants become essential economic and social agents, and thus contribute to develop and sustain new forms of rurality (Soronellas-Masdeu et al. 2014).

We hope that the presented empirically driven insights into social change of modern rurality will provide a fresh look at the old ways, present novel ways of doing things, and discover 'how rural spatial and social relations are constructed, represented, materialized, performed and contested' (Woods 2012: 3). Moreover, the research papers may shed new perspectives not only on the rural but also, by moving beyond localism, on the new contexts within which we can examine global issues such as mobility, development and change.

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MULTI-LOCAL RESEARCH OF MODERN RURALITY IN THE CZECH REPUBLIC: EPISTEMOLOGICAL AND METHODOLOGICAL CHALLENGES

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ABSTRACT

This article investigates the epistemological and methodological challenges concerning multi-local research in four Czech rural areas that have recently embarked upon a project of international tourism which uses public space and rural landscape as one of its principal attractions. The aim of the article is to discuss the degree of relevancy of particular methods, research strategies and conceptual tools in general and the ways they are reflected and applied in our research. The article also presents some of the research outcomes that illustrate the application of these theoretical and methodological approaches. The issues discussed in this article include theoretical and practical implications of defining modern rurality as an unbounded and fluid concept, and creating a conceptual framework for the author's empirical research. The main part of the article is devoted to theoretical and practical aspects of carrying out multi-sited ethnography as a research strategy for the study of rural development through tourism. The question is whether this method can be a legitimate proposition for contemporary research of modern rurality that seeks to understand social change associated with the post-socialist transformation of the Czech rural space.

Keywords: rural development, modern rurality, tourism, multi-sited ethnography

1. Introduction

In the past two decades complex processes of political, socio-economic and cultural change in the post-socialist countries of Central and Eastern Europe have dramatically affected rural localities and populations (Kay et al. 2012). A rapidly changing rural environment has witnessed new demands on the rural resources base. New patterns of economic activity emerged in rural areas; among them tourism, which was seen as a major agent for economic (re)development and as a lifeline for rural communities. Rural redevelopment through tourism has brought about a dilemma that lies in the symbiotic relationship between rural development processes and recreation and tourism. As the nature of rural tourism in general is to exploit rural environments for recreational purposes, it has brought the likelihood of new forms of impact, competition and conflict over identities, values and definitions of rurality (Halfacree 1997).

New interdisciplinary, theoretical and methodological approaches on how to conceptualize and study the rural, which have recently emerged in social sciences, could be employed to understand better the post-socialist rural condition impacted by tourism development. The initial stimulus for the paper came from an ongoing *iterative* ethnographic research (O'Reilly 2005; Burawoy 2003), a long-term research strategy based on systematic and focused revisits to the sites over the course of four years (2009–2013), which helped to examine the complexity of rural space and the current processes of global mobility including the movements of tourists and amenity migrants to all rural sites, as well as the processes of constructing new networks of power, social and economic relations. Within the new conceptual and methodological frameworks of rural research, modern rurality is increasingly perceived as a multiplicity of social spaces which allows and presupposes the interplay between different social actors, practices and ideas, rather than one single space. Thus, novel research focus is placed on how rural spatial and social relations are constructed, represented, materialised, performed and contested (Woods 2012: 3).

The aim of the paper is to discuss 1) modern rurality as an unbounded and fluid and its implications for chosen methods, research strategies and conceptual tools that are used to understand social change associated with the post-socialist transformation of Czech rural space, 2) theoretical and practical aspects of carrying out multi-sited ethnography as a research strategy for the study of rural development through tourism, and 3) the ways they are reflected and applied in the author's empirical research on 'Dutch villages' which refer to the Czech rural areas that have recently embarked upon a project of international tourism which uses public space and rural landscape as one of its principal attractions. As the paper is not intended to follow the 'standard' structure of a research text, it presents some of the outcomes based on the discussed methodological approaches only in a limited scope, to illustrate the appropriateness and applicability of the chosen concepts and methods. The presented results indicate that multiple views and representations of rurality are contingent on diverse memories of socialist past and post-socialist present.

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The paper is divided into four parts. The first part deals with the theoretical and methodological framework for the research of rural space under the postmodern condition particularly from the anthropological perspective. The second part presents a conceptual framework for the empirical research on 'Dutch villages' based on perspectives of the rural as a social representation, the 'local' as unbounded and fluid, and multi-sited ethnography, with the aim of understanding better locally-specific responses to post-socialist transformation of rurality. The third part outlines the research design and methods presenting the commonalities of research sites as well as the chosen method of inquiry based on the ethnography as collaboration. The fourth part presents selected results and suggestions for the empirical research on 'Dutch villages' which reflect the fluidity and diversity of the rural space, and the major component of multi-sited ethnography, that is 'following' across space.

The empirical data used in part 4 are based on participant and non-participant observation, semi-structured interviews and long, in-depth conversations, as well as informal conversations and narrations of life stories, to determine the impact of the tourism development on the rural community, and the complex ways the community deals with rural change and transformation.

2. Defining modern rurality

Over the past few decades, buzzwords such as flow, exchange, diversity, travel and mobility and/or cultural transmission have entered a new realm – rural space that used to be relatively immune from the postmodern condition. The emergence of modern rurality has opened up interdisciplinary discussions on how to conceptualise and how to study this unbounded, multifaceted and dynamic realm. Among anthropologists, key epistemological and methodological challenges concerning the complexity of intercultural encounters in rural contexts were raised: how to do anthropology in the twenty-first century in a post-paradigmatic period; how to reinvent fieldwork that is no longer a fixed entity; how to replace fieldwork 'by immersion' with the conception of the field as an 'on-and-off thing' (Hannerz 2003, 2010); and, what are the implications of doing multi-sited ethnography.

Key terminological issues, which scholars working on 'rural' from different perspectives have to tackle, revolve around the question of what modern rurality is and how it can be conceptualised (cf. Horáková 2012). Modern rurality is largely viewed as a complex organisation that permeates the economic and social structure of the countryside in the post-industrialised world (Cecchi 2001). Due to the post-productivist transition (Ilbery 1998) characterised by a shift from production to consumption, modern rurality is completely different from the traditional form; the rural no longer implies monolithic spaces of agricultural and light industry inhabited by peasant societies (Kay et al. 2012: 59). Instead, while being based predominantly on consumption, modern rurality involves the reproduction of the rural (Halfacree 1997) which implies an alternative use of rural space; different forms of land-use consumption and concerns over the environment as well as new mobility patterns and opportunities for entrepreneurial activity. New patterns of economic activity emerging in rural areas involve tourism, which is seen as a major agent for economic (re)development and as a rescue for rural communities. With the production of new recreational rural commodities, many rural places are transformed from a place of work to a place of recreation and 'escape'. Though 'rural' is commonly used in social scientific literature (and also in public discourse) there are multiple and contested meanings of this term. In general, it is modelled along an urban-rural dichotomy. However, such an approach does not suit our research purposes well as rurality is simply too dynamic and complex to be accounted for by either absolute measures (for instance the Rurality Index) or by different sets of delineating criteria[1]. Modern rural areas are heterogeneous, multifunctional spaces of production and consumption. The boundary between the urban and rural is often blurred or downright invisible. Thus, the theoretical categories of urban and rural seem of limited use when interpreting the real world. Barthelemy and Vidal (1999) point to the significance of the interconnection between the rural space and its inhabitants, especially through their jobs, lifestyles, cultural preferences, and consumption patterns. One of the major features of modern rurality is its ability to attract resources from outside. As Cecchi claims, '"[M]odern" rurality emerges because rural resources have attracted urban ones' (2009: 55). Thus, the distortion of the rural-urban dichotomy is a key feature of modern rurality, affecting post-socialist rural space. Instead of the urban-rural duality, we observe a continuum between the urban and rural social organisation in which the boundary between the rural and urban areas fades. The same pattern applies largely to Czech rurality which is shaped by a mosaic of settlements of various sizes and rural landscape, and thus demarcating boundaries between the urban and rural is not viable in the post-industrial age (Horáková 2012: 29).

The rural is increasingly perceived as a multiplicity of social spaces rather than one single space. Due to

[1] See for instance, Marsden's et al. (1993) four-fold typology of countryside categorised according to the 'contextual knowledge' shared among community members: the preserved countryside characterised by a strong anti-development attitude of an affluent middle-class which is in a position to influence the planning system and impose reconstitution of countryside; the contested countryside typical of unresolved conflicts over the ideas of how rural development should happen between the local community and the community of newcomers; the paternalist countryside, which is similar to the contested one in that there are conflicts between the established population and newcomers; and the clientelistic countryside that shows traits of a sectorally differentiated economy (for more information see Horáková 2012: 28).

the rapid and extensive nature of transformations in the post-socialist space, rural space is no longer a stable place with rigid social stratification and specific spatial configurations. Instead, a hybrid rural space emerges, while being differentiated through the processes of 'distribution of power and status, construction and configuration of sameness and difference in local-global relations' (Kay et al. 2012: 60). In other words, these processes involve the interplay between different social actors, practices and ideas. As Shubin (2006) claims, rurality is a complex construction, embracing different sets of social and cultural relations. In the same vein, Argent (2011) and Mitchell (2013) notice the emergence of a multi-functional rural space.

The complexity of rural societies and cultures, filled up with diverse expectations and desires producing a specific rural place, may result in tensions in rural place-making. Peoples' relationship to the rural is a contested issue. One person may see and seek different things in a rural area to another person. For instance, many people tend to think of it as a relaxing environment, but for those who live and work there, the environment may be stressful (Page & Connel 2006: 425). The likelihood of new forms of impact, competition and conflict over identities, values, and definitions of rurality is high because all involved social actors fight over the same resources. As I have argued in previous texts (cf. Horáková 2010, Horáková 2012: 30), inherent tensions between the diverse perceptions of rural place and nature entail multiple frictions. Such tensions are modelled not only along the 'host' and 'guest' line, in cases of international tourism in rural areas; fault-lines may be manifold and diverse. The demands of tourists for a genuine rural experience may be in agreement with the local elite and entrepreneurs who are likely to take an opportunity to cater for tourist demands (Cocco 2010: 41) but they may be at odds with other social groups who can look on tourists as uninvited intruders.

3. A conceptual framework for the empirical research on 'Dutch villages'

The commonalities of the research sites enable us to present a conceptual framework for the empirical research on 'Dutch villages', involving three mutually related characteristics: the the rural as a social representation, 'local' as unbounded and fluid, which is approached with the research strategy of multi-sited ethnography. For the analytical purposes of the text, these three aspects with be dealt with separately.

3.1 The rural as a social representation

Based on the above-mentioned critique of dichotomy models and descriptive measures to define rurality, our research on Czech post-socialist transformation of rural communities is based on perspectives of the rural as a social representation, with the aim of understanding local responses to post-socialist transformation of rurality; in other words, we seek to understand how 'rural people create, reflect on, respond to, incorporate, adapt and resist various aspects of change' (Kay et al. 2012: 60).

The concept of the rural as a social representation investigates how 'rural' is perceived and experienced, and how it relates to the social construction of the countryside both by individuals and groups, and by both the residents of rural areas and by tourists. The key question is what the term 'rural' means to those who 'live' it: how it is experienced by those who live in the rural areas (predominantly locals) and who stay in them (predominantly foreign visitors).

3.2 The 'local' as unbounded and fluid

Due to the ongoing rural change and transformation that interconnects the rural to global processes, existing boundaries are being challenged and identities disrupted. Hence, the 'local', rather than understood as a set of bounded units is perceived as unbounded and fluid, as space that is actively socially produced. Rural place-making always entails ongoing processes of negotiation and contestation between different social actors, practices and ideas. Conflicting meanings and interpretations over the meaning and value of the rural are particularly burning in the spaces impacted by tourism development since tourism industry has the potential to bring consumers and producers and their 'products' into a close contact. In fact, few other occasions of human encounter provide so many situations of exchange between people of different backgrounds – people of different class, ethnicity, economic position, religious denomination, and culture. Tourism is extremely 'culturally intimate' (Chambers 2000: 32). This statement has far-reaching theoretical and methodological implications. Firstly, how to conceptualise 'local' and 'global', 'us' and 'them', 'hosts' and 'guests'? Local space is 'filled up' by diverse social groups and communities whose boundaries can be either impenetrable, allowing little or virtually no interaction, or porous, in which movement is fluid. With a certain degree of simplification, there are two different communities in all the researched areas: a local one, rooted in time, space, and local social relations, and a 'global' one. However, as the categories of 'guests' and 'hosts' are socially constructed they are quite mutable in reality. Tourism is much more of a reciprocal endeavour than we might first imagine – people often exchange the roles of tourist and toured. Moreover, there is considerable variability among the 'guests', as well as among the 'hosts' – neither are homogeneous groups that would follow the same interests. There can be struggles both inside the host communities and between the 'hosts' and 'guests' over land use, resources and rural economies, due to the conflicting understandings what development means to different actors.

Defining the 'hosts' and 'guests' is one the most difficult tasks that every scholar dealing with international tourism (and not only) has to face. Let us have a look at the ways the category of 'host' is constructed in the above-mentioned fieldwork sites. We can discern four different categories of people which constitute the notion of host. Three of them refer to different types of residents: 1) local permanent residents, 2) local temporary residents – re-creational (cottage/chalet) owners, 3) seasonal workers; usually Czechs who work in tourism-related jobs and who are often perceived as cultural brokers. The fourth category is represented by friends and relatives (often urbanites) visiting all the three previous categories. As it is clear, such a typology does not correspond with the notion of the local or 'host'. Thus, there is a need to challenge a common view that 'local' is the original, the natural, the authentic, as opposed to 'global' as new, external, artificially imposed, and inauthentic. To understand the impact of tourism development on the hosts in the four rural areas, one has to 'uncover the lid' of the 'host' category as it involves different segments that compete among themselves for the power and authority to determine the ways in which their place is to be made and represented. The most important condition is a degree of autonomy people have in deciding for themselves – the degree to which a tourist-receiving community has the ability to control its interactions with tourists and tourism mediators. The essential question whether the locals have managed to incorporate tourism into existing social and political structures will be dealt with in one of the following chapters (5.2) concerning the key component of multi-sited ethnography, namely the 'following' (the conflict).

3.3 Multi-sited ethnography

Third, and by far the most important feature of our research is its multi-locality (multi-sitedness). Our research was multi-sited (Marcus 1995) in order to capture as much as possible of the diversity and complexity of the field. Multi-locality, rather than multiplicity of field sites, or extending a number of field sites side by side (Horst 2009; Marcus 2009) implies *the connection* between local sites by global – by transnational, political, economic and cultural forces. Hence, the key terms associated with the concept of multi-locality include world system, post-Fordism, globalisation, transnationalism, multiple modernities, hybridity, and cosmopolitanism, among others (Hannerz 2009).

The emergence of multi-locality prepared the way for introducing multi-sited ethnography in the mid-1990s, a methodological trend in anthropological research associated with the work of the American anthropologist George Marcus (1995). Multi-sited ethnography interrogated the assumptions of 'traditional', single-sited anthropological fieldwork that (1) the boundaries of the field, the place and the space coincide, and (2) long-term participant observation takes place in a small-scale, geographically-delimited, homogeneous place. According to the pioneers of the multi-sited ethnography research programme, the idea of community as a bounded unit cannot stand up in a postmodern, globalising, transnational world in which 'traditional' places are being dissolved (Marcus and Fischer 1986; Marcus 1995). Multi-sited ethnography is a response to the understanding of culture as increasingly in flux, which appears in the social sciences after the cultural and spatial turn. The model of culturally-bounded units appears as outmoded.

The idea of multi-sited ethnography is based on several assumptions: (1) Space, including anthropological sites, is socially constructed and thus is produced by human activity (Coleman and Collins 2006; Gupta and Ferguson 1997). Space is heterogeneous, which allows distinct trajectories and coexisting heterogeneity. (2) Space is *always* under construction (Falzon 2009: 4). Kay et al. (2012: 59) mention active processes of rural place-making and its reproduction. Hence, field construction is an ongoing process throughout the whole research project. Modes of constructing and selecting relevant multi-sited spaces for our research involved tasks (a) to define our research object theoretically (see section 3.1. in this text), (b) to find locations and social situations where, according to theoretical assumptions, this object may be found, and (c) to be prepared to follow the leads of the field and extend research (Nadai & Maeder 2009: 243). Multi-sited research is designed around chains, paths, threads, conjunctions, or juxtapositions of locations (Marcus 1995). According to Falzon, it is 'a spatially dispersed field through which the ethnographer moves', or 'a form of (geographical) spatial de-centredness' (Falzon 2009: 2). Thus, the term 'mobile ethnography' is sometimes alternatively used (Marcus 2009).

Multi-sited ethnography is a complex research strategy confronting the ethnographer with serious theoretical, methodological and practical problems (cf. Nadai & Maeder 2009). There have been many diverse reactions to this strategy since its inception in 1995, ranging from the 'nothing new under the sun' opinions, to new elaborations on Marcus' original formulation. They involved, among others, (1) the issue of holistic aspirations of multi-sitedness (Gallo 2009), (2) the issue of comparability, and (3) the core issue of 'following'. I shall briefly deal with them in the following sections.

3.3.1 Holistic aspirations of multi-sitedness

First of all, it is fair to claim that 'the myth of complete ethnography' (Falzon 2009) concerns both single-site studies and multi-sited ones. Within multi-sited ethnography, implicit holism suggests that by studying diverse phenomena in many places, one can encompass a totality we would miss in a single place. It develops a classic idea of fieldwork in which we study the 'entire culture and social life' of the people (Hannerz 2010: 73). We by no means believe that there is a chance of drawing up

a 'complete' picture. Thus, incompleteness is inherent in any ethnographic research designs, not only in multi-sited strategy. At the same time there is a firm belief that multi-sitedness, despite this 'deficiency', can bring a deeper understanding of studied phenomena.

Within multi-sited ethnography observation or participant observation has a more limited role than in the classic model of anthropological fieldwork. What is at stake is the degree of immersion in the field, and subsequently the perceived loss of depth of knowledge (Nadai and Maeder 2009: 244). Some scholars recommend replacing the classic ideal of participant observation as 'anthropology by immersion' with 'anthropology by appointment' (Hannerz 2010; Luhrmann 1996). Spending a relatively short period of time in each site is definitely one of the drawbacks of multi-sited ethnography. Others claim that depth and multi-sitedness can be well combined (Horst 2009). Finding a balance between depth and breadth is the most delicate task faced by fieldworkers engaged in this strategy. Our research involves a series of repetitive stays (ranging from a week to two or three weeks) in all sites all-year round between 2009 and 2013, not only in peak seasons (summer and winter) when tourist flood the villages in large numbers but also in relatively peaceful, calm periods.

3.3.2 A comparative aspect of multi-sited ethnography

Multi-sited ethnography is comparative by nature; comparison is an integral dimension of such a research design and the basis for its methodology; but it may exceed the conventional comparisons in traditional ethnography that were used to compare communities and looked for contrasts and similarities (Nadai and Maeder 2009: 244). As Hovland (2009: 137) argues multi-sited ethnography does not aim to compare categories across different locations but it should rather question the way these categories are constructed. Likewise, our effort was to avoid treating the research sites as a jigsaw puzzle, to fit the 'ideoscape' together.

The ability to compare depends foremost on how the researcher conceptualises the field. If he or she views it as a 'network of localities which are linked to each other through various types of flows'(Horst 2009: 120) then obviously it is possible. By investigating different sites one *can* create a single research project. Our research sites – villages – are not cultural islands isolated from the surrounding world; they are reasonably coherent and ready for comparisons. How do we capture the linkages between the different locations? How do we trace the connections and relationships among the sites? In our research we used two different methods concerning time: research was carried out both simultaneously in different places (mainly in summer and winter peak seasons) and stepwise; in practice it meant successive field trips to the sites. Doing fieldwork in a stepwise manner proved much more efficient as it enabled us to build on existing networks, follow up ideas that developed from the preceding fieldwork, accumulate and assemble new data as well as revise and revisit existing data, redirect research routes, etc.

What are the points of connection and comparison between the field sites? As our project has theoretical or generalizing ambitions, a range of theoretically-relevant points of comparison is built into the design of the field. Comparisons are made both across sites and over time as multi-sited ethnography is longitudinal research that provides insights into the past and the present.

The research sites show a number of commonalities, which make them suitable objects for comparison. They all decided to accept a concept of tourism as development, as a response to the complex political and economic transformation of the Country after 1989. The places have become dominated by tourism – not only by international nature-based tourism through large-scale Dutch investment but also increasingly by domestic tourism. As a result, rural space is being revitalised through processes of construction and re-construction (Bryden 1994). The villages' physical structure has been changing over the last two decades with the large-scale and extensive construction of new houses, often from investment from outside. As the commodification of the rural experience for tourism is underway in all areas under study, tourist enterprises – shops, restaurants, cafes, rooms and other rental units – tend to redraw physical boundaries and spatial patterns of the villages. Local development processes are conducive to newly-emerging material, social and symbolic orders. Local communities become arenas of heterogeneous entities with internal differences. The perception of social change is not homogenous but varied according to different groups and social actors. Conflicts over the issue of the rural arise between diverse sections of the rural population rather than between 'hosts' and 'guests', as is shown below.

4. Research design and methods

4.1 Research sites

Our research focuses on selected rural communities in the Czech Republic that are undergoing profound rural change and transformation due to the advent of international nature-based tourism, particularly Dutch, which has brought about the emergence of so-called 'Dutch villages'. The term is a vernacular name for standardised recreational houses owned by the Dutch in Czech tourist areas. It is used in public discourse, predominantly by internet users, to assert strong criticism with this new form of tourism.[1] Recently, the usage of the term (in the shape of 'so-called') has increasingly appeared in official

[1] As I have noticed during my fieldwork, the term is largely refused by the local villagers. On the contrary, Dutch tourists seemed to be rather indifferent towards this term, showing no particular interest.

Tab. 1 Basic statistics of research sites.

Municipality	**Stárkov**	**Stupná (Vidochov)**	**Lipno n. Vltavou**	**Čistá (Č. Důl)**
District	Náchod	Jičín	Český Krumlov	Trutnov
Region	East Bohemia	East Bohemia	South Bohemia	East Bohemia
Population	628	53	679	734
Name of recreational locality	Green Valley Park	Arcadian Park	Landal Marina Lipno; Lipno Dreams; Villa Park Lipno; Lipno Lake Resort, etc.	Villa Park Happy Hill
Number of objects Accommodation units Accommodation capacity	22 22 151	29 29 162	countless 306 4978	43 43 344
Construction period Opening of operation	1995/6 1997	1998/9–2008 1999	1998–now 2001	1998–2000 2001

reports and documents (e.g. Ministry of Regional Development). It is also increasingly used in academia (Horáková 2012: 33). We aim to examine how contemporary forms of 'voluntary' mobility and international tourism affect local ideas of development, and what is the impact of tourism on rural localities and communities.

We have selected four research sites in the Czech Republic as in-depth case studies: **Čistá**, **Stupná, Stárkov** and **Lipno nad Vltavou** (For basic information about the research sites, see Table 1, adapted from Horáková 2013).

The selection of the case studies was made on the basis of the following criteria:

(1) *Geographic location and environmental characteristics of the sites*: All research sites are typical of economic and spatial periphery, and are located in mountain or mountain-lake areas. Čistá, Stupná (both at the foothills of the Giant Mountains – Krkonoše) and Stárkov (near the Czech-Polish border) are situated in the Eastern Bohemia region; Lipno nad Vltavou lies in South Bohemia near a lake of the same name (see Figure 1).

(2) *Historical development*: All sites recently followed similar historical trends as for migration and economic development. Before 1945 they witnessed a period of *ad hoc* political out-migration of Germans which was further accelerated after World War II. Under state socialism the areas, shaped by centralised agricultural policies and light industry, suffered from long-term selective emigration of rural people, predominantly young and educated, which further depopulated the areas. After 1989 all sites faced the negative effects of political and economic transformation, such as a decline of the population's major subsistence economies followed by a rise in unemployment and a further drop in population, which brought about overall socio-economic decline. Under such circumstances, tourism was seen by the local authorities in all the studied municipalities as a major agent for economic (re)development and diversification, and as a lifeline for

Fig. 1 Localisation of research sites. Source: Hana Horáková

Fig. 2 Green Valley Park Stárkov.
Source: http://www.greenvalleypark.com/cz/

Fig. 4 Villa Park Happy Hill Čistá Černý Důl.
Source: http://farm5.staticflickr.com/4062/4520338326_76fa836e04_o.jpg

Fig. 3 Arcadian Park Stupná.
Source: http://www.arcadian.nl/images/0040.jpg

Fig. 5 Landal Marina Lipno.
Source: Hana Horáková

the rural communities. Thus, the local authorities of all the villages adopted the concept of tourism as development (Butler & Hall 1998; Davis & Morais 2004; de Kadt 1979). They decided to make deals with Dutch investors who built tourist resorts known as 'Dutch villages' within the village territories (see Horáková 2013).

(3) *Type of tourist destination*: All research sites are home to so-called 'Dutch villages'. In fact, there are two types of Dutch tourism in the Czech rural countryside: 1) individual ownership of second homes; and 2) international tourism in recreational parks initiated by Dutch investors, attracting a largely Dutch clientele. In both types, Dutch people as owners either use these accommodation units for their own recreation, or they further rent them for profit, predominantly to other Dutch people. Stárkov is home to the tourist resort *Green Valley Park* (GVP) comprising 22 villas with 151 beds which came into being in 1998 as the first 'Dutch village' in the Country (see Figure 2). Similarly, the recreational village *Arcadian Park Stupná* consisting of 29 luxurious houses (offering 162 beds) resembling old log cabins emerged in the small village of Stupná (see Figure 3). Čistá's *Villa Park Happy Hill* is one of the first recreational compounds built from Dutch investment in the Country. It offers 344 beds in 43 uniform-looking houses (see Figure 4). Lipno nad Vltavou became one of the Czech rural areas that fully adopted the concept of tourism as development. The area serves as a prime example of a large-scale, rapidly and extensively-evolving, and largely exogenous tourism enterprise situated in a rural host community. By 2012, the village with 679 inhabitants offered more than one hundred accommodation facilities providing 4,978 beds (Infocentrum Lipno nad Vltavou) in all types of tourist infrastructure and facilities: several compounds and recreational villages (*Landal Marina Lipno*, *Lipno Dreams*, *Villa Park Lipno*, *Lipno Lake Resort*, etc.), as well as an ever-increasing number of second homes. Recently, Lipno has become a stage for diverse outdoor recreational activities, facilities, and attractions that, apart from the ramified accommodation network, form the basis of the tourism industry. In the course of time, Lipno has turned into a full-destination resort targeting both a foreign, and

increasingly domestic, and rather well-off, clientele (see Figure 5).

(4) *Types of potential problems due to recent tourism development*: As tourism development increases substantially, a number of negative effects on community life can occur. Besides economic impacts such as a rise in prices or in real estate tax, social and environmental impacts can be recorded, such as social disruption of the local community, and irrevocable changes to the physical environment. As a result, rivalry may appear both between 'hosts' and 'guests', and among factions in the community.

4.2 Methods of inquiry: ethnography as collaboration

The conceptualisation of space and place as unbounded and fluid brings new challenges to the ways of doing fieldwork, which is perhaps the most important and most widely used qualitative mode of inquiry into social and cultural conditions. What is at the forefront is a reconfiguration of the classic fieldwork as a long-term stay in a field where a researcher, as a lone wolf, studies and compares social relations, and tries to generalise the outcomes into 'area, regional, or, most optimistically, universal knowledge (Falzon 2009: 1). Today 'ethnography as/of collaboration' (Marcus 2009) is being increasingly discussed as one of the possible collaborative models in anthropology. As disciplinary boundaries tend to blur, collaboration between social anthropology and other social sciences, be that social/human geography or rural sociology, is common. Our collaboration involves researchers from two different disciplinary backgrounds – social anthropology and social geography. Both the involved disciplines perceive the rural as indivisible physical and social space placed on the urban-rural continuum. They subscribe to a basic sociological assumption as to the connection between our personal experience and the wider social context, as well as to the tensions between social reproduction and transformation (continuity and change).

Our study comprises three senior researchers, two from social anthropology and one from social geography, and a number of graduate and postgraduate students from both disciplines (ranging from six to eight each year) who work as field or research assistants; they spend repetitive stays in the sites, doing reconnaissance of the field, carrying out participant and non-participant observation, conducting interviews, collecting, transcribing and processing the data. Our research also involves a number of collaborators who are residents of the villages, without which our study would not be possible. They comprise both representatives of the political and business elite and 'ordinary' residents. In certain sites (for instance in Stupná), there are also Dutch people (both second-home owners and tourists who repeatedly arrive in 'Dutch villages') who turned out to be our valuable collaborators – informants.

The use of empirical methods is another point on the joint agenda. Our collaboration is not mechanical data gathering under a common theoretical umbrella; instead a negotiation across epistemologically diverse terrains takes place. It is not just a division of labour, or of the sites among the participating researchers; we work on interpretation together. Collaboration takes place between the researchers themselves, between the researchers and field assistants, and of course a collaborative alliance, generated through ethnography itself, is also being established between the ethnographers and informants (collaborators), that is with the researcher and researched in tandem. Such an approach requires sustained coordination in the research design, fieldwork, data analysis and interpretation. Our goal is to reframe the project through the collaboration, which is dialectical, not synthetic.

5. Selected results and suggestions for the empirical research on 'Dutch villages'

5.1 The fluidity

The fluidity and diversity of the rural space under study can be best exemplified by applying Halfacree's (2006) three-fold model of rural space: (1) rural localities; (2) the everyday lives of the rural; (3) the formal representations of the rural. The first two dimensions show distinctive spatial practices linked to production or consumption processes, and examine how rurality is experienced by local actors through everyday activity. As has already been stated, the 'Dutch villages' were directly built into the above-mentioned rural settlements. Yet, diverse spatial patterns, both physical and symbolic, are clearly discernible in all research localities. In Lipno, the visual outlook proves the existence of three bounded parts: first, so called 'Old' Lipno which consists of the original village centre, and the periphery, intended for elderly residents who were moved there into newly built row houses after they had sold their flats or houses on more lucrative lands either directly to the Dutch, or to developer companies; second, a buffer zone called 'New Lipno' for the *n*ouveau riche local residents; and third, the newly built tourist complexes and facilities that have utterly changed the character of the local area, which remind us of a 'resort landscape', even 'seaside resort' with an aesthetic value of its own (Cohen 1978: 226). Spatial boundaries are equally visible in Stárkov and Stupná. The villages are divided into two zones, between the 'old' settlement and the Green Valley Park and a resort called Arcadian Park respectively. The physical closure is accompanied by a low opportunity for, or even absence of interaction. The Dutch do not go to see the locals, and the locals rarely go to see the Dutch. The situation loosely corresponds with the mayor's opinion in Stárkov he had expressed prior to the construction of the villas. 'I want the Dutch to be on the area of 13 hectares so that they do not bother the locals in the village, so that they stay in their own places'. From time to time, mainly in the peak season,

locals do pop into the area for a drink. They commonly call it as 'going for a beer to Holland'. Locals also use an old outdoor swimming pool and children playground built during the socialist era that are accidentally situated within the 'Dutch' private area. The structure of the rural settlement in Stárkov is striking: residents occupy fifteen houses, cottage dwellers thirty and twenty-nine houses serve the Dutch touristic needs. The average influx of some 140–150 Dutch per year outnumbers the local population, including the cottage dwellers, and thus it has far-reaching consequences on the way the rural place is experienced by diverse actors.

The third aspect of Halfacree's model of rural space focuses on the formal representations of the rural, that is how rurality is framed within capitalist production, policy and media discourses. Radical transformation of the rural space under study has been following the logic of Western discourse on modernity based on a linear conceptualisation of social change paved by the processes of privatisation, marketisation and individuation. The assumption that the former socialist countries can follow the development path of Western capitalism (Verdery 1996) forms the basis for formal representation of the rural places under study spread by the local political and business elite as well as by the mainstream media. Their views certifying that tourism is the right road to success and happy future of the village can be illustrated by a remark pronounced by one of the local political elite on the physical change of Lipno rural space: 'Who would object to the changes? They are overall positive … there is a new square with plentiful cosy cafés, decorative greenery, and promenade pavements.' Similarly, a member of the local business elite said that 'Lipno used to be like a bush but now it is being civilised. If we go "to town" (to the new centre), one has to get dressed, not like in a village. Lipno links village with town. Our children won't be country bumpkins any more'. Such statement is however, often contradicted by a whole host of critics (both locals and outsiders) who largely point to excessive concentration of the tourism industry in one place which makes an entirely unnatural impression on the landscape. In sum, formal representation of the rural areas under study stems from the post-socialist power discourse on modernity advocating radical and rapid social change. It is promoted by the actors whose thoughts and practices are dominated by a post-productivist vision and are associated with the exploitation of new economic opportunities, often at all costs. Such discourse tends to disregard the complexity of social and cultural worlds in which local people live (Lampland 2002).

5.2 Following in multi-sited ethnography

The key component of multi-sited ethnography is 'following' (of ideas, people, connections, associations, relationships, objects, conflict etc.) across space. Critics, however, argue that it can be also applied in a single, local setting because ethnographers have always followed their subjects, topics and ideas. As Candea claims, any local context is always intrinsically multi-sited (Candea 2009: 34). Multiple sites may exist within a single city or village; it is up to the researcher to decide what to include in their study and what to omit. Though our research is 'traditional', namely focused on villages, we as ethnographers are faced with a multiplicity of context within a single site. There are many heterogeneous spaces of 'the village' as a physical location: one space as a human community of face-to-face interaction (for instance 'Old' Lipno which is physically separated from the recreational compounds and villages, and where most of the residents live), another space embedded in the recreational parks rather emerges as a stage for tourists and people working in the tourism sector, as a socio-economic aggregate (for instance a physically separated 'Dutch village' in Stárkov, Čistá and Stupná). The issue we study is how these spaces are held together, and whether they can lead to social disruption.

As has already been mentioned, at the core of multi-sited ethnography is an obligation to follow. We followed a *conflict* that stemmed from our initial assumptions, derived from a vast body of (predominantly) Western literature on rural change: 1) Rural resources are becoming increasingly subject to pressures arising from an ever-wider range of economic, social, political and environmental influences; 2) The commodification of rural landscape creates conflict; 3) Relationships between 'hosts' and 'guests' in modern rurality are inherently ambivalent and contested. All the facets of potential conflict stemmed from the oft-cited assumption that rural people are active agents in multiple processes of transformation (Kay et al. 2012; Pasieka 2012). Hence, the agency of local people was taken for granted. But our researched reality gradually showed itself in a different light. In practically all areas under study we as researchers came across with indifference, apathy and passivity on the part of large sections of local population (except for rare representatives of the local political and business elite), rather than with willingness to get involved in the planning and control of the development processes. Rural people tended to appear in outmoded garb as 'passive victims', 'losers' or 'objects' of social transformation, unable to cope with or adapt to the pace and scale of change (Kay et al. 2012). Thus, we had to redirect the conflict from the assumed tensions between 'hosts' and 'guests' to the conflict (mostly latent, sometimes overt) between different sections of the rural population. The major conflict that gradually emerged in all research sites is between different conceptions of development and modernity, namely post-socialist and socialist modernity. Hence, multi-sited ethnography became an opportunity to theoretically re-conceptualise fieldwork itself.

Development through tourism in all sites is presented by local government as a modernisation project that will ensure economic and demographic survival

and prosperity for the local community. This project of post-socialist modernity is shaped by the Western-oriented emphasis on a self-regulated market economy and an active civil society. It seems that those who reject this post-socialist modernity are against modernity *per se*. However, instead of the struggle between modernity and tradition, two different projects of modernity, socialist and capitalist, seem to prevail, which share a common goal to construct an entirely new social, political and economic order. Post-socialism thus creates space for cultural struggles between two modernisation projects backed by two opposing ideologies – socialism and capitalism. These struggles are over the meaning and ownership of modernity (Brandstädter 2007: 134–135).

The contest over the concept of modernity is an unequal power struggle. On the one hand, the Western discourse of modernity is presented as 'natural', as an ideal to pursue as was clear from the interviews with the local power and business elite and from media representation. Such a discourse of progressiveness silences any resistance. Any calls for a slower pace of 'modernisation' sound backward and obscurant.

Conflict over development basically takes place between the interests of a newly-created middle class which strives to increase the quality of life by creating a 'new rurality', often at all costs, and between those who have failed to adapt to the new logic of a Western-style modernity. A new hierarchy between central and marginal worlds emerges; these worlds intersect both physical and symbolic zones, and are accompanied by distinct, often incompatible practices and life-styles. Geographically marginal spaces translate into cultural marginality.

The former category includes individuals whose activities are dominated by a post-productivist vision and are associated with the exploitation of new economic opportunities (Galani-Noutafi 2013: 103). It involves various sections of the community including active resource users, project planners and leaders, local businesspeople and politicians.

The latter category represents those who oppose the hegemonic post-socialist discourse on modernity, which tends to destroy the pre-existing balance of social and cultural life; they prefer 'traditional' arrangements of the community and images of the countryside to be retained. This social group involves diverse individuals: those who have been impacted negatively by economic liberalisation and privatisation; those who miss a vital rural life of the past based on the centrality of productive activities and social and community relations; those endowed with the obsolete form of social capital based on the 'particularised trust', who are actively engaged in the intra-community bonds and networks inherited from the past (Kovács 2012: 115). Their social capital based on bonds created particularly among family members and friends, or former fellow-workers and colleagues is typical for horizontal relations. They miss linking social capital, which is formed by *vertical* bonds which interconnect people from various socio-economic and demographic groups. These residents are caught in a trap of their own, relatively-closed bonds inside their local community. Thus, continuity with the socialist past appears as a major barrier in 'development'. By lacking the 'effective' social capital they cannot comply with the requirements of post-socialist discourse on progress and modernity, and, as a result, they appear to be the most marginal actors whose attitudes towards tourism development are overwhelmingly characterised by apathy, passivity and indifference.

Their marginality is more spatial, cultural and symbolic, rather than expressed in economic terms: the differences in living standards between the two categories are not sharp, economic disparities are rather negligible. The major point of difference, highlighting social and cultural cleavages, emerges in a discursive level and revolves round the ambivalent narratives of the socialist past. The local people's diverse accounts of the past and the varied ways in which they bring the past into the present are 'used' not only as a way of resisting the changes but also a way of adapting to the new reality. As Hörschelmann and Stenning (2008: 346) point out, references to past ideologies and practices represent a symbolic resource both for challenging the new status quo, and for establishing and maintaining power in the new social order. Hence, references to the socialist past are part of the negotiation of contemporary realities framed by two complementary social processes: local empowerment vs. internal displacement and exclusion. The former is typical for those who fully support the post-socialist, Western-oriented discourse on modernity, the latter is experienced among those who share largely positive memories of socialist modernisation – both those old enough to have experienced 'really existing socialism', and younger people who did not live most of their adult lives under socialism but are severely afflicted by post-socialist Western-oriented modernisation embodied by privatisation, marketisation and individuation.

As neoliberal restructuring takes hold in the Czech Republic, these marginal people are drawing on memories to secure themselves to the ties of the socialist past. As economic reforms have done away with the social safety net of socialism, those who have failed to catch up with reforms are reimagining its positive attributes. Villagers' narratives reflect an affirmation of collective belonging rather than oppressive system of state socialism. For some, the past appears as a time of relative well-being. They are often nostalgic for a time when they were 'at the centre' of socialist society. Many identify with the ethos of socialist modernity linking people with the state through their rights to share in the redistributed social product. Thus, dependency, rather than agency informs their attitude to the current development project. Accounts of prevailing attitudes of passivity, indifference, and lack of agency are reflections of socialist paternalism which implicitly viewed society as a family, headed by a

'wise' Party (Verdery 1996: 63–64). For those who failed to catch up with the demands of the present, socialism is not dead in their social memory; instead it develops *within* capitalism, as the constant, necessary, critical accompaniment of capitalism (Caldwell 2013). The utopia-oriented language of state socialism, no matter how infamously it ended up, enables them to raise questions about 'social justice' – housing, unemployment, overall economic insecurity, simply the most acute problems of everyday life. Socialism is evoked as a kind of moral and political enlivener. Socialism, the villagers claim, would ensure to distribute wealth on ethical grounds and help vitalise the community's moral fibre.

6. Conclusion

The paper sought to examine certain epistemological and methodological challenges concerning multi-local research of four Czech rural areas that recently adopted the concept of tourism as development. Based on the perspective of modern rurality as an unbounded and fluid concept I argued that classic modes of doing fieldwork should be replaced by those that better correspond to the new conceptions of the rural as social representation. The core question the text raised was whether multi-sited ethnography can be a legitimate proposition for contemporary research of modern rurality.

Multi-sitedness seems to be inevitable in dealing with a complex world and the realities of many people's lives (Horst 2009). This research strategy has proved to be a positive development for anthropology as well as other social sciences as it enables us to transcend spatial, intellectual and disciplinary boundaries, to 'weave together accounts of ever-increasing complexity' (Candea 2009: 27). Marcus listed a number of appropriate topics for multi-sited ethnography, namely the media, science, and the global political economy. Is this strategy appropriate for a village ethnography we are currently carrying out? As Fitzgerald claims (2004), multi-sited ethnography is best suited to study different types of motion. Thus, it is suitable for studies of globalisation and modernity, of which mobility is part. Our research, though seemingly 'bounded' in four distinct localities, meets these criteria, as I was trying to show in this paper. The 'local' perceived as fluid and unbounded, is understood as a nodal point of interconnection in socially-produced space rather than as a set of bounded units. Moreover, a mobile-research style has proved highly compatible with our project, seeking to explore the dynamic of rural development through tourism. We can confirm that mobility and flow embodied by tourism and recreational activities does not allow for conceptualising the field as immobile and bounded.

The struggle to move among different sites may be rewarding since it may lead to opening up new horizons of understanding. Alternatively, the strategy may result in spoiling the outcome when a fieldworker fails to put his or her fragmented data together in a meaningful whole. Hence, multi-sited ethnography should not be thought of as a *sine qua non* of good ethnography (Candea 2009: 42). Despite some constraints mentioned above in the text, multi-sited ethnography has so far brought to our research more gains than losses. First of all, it made us more aware of the tensions between global mobility embodied by tourists' lifestyles and largely immobile and 'bounded' local communities. Next, we fully adopted the concept of following as the key component of multi-sited ethnography. By following the conflict we were able to uncover its deeper, often less-visible layers than we had thought; thus, this strategy has offered us insights into ambiguous relations among different sections of the rural population under study. It helped us to follow the emergence of a hybrid rural place filled up with changing social and power relations, and the processes of the internal 'othering' and marginalisation of the post-socialist rural place and people, particularly those who are caught in the trap of socialist modernity, characterised by bonding horizontal social capital. Finally, thanks to the possibilities to follow diverse trajectories in the sites, multi-sited ethnography has enabled intense methodological reflection within the research process as well as further theoretical developments. Our research topic has crystallized over time.

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RESUMÉ

Multilokální výzkum moderní rurality v České republice: epistemologické a metodologické problémy

Text se zabývá epistemologickými a metodologickými problémy spojenými s výzkumem polistopadové transformace venkovského prostoru z antropologické perspektivy. Na příkladu čtyř obcí v České republice, které za svoji klíčovou rozvojovou prioritu přijaly platformu mezinárodního turismu, je cílem diskutovat jak obecnou relevanci vybraných metod, výzkumných strategií a konceptuálních nástrojů, tak i jejich využití ve výzkumu tzv. holandských vesniček. Diskutované problémy zahrnují otázku definice tzv. moderní rurality jako neohraničeného a tekutého konceptu, otázku chápání venkovského prostoru jako sociální reprezentace a otázku využití etnografie mnoha dějišť (tzv. multi-sited ethnography). Text si zejména klade za cíl zodpovědět otázku, jestli je tato výzkumná metoda legitimním nástrojem při studiu moderní rurality a zdali napomáhá porozumění sociální změně spojené s postsocialistickou transformací českého venkovského prostoru

THE OWNERS OF SECOND HOMES AS USERS OF RURAL SPACE IN CZECHIA

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ABSTRACT

Although the second home tourism is considered to be an element of the lifestyle of a predominantly urban population, it has a strong influence on rural life. Thus, research on the relations within both urban and rural communities that share the transforming space seems crucial for future rural development. This article focuses on second home owners and users as significant agents in the transformation of the Czech countryside. Available statistical data indicates a high number of second homes with an uneven location pattern in the landscape. Primary data, based on our own field surveys, in-depth interviews and observations, show the significant social impact of second home tourism on the local social environment. The models of conflicts, coexistence and cooperation are investigated in selected peripheral areas in Czechia. Our own contribution to the research is in the specific focus on community development in municipalities with a significant tourist and recreational function. The major aim is to demonstrate and discuss linkages between second home owners and users and territorial identity with the use of empirical data. Our crucial findings contradict statements about conflicts in relations between the local population and incomers from cities. Especially long-term cottage users are no longer considered as outside invaders in rural areas, which used to cause social conflicts. The differences between second homes and primary residences seem to be more blurred than in the past. The conclusion outlines the possible future directions of research with focus on social capital, multiple dwelling and semi-migration concepts.

Keywords: second homes, rural space, territorial identity, recreation, tourism, Czechia

1. Introduction

Our research follows the concept of community development elaborated by Giddens (1991) and Wellman (1996), where the local community is perceived as a potential collective agent. There are two aspects of the community development: development within the community and development of the community as a whole. The development of communication and cooperation inside local communities was studied for instance by Gans (1968), Wellman (2001) and Day (2006) where potential conflicts between traditional rural local community and incomers from cities bringing features of urban lifestyle were described. Mutual relations between residents and tourists can be conditioned also by their relations to the territory used. As far as the local community structure is concerned, crucial actors are traditionally defined as the residents, the local authorities, entrepreneurs and civic associations. Various actors have different visions of the use of the area, its function and future development. They also perceive diverse territorial identities which also differ in their formation process.

Reconceptualisation of the territorial identities has been introduced to contemporary geographical discourse in the 1980s and has been strongly accented in the world (e.g. Knight 1982; Paasi 1986; 2009; Giddens 1991; Raagmaa 2002; Fukuyama 2006) as well as in Czech scientific literature (Vencálek 1998; Chromý 2003; Zich 2003; Chromý et al. 2009; Semian 2012). The territorial identity can be conceptualised as two complementary parts (Paasi 1986; 2009): 1) the territorial consciousness of inhabitants, their sense of belonging to a territory and their perception of it and 2) territorial images formulated and reproduced by various agents. Territorial identity is thus continuously reproduced through socio-spatial, politico-economic and cultural changes. In contemporary discourse, territorial identities are often related to the territorial development of various areas (Antonsich 2010), sometimes accenting tourist potential for development (Kneafsey 2000; Light 2001). Territorial identities in development strategies are often seen as narratives reinterpreted for different purposes by different actors of regional development (Frisvoll, Rye 2009). Nevertheless, the importance of the reshaping of territorial identity by different actors (residents versus second home owners and users versus organised and individual tourists versus municipality representatives, etc.) has not been studied sufficiently.

The relations of people to a territory are a natural component of life. The areas with changing environmental, socio-economical and socio-cultural conditions and areas with specific historical development play different roles in the processes of the shaping the peoples' territorial identity. The different spatial relations are mostly supposed for two groups of identity creators: the residents and the second home users. The different relations are influenced not only by the length of stay but also different values and behaviour/performance of the groups.

Recent research on territorial identity in rural areas of Czechia (Chromý et al. 2009; Chromý, Skála 2010;

http://dx.doi.org/10.14712/23361980.2014.11
Fialová, D. – Vágner, J. (2014): The owners of second homes as users of rural space in Czechia
AUC Geographica, 49, No. 2, pp. 21–28

Chromý et al. 2010) has been focused on the opinions of members of local authorities and on the residents. However, second home users have been rather neglected despite the fact their being significant or even dominant agents. This required the acquisition also of primary data for the survey, described in the next chapter.

Our own contribution to the research is in the specific focus on community development in the municipalities with a significant tourist and recreational function. The major aim is to demonstrate and discuss linkages between second homes owners and users and territorial identity with the use of empirical data.

The Czech countryside has been transforming into a multifunctional environment in which the recreational function, significantly represented by second homes, prevails in many localities and even regions (Frantál, Martinát 2013). Therefore, several research questions have been formulated: Whether at all and how second home users affect the countryside, how they perceive it, whether and how they participate in the creation of the social capital, whether they identify themselves with the place they use and how they form its territorial identity? The issue also is whether second home users are significant agents that have to be considered in the research into the rural areas with a high concentration of second homes. It should further be determined what their relation with the other agents is and what methods may be used to study this situation.

The text below outlines the methods of the identification of regions with the high concentration of second homes, with respect to the specificities of Czechia. This is followed by a detailed description of the actual survey in the selected regions, whose results make it possible to answer the key questions in the conclusion.

2. Methods

2.1 Selection and description of the areas surveyed

Second home tourism in Czechia has traditionally been a significant phenomenon. 12% of households own a second home (with the number of the owners being twice as high in big cities); a quarter of population uses a second home regularly. Second homes cover 20% of all dwellings in Czechia. The data have been provided by the Czech Office for Surveying, Mapping and Cadastre (ČÚZK), which keeps records of all real estates, classified by functional usage. We focused on residential dwellings as well as second homes, labelled as individual recreation dwellings in the register (Bičík et al. 2001). The smallest units registered are the cadastre units (c. u.); the whole area of Czechia is covered by over 13,000 c. u. (Kuba, Olivová 2005).

Our emphasis was placed on second home users who regularly exploit the space (see Figure 1). The darker the colour, the higher the share of second homes (i.e. the higher the share of second home users as compared to residents). The second homes significantly prevail in the southern hinterland of Prague, mountainous regions (Krušné hory, Jizerské hory, Jeseníky, Beskydy), and at water reservoirs (Lipno, Hracholusky, Orlík, Vranov) which confirmed the results by Vystoupil et al. (2006).

In different numbers and at varying intensity, second homes are practically spread all over Czechia. Nevertheless, the concentration of second homes may be measured by the auto-correlation method (LISA). The main zones of concentration include the southern hinterland of Prague (for a detailed survey, see e.g. Fialová 2012), Plzeň outskirts, the western part of the Krušné hory Region, the

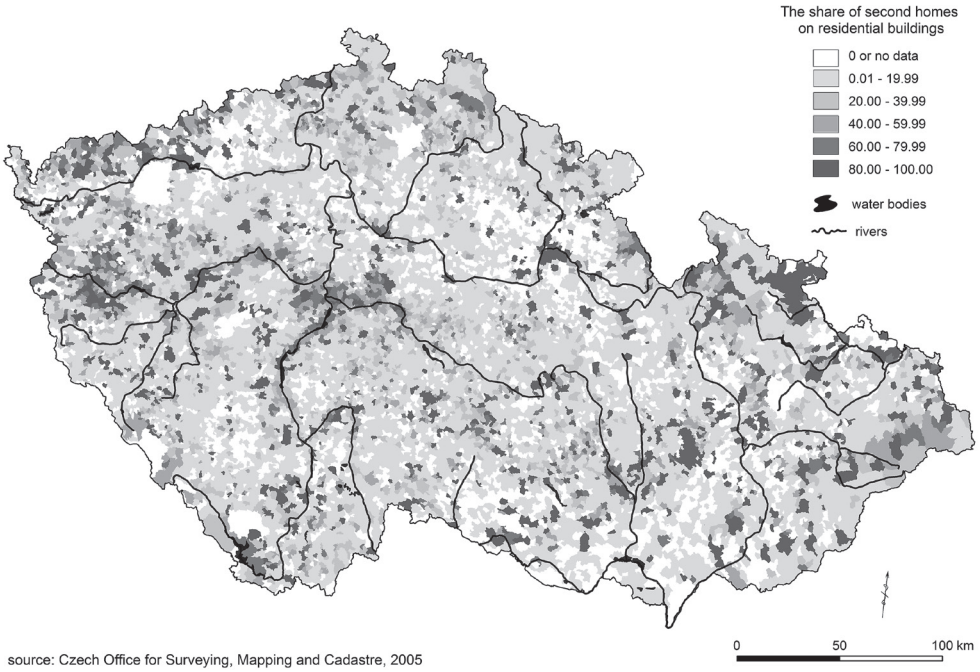

Fig. 1 The share of second homes in the number of residential dwellings. Source: Vágner, Fialová 2009

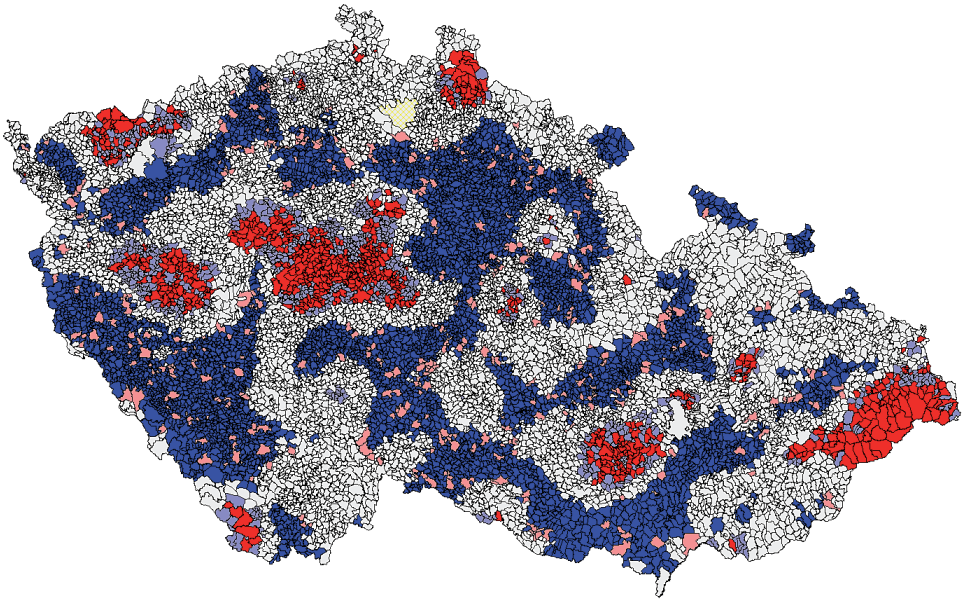

Fig. 2 The main concentrations of second homes identified by auto-correlation method (LISA).
Note: The autocorrelation method enables to measure similarity of neighbouring cadastre units according to values of the share of total amount of second homes on all dwellings (Novák, Netrdová 2011).
Source: own elaboration, data from ČÚZK 2010

Liberec Region, Brno outskirts, the Beskydy. Secondary zones are represented e.g. by the banks of water reservoirs (Lipno, Seč). The concentration of municipalities with a dominant second home function (in red colour) is very clear in such areas (Figure 2).

The first research stage proceeded from the quantitative statistical data on the population, second homes and residential dwellings provided by the ČÚZK and the Czech Statistical Office (Census). The absolute data were relativized to the area, population and dwellings (see Figure 1 and Figure 2). Subsequently, case-study regions for a deeper survey were selected. This was followed by qualitative field research, predominantly in the form of questionnaire surveys and in-depth interviews with the agents.

Eight case-study regions were selected for a detailed field survey based on the share of second homes in the number of residential dwellings (Figure 3). Second homes in Czechia are classified as a) cabins and recreational homes – buildings built primarily for recreational purposes; b) cottages – primarily built for another, mostly residential, function (Fialová, Vágner 2005a). Long-term non-occupied flats used for recreational purposes were taken into account, too.

During the selection of case-study regions the geographic position was also considered. Case-study region No. 1 represents an area in the inner periphery in the amenity-rich hinterland of Prague with sparse settlement, which had been depopulated during the Second World War, with a subsequent large-scale population exchange.

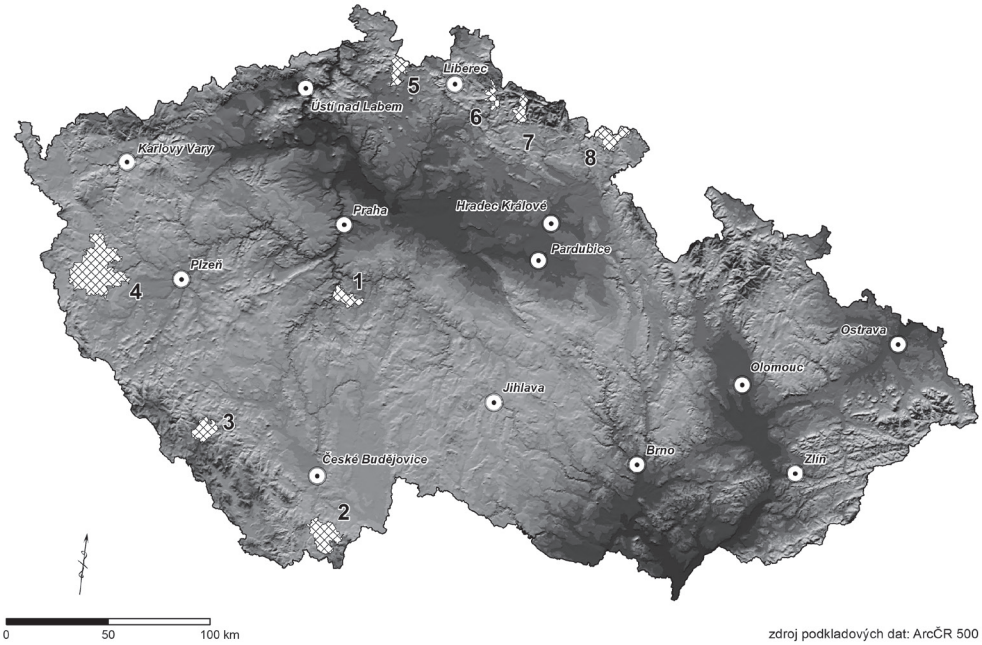

Fig. 3 The case-study regions for the field research and questionnaire surveys.
Note: Numbers of case-study regions: 1 – Neveklovsko, 2 – Kaplicko, 3 – Vacovsko, 4 – Borsko, 5 – Cvikovsko, 6 – Tanvaldsko, 7 – Benecko, 8 – Teplicko n. M.

Case-study regions Nos. 2, 4, 5, 8 are peripheral areas with worse accessibility, weaker economic power and not fully exploited recreational potential, which are, however, very valuable from the environmental point of view (amenity-rich areas). Case-study regions Nos. 3, 6, 7 represent attractive hilly and mountainous regions visited by a high number of tourists.

2.2 Research in case-study regions

Our focus was placed on the opinions of the local representatives (mayors), residents but predominantly second home users, obtained from in-depth interviews and questionnaire surveys.

One hundred respondents were interviewed in each case-study region; the ratio of the residents and second home users reflected the share of second homes. The surveys were conducted in 2010 and 2011, mostly in the summer recreation season (when the frequency of second home use is the highest) in the form of structured interviews by qualified questioners trained by the authors. The questions asked focused on perceived identity to three hierarchical levels of the territory (methodologically based on recent research Chromý 2004; Fialová et al. 2010). The highest level was represented by the case-study region as the whole, i.e. (larger) neighbourhood of the residence/second home, the second level by the municipality (village) and the lowest level by the place (locality) which means the close neighbourhood of the resident/second home (settlement, a part of the municipality). The emotional relations to the territory and generation ties were surveyed as well as the identification of the singularity of the territory, their symbols and functions. The respondents were asked about the most painful problems, in the residents versus second home users relations especially, and about their involvement in rural life. They also expressed on their satisfaction and potential future use of the territory. The basic identifiers as gender and age group concluded the surveys.

The structure of the respondents was the following: a total of 734 questionnaires were obtained from 440 residents (60%) and from 294 second home users. Both men (47%) and women (53%) were interviewed. More than 60% people were above 46 years of age. The closed questions in the questionnaire were analysed with simple descriptive statistics and complemented with an analysis of the open questions and with other findings obtained from the analysis of the interviews.

3. Discussion

The respondents in the case-study regions evaluated their own perceived identity to the different hierarchical levels of the territory commonly used in their everyday lives routine. As far as the municipality level is concerned, an important finding emerged, namely that one-third of second home users consider themselves as locals (Fig. 4). This is caused by the fact that there is a high share of long-term cottage users with close ties (80% of the residents and 65% of the second home users have visited the municipality more or less regularly for at least 20 years, which means for more than one generation) to the local life in the case-study regions. The questionnaire survey revealed quite a stable population with 30% people born locally with little variation among the case-study areas.

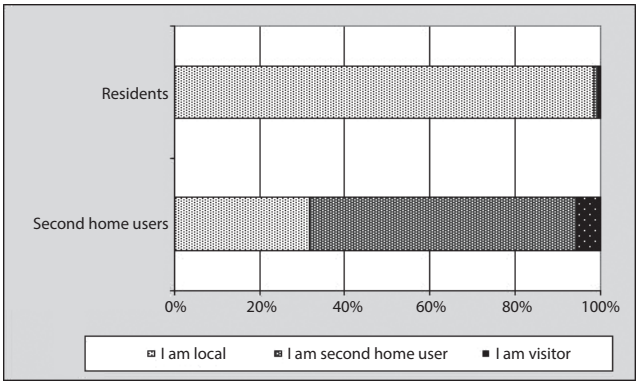

Fig. 4 The perceived identification of the respondents with the territory.
Source: the authors' own surveys in 2010, 2011

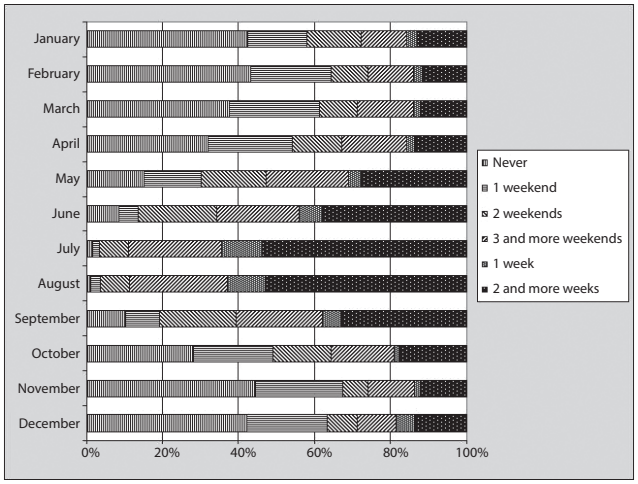

Fig. 5 The frequency of the use of second homes during the calendar year.
Source: the author's own surveys in 2010, 2011

The Figure 5 indicates the frequency, the length of stays of second home users and their distribution within a year. The summer season from May until September is dominant. No visit between November and February was declared by 40% respondents.

The residents live in the area mainly because of their ancestors, family roots and relationships. A big share of the second home users (30%) have also known the place of second home since their childhood. The importance of friendship was declared by 40% respondents. Social and family ties belong to the most important factors of the ownership, use and location of second homes.

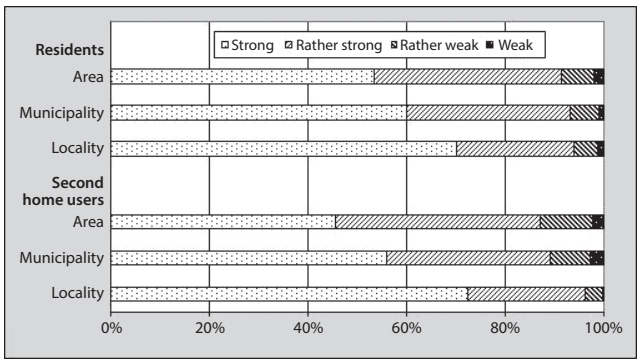

Fig. 6 The perceived identity of the respondents to three hierarchical levels of territory.
Source: the authors' own surveys in 2010, 2011

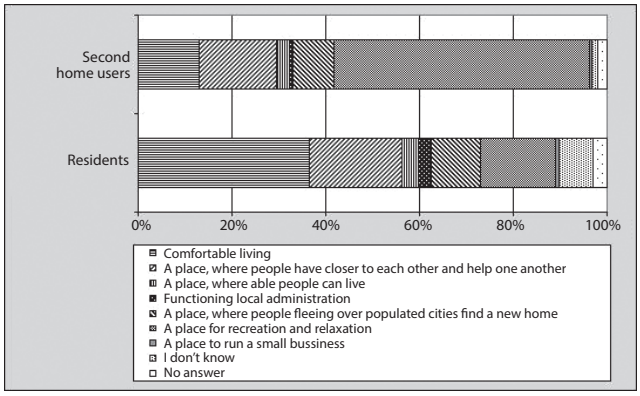

Fig. 7 The characteristics of the residence/second home territory and opinions on it.
Source: own surveys in 2010, 2011

The respondents explained their spatial ties on the scale: strong, rather strong, rather weak, weak, related to three hierarchical levels of territory. Both groups of respondents (second home users even more clearly) have declared stronger relations to closer and smaller-area units (Figure 6).

Both groups of informants declared that the regions are unique because of their environmental quality, landscape, nature and calmness. They are also proud of these features of the regions.

The respondents were also asked to characterize and give their opinions on their residence/second home territory (Figure 7). The second home users mostly declared that the area is appropriate for recreation (55%) and also a place where people have closer relations to each other (20%). The residents had similar opinions. However, their main reason for presence was comfortable living (36%). Closer inter-personal contacts where people help each other were mentioned as the highest value by 20% of the respondents in both groups which indicates the high importance of good social climate for living and recreation.

Second home users used to be considered as a burden for the municipality (Gallent, Tewdwr-Jones 2000; Fialová, Vágner 2005b). This statement was agreed by 40% of the mayors, mostly in the municipalities with extremely high concentrations of second homes and with some new forms close to commercial tourism – e.g. holiday apartments in mountain resorts. In our survey, however, this negative opinion was neither confirmed by second home users nor by 80% of the residents, which was rather surprising. A half of the respondents (as well as a half of the residents) declared that long-term second home owners should also obtain a chance to become representatives of municipal councils!

The questionnaire made it possible to receive opinions on the quality of social relations among residents, second home users and between those two groups. Generally, the relations seem to be perceived more positively by second home owners. The final results appear very optimistic, because more than two-thirds of the population declared good relations and only about 5% of locals feel bad relations between residents and also between residents and second home owners (Table 1). However, a part of the respondents feel a trend of worsening relations, which may be seen as a potential problem.

The residents and second home owners declared similar interests in the participation in traditional social events as funfairs, balls and sport events.

The chief organisers of social events are traditional clubs and associations – volunteer fire brigades, soccer teams and game-keepers in Czech countryside (Kůsová 2013). Our survey indicated high activity of second home users not only in participation but also in organization of social events in cooperation with active local residents.

4. Conclusions

As stated in the introduction, mutual relations between residents and tourists can be conditioned also

Tab. 1 The social relations among residents, second home owners and between the groups (%).

Social relations	Opinions of residents			Opinions of second home owners		
	residents vs. residents	residents vs. SHO	SHO vs. SHO	residents vs. residents	residents vs. SHO	SHO vs. SHO
very good and good	68.8	69.8	71.8	76.2	72.7	77.5
rather bad and very bad	5.5	4.4	1.0	1.4	4.5	0.7

Note: SHO – second home owners. Source: own surveys in 2010, 2011

by their relations to the territory used. As far as the local community structure is concerned, crucial actors are traditionally defined as the residents, the local authorities, entrepreneurs and civic associations. Various actors have different visions of the use of the area, its function and future development. They also perceive diverse territorial identities, which also differ in their formation process.

Our research pointed out that second home owners and users are additional significant agents with a considerable influence especially on social life in the rural space and local community and it is necessary to take them into account, especially in areas with a higher concentration of second homes. The quantitative data have indicated specific territories where detailed field surveys have been conducted in the form of interviews with the agents and questionnaire surveys. The data have been analysed and explained with using both quantitative and qualitative methods with respect to their characteristics. Although the generalization of the results is rather problematic, in fact the only one (i.e. joint) community of residents and second home users together has been found in most surveyed regions, not separated groups of the residents and second home users with strongly different interests. The similarity of social behaviour and perceived identity to the territory was high especially in regions with a higher share of cottages with long-term stays of the second home users.

Therefore our results contradict general statements (frequently shown in the media) about antagonistic relations between the local population and the 'invaders from cities'. Likewise, social conflicts between the rural hosting and the visiting second home populations were expected according to key researchers on this issue (Doxey 1975; Farstad, Rye 2013). Similar conflict results were obtained also from with users of more or less separated cabin and recreational home localities or holiday villages (Fialová, Horáková 2013). Our research has shown that the long-term cottage users are mostly no longer considered as allochthonous elements in the rural space, which used to bring social conflicts.

Further research should focus on those regions where second home users are less involved in the local and rural life (cabin and recreational home users). Other studies might explore the formation of social capital in the various types of countryside (as defined by Bourdieu (1986), Coleman (1988) or Putnam (1993)), following the pilot studies elaborated by Pileček (2010); Pileček, Jančák (2010) in the Czech countryside.

Importantly the differences between second homes and primary residences seem to be more blurred than in the past. Therefore the concept of multiple dwellings (McIntyre, Pavlovich 2006) becomes common in developed societies. Second home commuting is replaced with semi-migration or circulation processes (Flognfeldt 2004; Overvåg 2011). These principles as well as the theory of heterolocal identities as described by Halfacree (2012) have not been surveyed in the rural space of Czechia yet and, therefore, become challenges for future research.

Acknowledgements

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RESUMÉ

Vlastníci druhého bydlení jako uživatelé venkovského prostoru v Česku

Druhé bydlení je obecně považováno za prvek životního stylu především městského obyvatelstva. Důležitý je však vliv aktivit, spjatých s druhým bydlením, působících silně na venkovský prostor a ovlivňující život obyvatel na venkově. Proto výzkum vztahů mezi městskou a venkovskou komunitou, které sdílejí a přeměňují společný prostor, je významný i pro budoucí rozvoj venkova. Článek klade důraz na vlastníky a uživatele druhého bydlení jako na důležité aktéry při transformaci českého venkova. Statistická data ukazují vysoký počet druhý domů se značně nerovnoměrným rozložením v krajině. Primární data, založená na vlastním terénním výzkumu, hloubkových rozhovorech a pozorováních, dokládají významný sociální vliv druhého bydlení na místní prostředí. Ve vybraných modelových územích Česka je ověřován koncept konfliktu, rivality, koexistence a kooperace. Naším vlastním příspěvkem k výzkumu je specifický zájem o rozvoj komunit v obcích s významnou turistickou a rekreační funkcí. Cílem je, s využitím empirických dat, prokázat a diskutovat vztahy mezi vlastníky a uživateli druhého bydlení a lokální populací, a analyzovat specifika rekreantů při vytváření teritoriální identity. Hlavní výsledky popírají tvrzení o převážně konfliktních vztazích mezi venkovskou populací a dojíždějícími rekreanty z měst. Především chalupáři s dlouhodobým pobytem a rodinnými kořeny v lokalitě již nejsou považováni za cizorodé a negativní prvky, přinášející do venkovského prostředí sociální konflikty. Nejsou jen pasivními účastníky, ale často přebírají i roli organizátorů lokálního rozvoje. Stále intenzivněji dochází ke stírání rozdílů mezi prvním a druhým bydlením. Závěry též naznačují další možné směry výzkumu s orientací na sociální kapitál, koncepty vícečetného bydliště a semi-migrace.

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AND THE FARMER BECAME A GARDENER METHODOLOGICAL CHALLENGES OF ANTHROPOLOGICAL RESEARCH IN THE SWISS ALPS

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ABSTRACT

This paper will discuss the rural and touristic context in which current changes and tensions pose methodological challenges to anthropological research. The canton of Valais, in Switzerland, is a rural mountain region that has undergone deep transformations, particularly during the second half of the 20th century. The Alpine valleys have seen intense construction activity: traditional farming systems have decreased drastically whereas tourist facilities have significantly increased in number. The recent changes in agricultural policies have amplified farmers' discontent and a new law on construction restrictions in mountain settings has brought to light a marked cleavage between the inhabitants of the Swiss Plateau and mountain dwellers. Economic and environmental interests create substantial tensions. Given these tensions, carrying out research in this setting became quite sensitive and politicised. I will present some results of exploratory research conducted in Valais in September 2012, as well as the challenges that have to be taken into account when organising long-term ethnographic research. It is proposed that one way to overcome personal and discipline-related obstacles is to carry out multidisciplinary research with social geographers, specialists of environmental sciences, agronomists and experts in regional planning and land use. Accordingly, interdisciplinarity and the comparison of various rural contexts are crucial in order to achieve relevant results.

Keywords: rural tourism, agricultural policies, anthropological research, Switzerland

1. Introduction

I teach social anthropology at the University of Fribourg, in Switzerland. When I told my students that we would conduct an anthropological research in Switzerland, they were somewhat surprised and probably disappointed, possibly because they chose to study social anthropology thinking they would research exotic places and cultures. For a long time, anthropology was indeed defined by the exoticism of its subject matter and by the cultural and geographic distance that separated the researcher from the researched group. I went on to explain to the students that anthropological tools can also be used to study our own societies and cultures and that anthropology is also useful "at home".[1] Regardless of where the fieldwork takes place, in certain cases the challenges it presents may be very similar. In order to give students an insight into the methodological challenges of fieldwork "at home" and introduce them to the sensitive aspects of local issues, my colleague François Ruegg and I organised a summer school in September 2012 in the canton of Valais, a touristic mountain region in the southwest of Switzerland. The subject of the summer school was the transformation of mountain regions with specific attention to the topics of tourism, heritage and agriculture. Our first aim was to compare the viewpoints of local knowledge to national policies on environment, tourism and heritage. Professors and students from both Switzerland and Bulgaria participated in this summer school, which included conferences by specialists on the main topics, visits to emblematic places and interviews with local actors on the above-mentioned three topics. The interviews done during the summer school were completed with discussions and interviews held by the author between September 2012 and September 2013. Altogether, we taped 18 semi-directed interviews with representatives from different areas: four intellectuals and cultural actors (sociologist, museum curator, heritage expert, actor), two politicians (municipality representative), two entrepreneurs (cheese factory cooperative member), four tourism actors (tourism promoter and travel agents, hotel owner, tourist bureau employee, architect) and six farmers. Thus we were able to gather different opinions and to confront views from various sectors of the population concerning the development and current situation of this canton. Qualitative interviews are an effective method to learn from people what they believe and how events affect their life. The information gathered for this paper has been enriched with newspaper articles, television programs, and debates with students' research in the frame of a seminar on the transformation of rural space held in autumn 2013 at the University of Fribourg. The research method and analysis is thus qualitative, based in an ethnographic approach. The core of qualitative analysis

[1] There are several writings on the subject of anthropology "at home", where "home" may incorporate quite different meanings. For insights into anthropological research at home, see for instance the articles gathered in Giordano, Greverus and Römhild (1999). Some authors now propose to overcome the division between anthropology "at home" and "abroad": for example, Marianne Gullestad in a conversation with Marianne Lien and Marit Melhuus (2008).

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lies on three related processes: describing phenomena, classifying it and seeing how the concepts interconnect. Qualitative data are words rather than numbers. Words describe and explain. Our information comes from words and our analysis is based on affirmations, points of view, beliefs and interpretations collected through interviews and also informal discussions. Qualitative analysis involves going through pieces of data to detect and interpret thematic categorisations, search for information, and generate conclusions about what is happening and why.

At the time of the summer school, in 2012, the Agricultural Policy for 2014–2017 was not a question of debate. However, in March 2012 an initiative restricting new constructions which will be discussed further on, was accepted by the population, raised discontent in touristic regions and is still today a heated topic among the population. Thus, political decisions and new laws engendered several tensions presenting challenges that need to be faced in anthropological research. I will first present the context, the recent changes and the discussions that ensued in order to better understand the implications for a methodological empirical research, which is the goal of this paper.

2. Farmers[2] and tourism

The Valais where we carried out our small-scale research presents a combination of touristic attractions (ski resorts in winter, trekking in summer, natural landscapes and spa resorts in both seasons) and a farmer/agrarian context. The fact that tourism is developed in a rural environment allows us to introduce the notion of rural tourism. Usually rural tourism is used as a form of tourism or travel in a traditionally rural area that can no longer survive solely on agriculture or "traditional" land exploitation. Tourism and tourism related services or "attractions" are a possible alternative when farmers need to diversify their activities to get more income. Rural areas are now places to be consumed and production is based on establishing new commodities and rediscovering places for recreation and tourism (Hall and Page 1999: 180). The idea of rural tourism is usually linked to authenticity, to life as it once was and as a means to improve the welfare of local communities by bolstering their economic and social development. Ideally, therefore, rural tourism is an activity that promotes employment as well as economic and social development, inasmuch as it acts as an alternative income source for farmers and social sectors living in difficult economic situations (Bessière 1998, 2000; Dumas et al. 2006; Grünewald 2002; Iorio and Corsale 2010). Moreover, rural contexts display huge differences in terms of available resources (infrastructural, economic and cultural) depending on the country in which they are located. Consequently, rural tourism options vary considerably from one country to another and from one location to another.

For all those who enjoy nature, Switzerland offers a wide range of possibilities, from an adventure in the straw, a tipi or yurt rental or a house in a vineyard to accommodations in a holiday apartment by a lake, a chalet in the mountains or a cottage in a rural setting (www.tourisme-rural.ch). The country's natural and cultural landscape attracts many tourists. Coupled with the beauty of its scenery, Switzerland has maintained the image of a rural country with farmers at the core of its national identity. Swiss Enlightenment philosophers played a major role in shaping and strengthening the notion of Swiss identity by drawing on the image of "godly, virtuous, modest and peaceable farmers" (Marchal 1992: 39). Swiss national identity is centred on foundation myths linked to the valorisation of farmers and Alpine communities, as shown in several works (amongst others, Tanner and Head-König 1992; Marchal and Mattioli 1992; see also Droz 2004 for an annotated literature on Swiss rural studies). Though possibly a cliché, the character of "Swissness", i.e. of what is authentically Swiss, is linked to land virtues and to a particular mountain landscape. This relation between landscape and national identity construction has been extensively explored by the historian François Walter (1991, 2004, 2011 amongst other titles).

As in other rural contexts, contemporary farmers in Switzerland also need to diversify their activities. Political decisions concerning agriculture are changing the farmer "ethos" (Droz and Miéville-Ott 2001), thus they need to explore other sources of income, namely through tourism. Besides the range of accommodations, rural tourism includes catering facilities (*table d'hôtes*) and wine tasting, the selling of home-made and local produce, educational farms, open air activities, vineyard and farm tours, as well as the chance to participate in rural festivities and traditions.

However, tourism and traditional rural economy followed opposite trends: wherever the former increased, the latter decreased. According to the Federal Statistical Office, agricultural areas are decreasing. Since 1996, 32,000 ha are no longer exploited. On average, approximately 2000 ha have been abandoned per year (http://www.bfs.admin.ch/bfs/portal/en/index/themen/07.html). Moreover, habitat areas and infrastructure have expanded at the expense of agricultural land (http://issuu.com/sfso/docs/002-0902#). In the Alpine valleys, traditional farming systems shrank drastically during the 20th century, whereas tourist facilities increased heavily in number. There was a shift from an exploitation of the land to an exploitation of the landscape. From being the core of Swiss identity, where farmers historically played a central role, they became "gardeners of the Alps", as the

[2] There is usually a question about how the population the anthropologist is working with should be named. The preferred term is the one used by the population itself, in our case 'paysan' in French. I have opted for the term 'farmer', which translates the French 'paysan', German 'Bauer' and Italian 'contadino' as found on the Internet site of the concerned group (http://www.sbv-usp.ch).

farmers themselves say today. Legislation on agriculture and dairy production is regulated by article 104 of the Swiss Federal Constitution, voted by the population on June 9th 1996. This article designates agriculture as a pivotal sector for the conservation of natural resources, the upkeep of the countryside and the preservation of the country's decentralised population in rural areas.

Swiss agricultural policy has changed enormously over the last 20 years. In 1993, Parliament introduced the concept of direct payments, a key element in current Swiss agricultural policy, which represent remuneration for services provided by farmers for the common good. There is a distinction between general direct payment and ecological direct payment. The first one is used to remunerate services such as the protection and maintenance of rural landscape, ensuring food production and the preservation of natural heritage. In hilly and mountainous regions, the demanding farming conditions are compensated through payments for steep topography and animal husbandry under difficult conditions. The ecological compensation takes into consideration efforts with regards to the environment and livestock. The federal authority aims to promote biodiversity in agricultural areas, reduce the use of fertilisers, promote in particular animal-friendly conditions for livestock and ensure the sustainable use of summer pastures, amongst others. This is the policy makers' discourse. The perspective changes when we listen to farmers. In Switzerland, most farms were traditionally small-scale and family-run. For this category of farmers all these obligations are very hard to meet and are perceived by them as quite unfair. They feel they are subject to numerous controls that prevent them from properly executing their traditional job. They feel politicians and urbanites impose particular conditions on them that weigh down their already demanding everyday work. Moreover, some Swiss farmers we talked to also take issue with what they perceive as a kind of hypocrisy. In their opinion, the government imposes very strict regulations on how their work has to be done, either with livestock or agriculture, whereas foodstuff imported from various countries undergoes less control and is often sold at lower prices. Many of these issues were also presented in the interviews with farmers taped for the television report aired on January 16th 2014 on the situation of Swiss farmers (RTS 2014).

New changes were introduced by a new Agricultural Policy for 2014–2017 adopted by the Swiss Parliament. The main goals of this policy are to improve the competitiveness of Swiss agriculture, increase services provided by farmers to the community as well as the efficient use of resources in agricultural production and minimise the negative effects of farming on the environment. In other words, the farmer's chief job is no longer to provide nourishment for the population, but to contribute to many other different tasks, in line with the idea of the multi-functionality of agriculture. Therefore, the farmer's main role is not agrarian production, but environmental and settlement control as well as keeping the "garden clean and tidy for visitors". This idea was and still is relayed regularly in different media as for instance in the journal Le Matin, with an article entitled "Le paysan sera payé pour planter des geraniums" [The farmer will be paid to plant geraniums] (Le Matin 2012). These changes not only influence the economic context, but also deeply affect the identity of the farmers who feel that their traditional labour is neglected by authorities and overlooked by the urbanites who sustain these policies by their vote, as some of them declare. The political system in Switzerland is a semi-direct democracy where referenda, initiatives, changes to the constitution and law amendments are voted and need to be approved by the population. For an initiative to be accepted, the so-called double majority is required, i.e. it has to be accepted by a majority of votes at the national level and by a majority of cantons.[3] Anyone can launch an initiative provided that the number of required signatures is reached.

If farmers were once traditionally paid for their products, and thus the price of the product rewarded their work, they are now paid for other "services" rendered to the community such as maintaining biodiversity, taking care of the landscape, land management and ensuring social life in the countryside. To some farmers, being paid for these tasks means "being paid for doing nothing" (see Droz and Miéville-Ott 2001: 15–16) because for them it is not linked to productive work. Moreover, in interviews and discussions they complained that "In addition to all the work on the farm, [*there is*] all the paperwork", since now most of their work also involves filling forms, keeping daily records, writing down each farm activity.

Through national policies, Swiss farmers are thus encouraged to transform their farming activity into a "landscape" activity, often for tourism purposes. A green scenery with cows is created for tourists to consume. Many farmers we interviewed confirmed the large drop in number of farmers over the last 50 years. This reality is not strictly linked to new legislation, but rather to a general trend in the agricultural world where relatively small family farms are disappearing to make way for housing development or increasingly large farms, as documents provided by the statistical office (http://issuu.com/sfso/docs/871-1300) confirm. One farmer we interviewed stated that most farmers nowadays are quite elderly, and that young people are not interested in taking on the family farm. Aged farmers or not, the decline of farms is attested regularly in official documents (cf. Swiss Farmer's Union and Statistical Office internet sites), which indicate that between 2011 and 2012 the decrease was by 1,042 farms, which corresponds to the disappearance of three farms per day.

The United Nations has declared 2014 as the International Year of Family Farming to stimulate policies for the sustainable development of farmer families and to

[3] A concrete example of an initiative will be provided later.

increase public awareness of the importance of family farms, which are decreasing across the globe. In Switzerland, the reasons behind this decline are varied but mostly linked to the policy changes concerning agriculture and the changing role of farmers. One of the reasons given by the interviewed farmers is that work on the farm is not as valued as in the past: what counts now is the aesthetical aspect and landscape preservation. Two farmers we talked to confirmed what Droz and Miéville-Ott had already recorded more than 10 years before: it is absolutely unacceptable for a farmer to become *solely* a landscape gardener (Droz and Miéville-Ott 2001: 17). In order to better understand the farmer's discontent about becoming a landscape protector, it should be recalled that the research made by Miéville-Ott also pointed up that farmers have different perceptions about what landscape is and how it should be, depending mostly on gender, but also on their aesthetic criteria and experiences (2001: 59–101).

Probably some young people would prefer to continue working with livestock or pursuing agriculture and being paid for it, instead of being subsidised to keep the landscape beautiful. To pay farmers for working with livestock and sustainable agricultural activities is precisely what the government policy aims to achieve with the direct payments, but this is not how the farmers perceive it. As mentioned above, the farmers with whom we discussed do not perceive agricultural policies in the same way as policy makers. The farmers also stated that there is almost no profit in family farms and that they are working at a loss: "Despite all the work we do, without counting our work hours, we do not have any benefit". As another farmer claimed, "compared to the country's lowest wages, our incomes are clearly lower. We are the poorest of Switzerland and even if we work, we feel like beggars with these direct payments".

3. Cows and tourists

While agriculture declines, tourism industry flourishes and the farmer is almost forced into job reconversion. This is not a new fact. Until around 1950, the population in Valais lived on traditional Alpine economy, but after that date they began working in the construction industry, either on dams that were being constructed in that period or in tourism infrastructure. Construction and tourism are two economic activities that developed rapidly in this region.

However, farmers are not yet completely extinct even if they are endangered. This image was used in the title of a television coverage "Paysan, une espèce en voie d'extinction" [Farmer, an endangered species] (RTS 2014). In this TV program, farmers affirm they are no longer understood and are barely tolerated for tourism advertising. Indeed, farmers, their occupation, their cattle and their land are needed for tourism purposes. Tourism promoters need cows in the landscape, plus some genuine products, including farm products (called *produits du terroir*), to sell to tourists. In other words, the tourist industry needs farmers to maintain "the garden" and sell the traditions expected by tourists. These expectations are nourished by the picture-postcard images that Swiss tourism offers linked to watches, chocolates and landscape. This last one includes lakes as well as mountains, ski resorts and idyllic scenery as in "Heidi", a novel written in 1880 by Johanna Spyri about the life of a young girl in the Swiss Alps, translated to several languages and largely known through films and animated TV series. The Swiss type of landscape needs to be preserved as an "organised meadow", as stated by one of our informants, thus agriculture fulfils its landscape function. Indeed, there is almost no wasteland in Switzerland and farmers make it a point of honour to take care of their land and keep it clean. As one farmer declared, "You know, we have always worked the land well, mowing the edges to clean the field. The meadow must be well mowed". Yvan Droz and Jérémie Forney mention that to mow borders is only slightly justified from an economic point of view. This activity makes sense in an ordering of nature, a struggle against wildness and disorder (Droz and Forney 2007: 69). Since they deem to have always maintained the landscape "clean and tidy", a "cultivated nature" as opposed to a "savage nature", together with all agricultural labour, they do not understand why they are now being paid to do that and only for that. As one of them stated, "And I have always done that without anyone asking me to do so. Now they ask me, and they even pay me for that, but there are also a lot of inspections that we didn't have before". Of course, one could argue that the authorities (finally) realised the value of what farmers do, thus now they get money for it, but if they complain, they come across as ungrateful. Here again we can notice the tensions created by diverse perceptions of the situation. Moreover, this misunderstanding highlights the consequences of the same notion, in this case landscape keeping, with different connotations and significance for distinct actors.

Moreover, rural heritage is incorporated into the tourist product and includes not only landscape or agriculture heritage, but also construction heritage (vernacular architecture), art and folk traditions (local music, local cuisine, local handicraft, festivities etc.) that have a potential to attract tourists. As Dewailly mentions, "a general overview of rural heritage demonstrates the wide variety of its constituent elements, but suggests also some problems which are bound up with its commodification as a tourist product" (Dewailly 1998: 124). In the Valais region, traditional products offered to tourists are related to apricot trees, vineyards, cheese, rye, Blacknosed sheep and Herens cattle. These last deserve a further comment. The cows of the Herens breed, considered a true symbol of mountain life in the Valais, have an aggressive nature. The natural confrontation between cows of this breed has led to the organisation of a major event called "Queens

fights". This festival, in which the cows, divided in different categories, fight against each other by locking horns, is held every spring before the climb to the high mountain pastures. The winner is called *La Reine des Reines* (the queen of queens), increases greatly in economic value and gains a higher standing in a hierarchy within the herd. As such, she will lead the herd during the summer. The cow fighting, nowadays surrounded by folk festivals, attracts numerous stockbreeders and an increasing number of spectators beyond the breeders' world.

A further traditional mountain festivity linked to cows that constitutes another attraction to tourists is the "*Désalpe*", an event that takes place in different regions of Switzerland between September and October and involves the descent of a herd of cows to the plain after about four months spent grazing in Alpine pastures. The cows are decorated with garlands on their heads and coloured cowbells around their necks. A parade, traditional music and a market with local products take place on this occasion. The cows' procession, accompanied by the farmers and the herdsmen wearing traditional costumes, continues with Swiss Alpine traditions such as flag throwing, which involves swinging a flag and then throwing it into the air and catching it as it comes down; the sounds of the Alphorn, which is the traditional herdsman's instrument; and yodelling, a form of singing that probably developed in the Swiss Alps as a method of communication between mountain peaks. The festival brings together local farmers and guests to celebrate Alpine traditions.

All the elements mentioned above illustrate the development of heritage products attracting both local population and visitors. Moreover, as stated to us by the president of a municipality in Valais, they show a complementary relationship between tourism and agriculture: each one needs the other. According to other informants of ours as well, agriculture can survive thanks to tourism, but at the same time is in its service: it is an agriculture for tourism purposes. Accordingly, agriculture and tourism are linked in a mutual relation: each one is essential for the survival of the other. Farms become bigger and less family run (see Federal statistical office). Yet, there are fewer and fewer farmers engaged in agriculture because they are becoming increasingly involved in tourism activities and other jobs in the tertiary sector. Those who remain mostly linked to agricultural jobs are not always happy to see the arrival of tourists and the waste they generate.

4. Land and houses

The increase of tourism went together with an increase in constructions in rural areas all along the second half of the 20th century. Environmentalist movements and citizens began being concerned with what they called the "bétonnage des Alpes" (literally, concreting the Alps). In the Swiss semi-direct democracy, the ecologist Franz Weber in 2006 launched an initiative called "Put a stop to the invasive spread of second homes". The initiative focused on three principal aspects: save nature, preserve heritage and protect local population. On March 11, 2012, 50.6% of voters and most of the cantons voted in favour of the initiative. This initiative limited the number of second homes by 20% in each municipality. In the Valais some municipalities have already between 70 and 80% of second homes. Many of them are empty most of the time because their owners come only for a few days or weeks a year and the accommodation units are rarely available on rental.

The initiative's results have shown a strong cleavage between urbanite plain dwellers and inhabitants of the mountain regions, though some mountain municipalities in long-established tourist regions, such as Engadine, Davos, Flims and Zermatt, also voted in favour of the Weber initiative. The marked geographical split between regions accepting and rejecting the proposal was at first perceived as a true political bombshell, dividing lowland areas from mountain areas (the Alps), urban centres from tourist regions, and the economic core from peripheral areas (Schuler and Dessemontet 2013: 2). Valais rejected the initiative because people of this canton thought (and still think) it would put a stop on its economy. If they could no longer build, there would be unemployment, recession and economic crisis. On the other hand, people from cities supported the initiative in order to protect the landscape: a landscape they want to preserve for their holidays. This statement is clearly reductive and somewhat provocative, but highlights the divergent voices and perceptions. Roughly said, according to those who voted in favour, if promoters go on constructing, the image of a beautiful natural landscape would no longer be available. Opinions from both sides clashed and could be followed on all media. For urbanites, if the construction industry does not stop there will only be houses and no landscape, no traditions, no agriculture. For mountain dwellers, if the construction industry stops there will be unemployment and recession. Mountain farmers constitute still another case: they are already worried about the agricultural policy decided by urban politicians. Schuler and Dessemontet (2013) as well as the other articles gathered in the Forum of the Journal of Alpine research "Issues at stake in the Swiss vote of 11 March 2012 regarding second homes" (http://rga.revues.org/1856), provide an exhaustive analysis of this vote's outcome.

The opposition between residents and non-residents of these municipalities with a high number of second homes follows the essential dichotomy between residents who view the community as their place to live, which should be also economically attractive, and tourists and visitors who view the community as a commodified place to consume (Urry 1995). The long debates among Swiss population show the increasingly diverse set of viewpoints of the different interest groups, not only between urbanites and

farmers, but also entrepreneurs, promoters, ecologists, local dwellers, politicians and others, which are linked to the way each group perceives and uses the rural areas. The inevitable outcome of such a variety of viewpoints is a disagreement over the goals and objectives and the policies and methods to achieve such goals (Butler and Hall 1998: 115). Gill (1998) states that opposition to development in rural areas is sometimes strongly expressed by urban, rather than rural residents who are often largely economically dependent on the local area. However, community responses to rural and tourism development are equally varied: not all rural communities actively seek tourism development. Tourism promoters may encounter opposition from local residents who raise objections on the basis of potential environmental disruption. This is however rare in Valais.

The fact is that not only the landscape, but also the hotels suffer from second-home boom, creating further tensions. For instance, a hotel owner declared that many of his hotel's former clients now own a second home in the valley: "Before, people came five, six or seven times at the hotel. Today, customers come to the hotel on their first visit and the last day of their holiday they sign to buy a second home". Owners face many problems in trying to keep their hotels running; in fact, many have been shut down and turned into second homes.

Even if the initiative was not directly linked to risk and vulnerability, these aspects were nevertheless recalled. In stressing the protection of nature and local population, it was somehow implied that their vulnerability increased with the second homes expansion. In the original sense of the term (from Latin *vulnus,* injury), vulnerability expresses the character of something or someone that may be injured. By extension, it is synonymous with fragility in face of a threat. Thus vulnerability covers multiple dimensions: economic, social, territorial, heritage, institutional etc. In this frame, vulnerability is linked to most of them. Focusing on the territorial aspect, would not all these new constructions ultimately increase physical or environmental vulnerability? Vulnerability is not just inherent to physical and geographical conditions, but is also "caused" in particular by inadequate constructions in inadequate places. Even if some actions are made to reduce vulnerability, some other human transformation of the environment, such as constructions in high-risk areas, increase physical vulnerability. Although buildings and materials are subject to stringent regulations, the changes in the environment due to tourism constructions and tourism development can increase conditions of vulnerability (Boscoboinik 2012).

The result of this initiative gave way to many tensions; people from Valais felt misunderstood, rejected and betrayed by the rest of the country. The tension is still palpable; the debates are quite heated, polarised and politicised. They highlight the different visions of rurality, environment, development, tourism and finally of who has the right to decide what and where.

5. Methodology implications

After having introduced the context and the tensions created by different viewpoints concerning rural and mountain areas, the question I would like to address in this section is how all this situation influences an anthropological research and fieldwork methodology. Ethnography, the method of research in anthropology, involves a researcher's direct, personal observation. To begin with, there is no doubt that this context creates an extremely sensitive setting for doing research, in which interests and goals diverge enormously between promoters, politicians, local population including farmers and external population. It is a sensitive field in which conflict may arise also due to the different meanings of place.

A place is shaped by the whole relationships and the power struggles of the people involved in a given space. It is primarily a set of relationships, of people, of networks, of friendships and of conflicts (see the articles in Brochot and De la Soudière 2010). In the anthropological sense of the term, a place is, as Marc Augé asserts, a relational and historical space, concerned with identity (1992). A place thus considered has also different meanings according to its use. In our case, the meaning of rural space depends on whether it is used by farmers, tourists, rural dwellers or urban visitors. Places have different meanings for those who live and work there, for those who use the rural landscape for recreational activities and for those who administer it.

Anthropological work done in sensitive settings is not at all new, but continues to challenge how research should be carried out. Accounts of research done in sensitive settings give us some indications of problems that may arise (cf. Di Trani 2008; Gagné 2008). Since Malinowski's introduction to "The Argonauts of the Western Pacific" (1922), much has been said and written in methodological manuals about the figure, role and status of an anthropologist in the field and the way in which his or her personal characteristics could influence the research results. After reflecting on the role of the anthropologist as an observer, methodology literature focused on the anthropologist as the observed. Among the many major transformations in anthropology, a highly articulate population of "native" ethnographers has emerged, including various bicultural inside/outsiders (Tedlock 1991: 80). In the case of research done in postcolonial countries, anthropologists may encounter resistance to their research not only from local people, but also from local anthropologists, particularly where there are interests concerning who owns the land or who is more qualified to speak about a particular culture or a particular tradition. Now that some anthropologists work at home, anthropologists from "outside" are sometimes looked upon with suspicion (see the various articles in Giordano, Greverus and Römhild 1999; Gagné 2008).

In this particular case, all those not originally from or living in Valais are non-native. Moreover, all urbanites

from the plain are seen not only as removed from both rural and local concerns, but also as having possibly opposite interests. Two attitudes between local people and a non-native anthropologist may surface in this context: one of clear suspicion, mistrust and refusal to cooperate, the other of convincing the researcher to support their cause. The latter represents a way of applying anthropology to defend a particular stance that could be understood as a kind of manipulation of anthropological research. None of these were detected in our short research. Instead of rejection or mistrust, we were able to conduct long and friendly interviews. Probably the fact that we were introduced by the secretary of the regionally-known centre CREPA (Centre Régional d'Etudes des Populations Alpines) and that there were students from both Switzerland and Bulgaria, facilitated our approach. The persons we had the possibility of interviewing (municipality representative, tourism promoter and travel agents, hotel owner, farmers, cultural actors, amongst others) were very much engaged in presenting us their point of view so that we would better understand their region and what is at stake.

Beyond a particular study, anthropologists will face the instrumentalisation of research. Anthropological research is confronted by social tensions and local claims, be it in New Zealand when doing research on the Maori culture, in Canada in terms of indigenous people, or in Switzerland as regards to the development of tourism and landscape.

In sensitive settings, reliable information may be very difficult to acquire: if mistrust is generalized, almost no one will speak openly and honestly. As already said, mistrust was not detected in our short-term research. However, in a long-term research this eventuality should be heeded since the anthropologist is present for a longer time and more frequently. In our pilot research, the region and the opinions about the recent changes were presented to us, and particularly to our Bulgarian colleagues, for a first time. In a long-term research, when there is a need to delve into some topics, the different interests at stake should be taken into account.

One way to overcome personal and discipline-related obstacles is to carry out a multidisciplinary research involving different researchers presenting various points of view. I believe that interdisciplinarity is a must if we want to achieve relevant results. This does not mean that interdisciplinarity is a panacea for all research, but it could help to better understand the impact and consequences of the various changes in this region. The topics presented in this paper are broad and a clear research question addressed from different disciplines' perspectives is required. A joint study with social geographers, specialists of environmental sciences, agronomists and experts in regional planning and land use, together with historians and architects, is essential. It is also essential to compare and contrast what happens in different touristic mountain and rural regions in Switzerland. Moreover, comparing situations in various rural contexts would provide indications as to different ways of facing political decisions.

6. Conclusion

There are increasingly less countries in the so-called developed world where rural landscape involves solely rural activities and agriculture. On the contrary, rural landscape has rather become an arena of different and conflicting interests. New approaches in social theory have argued that rural areas are inextricably linked to the national and international political economy (Hall and Page 1999; Cloke 2013). In Switzerland, the recurrent crises in the agricultural sector and its related policies have resulted in a decrease in the number of farmers and in the agricultural use of space. Rural areas are increasingly valued for their environmental "function". Places that are essentially considered as food producers are also increasingly perceived (socially and institutionally) as reserves of environmental excellence (Horáková and Boscoboinik 2012). Consequently, tourism projects may be conceived as an answer to a new need, where landscape may be promoted in a new way. Some types of rural tourism are projects aimed at fulfilling the ideals and expectations of modern urban citizens, while providing farmers with a way to survive and a solution to their isolation (Iorio and Corsale 2010; Butler, Hall and Jenkins 1998). However, farmers in Switzerland are not always entirely convinced about changing their activity from production to services and they feel left out by authorities and co-citizens. On the one hand, the tourist industry brings money and jobs, but on the other, some farmers are not happy about the arrival of tourists and the waste they generate. Moreover, the "Queen fights" contests may have saved some Alpine pastures and the Herens breed, but the money at stake in the competition creates tensions and jealousies. Farmers sometimes see tourism as a devil to whom they sell their souls, in the form of traditions and landscape, in order to make some money.

Ultimately, when the farming activity is not enough to make a living, the farmers' diversification activities are directly linked to tourism services. Tourism, although not always seen by farmers in a positive light, is useful for agriculture; it may promote it and may help it survive. At the same time, agriculture is useful to tourism because it preserves the landscape that tourists want to see. Tourism could then be useful for the maintenance of landscapes and the conservation of traditions; however, some rural areas may quickly become ecologically fragile if the traditional habitat is turned into second homes and the cultivated spaces become empty and unproductive.

Policies affecting agriculture and tourism define a context of tensions among different actors in the regions concerned (farmers, tourism promoters, local and national politicians, insiders and outsiders). For anthropological

research, the political, economic and ecological interests are so divergent that they pose a challenge to the way fieldwork may be carried out in this region. Therefore, multidisciplinarity and multilocality may offer a solution to the difficulties arising from a sensitive context with high interests at stake.

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RÉSUMÉ

This paper analyses aspects of the current changes in a mountain region of Switzerland and the methodological challenges they could pose to an anthropological empirical research. Qualitative research methods are effective to determine the people's opinions and how events affect their lives. However, tensions created by recent changes in agricultural policies and new construction restrictions should be taken into account in carrying out qualitative research. The article opens by presenting the context and how it became quite sensitive and politicised due to economic and environmental interests that trigger substantial oppositions. We argue that a multidisciplinary research should be carried out in order to obtain better results and overcome personal and discipline-related obstacles.

The first part presents the region's touristic attractions in a mountainous area in combination with a traditionally rural environment, which allows us to introduce the notion of rural tourism in Switzerland. As in other rural contexts, also contemporary farmers in Switzerland need to diversify their income sources, many of which involve tourism-related activities. Some farmers feel that the new agricultural policy's focus on environment has actually turned them into the "gardeners of the Alps" for tourism purposes.

The second part illustrates the tensions created by the diverse perceptions of the situation, which in turn highlight the fact that the same notion, such as landscape preservation, may have different connotations and significance for distinct actors. It is here shown how rural heritage and traditions are incorporated into the tourist product, hence illustrating the interdependence of tourism and agriculture.

The third part introduces another source of tensions sparked by the ordinance limiting the construction of second homes. The extensive debates among the Swiss population show the different interest groups' increasingly diverse set of viewpoints, which are linked to the way each group perceives and uses the rural areas.

The fourth part considers how the different visions of rurality, environment, development and tourism and their resultant conflicts may constitute a sensitive setting for a qualitative research. Reliable information through interviews and discussions may be difficult to acquire in sensitive settings. The possibility of an instrumentalisation of research is also considered.

Finally, it is proposed that the political, economic and ecological interests are so divergent that multidisciplinarity and multilocality may offer a solution to the difficulties arising from a sensitive context in which high interests are at stake.

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THE MIGRATION OF FOREIGN WOMEN TO RURAL CATALONIA (SPAIN) IN THE CONTEXT OF ECONOMIC AND SOCIAL TRANSFORMATION IN LOCAL COMMUNITIES[1]

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ABSTRACT

This article analyzes the impact of the arrival of immigrants to Catalan rural areas from a gender perspective. We specifically observed the female migration routes to municipalities experiencing problems in ensuring the reproduction of their communities (depopulation, masculinization, aging, singleness, economic marginality), and suggest that these women make a remarkable contribution to their development and the revival of some of the human capital and labor lost in the process of decline that has characterized rural areas throughout the twentieth century. We noted the demographic trends and characteristics of immigration to rural areas, together with their migratory routes, expectations and the distinguishing factors of their incorporation into such a specific social, economic and cultural environment. Unlike male immigrants to these areas, who are usually employed in the primary sector, women work mainly in the service sector (hotels and tourism), in the agro-processing industry and above all, in work related to the reproductive sphere: care and attention of the aging population who because of the rural exodus, frequently lack either the family or institutional context to meet their care needs. We understand that the foreign women help to re-feminize these communities and become essential economic and social agents.

Keywords: international migration, female migration, new rurality, attention and care, Catalonia (Spain)

1. Introduction[1]

This article reviews the impact of international immigration to rural Catalonia, with a particular focus on women's immigration, taking into account the changes that have had both positive and negative impacts on the conditions for social reproduction in its towns and villages. Our analysis is contextualized within the changes in the economic base of rural areas, namely, deagrarianization and lack of opportunities, but also the development of a service sector linked to rural tourism, economic diversification and the emergence of agro-transformation projects that revitalize declining agricultural sectors. We take into account the negative impact on towns and villages of the long-standing demographic dynamics of depopulation, including masculinization, aging or singleness, which threaten the capacity of rural communities to face the future; but we also explore the demographic changes that have had a positive effect on rural areas, and which have also attracted some of the million immigrants who have arrived in Catalonia in the last two decades.[2]

The objectives of our research include the characterization of the foreign population arriving in the small municipalities, their migration routes, their expectations and, in particular, the distinctive features of the process of incorporation into an environment with very different social, economic and cultural aspects from those in the urban environments that, as the main destinations for immigrant populations, have been studied much more widely. In analyzing the processes of incorporation into town and village communities, we questioned the widely held presumption that becoming part of a small community is easier and more advantageous for the immigrant population than in a large city. This question is addressed in the present paper.

2. Methodological notes

To meet our research objectives, we conducted a demographic analysis of the rural population of Catalonia

[1] This paper presents some of the results of a study that ended in 2011, *The migration of foreign women to rural Catalonia in the context of economic and social transformation in local communities* (ARAF1 00047), led by Montserrat Soronellas with the participation of the following researchers: Yolanda Bodoque, Gemma Casal and Ramona Torrens, from the Department of Anthropology, Philosophy and Social Work at the Universitat Rovira i Virgili; and Jordi Blay and Santiago Roquer, from the Department of Geography of the same university.

[2] Between 2000 and 2010 the population in Catalonia grew by 1,250,382 inhabitants, of whom 38,884 were foreigners living in rural towns and villages, and represented 10.7% of the rural population (in the rest of Catalonia the foreign population accounted for 19.8% of the total). In 2000 the population over the age of 65 represented 24% of the rural population, while those below the age of 20 accounted for only 16.8%, resulting in an aging index of 157 (much higher than the figure of 88.2 for the rest of Catalonia). By 2010 the aging index figure had fallen back to 118. The same cannot be said for the male-female ratio, which stood at 95.6 women to every 100 men in 2000 (when the average across Catalonia was 101.3), and had fallen to 92.4 women to every 100 men by 2010, essentially because foreign immigration into rural areas was predominantly male.

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AUC Geographica, 49, No. 2, pp. 39–48

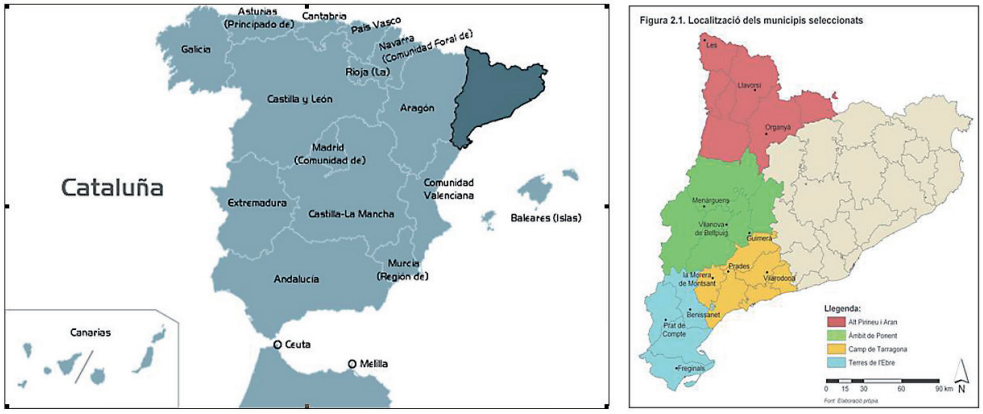

Fig. 1 Location of Catalonia in Spain (left). Location of the selected municipalities in Catalonia (right)

(with data from the local census corresponding to January 1, 2010) and devised a type of Catalan rural municipalities with fewer than two thousand inhabitants.[3] This enabled us to define the characteristics for selecting the twelve villages in which to conduct the fieldwork and collect data[4] using techniques such as participant observation and interviews with immigrant women, employers and local agents. The type of rural areas was based on the characteristics of the local economic structure, from which we obtained seven categories of municipalities: three with a significant agricultural sector, and four with less agricultural activity (tourist-service municipalities, industrial municipalities, peri-urban dormitory municipalities and those with a diverse range of economic activities). We then selected twelve towns or villages (see Figure 1), with significant, although not representative, realities reflecting the diversity that can be found in rural Catalonia today. They all had an immigrant population of over 10% with a significant female presence; this population came from a diverse range of countries; the municipalities were of different sizes (between one hundred and two thousand inhabitants), and finally, they were located in diverse geographical areas: mountainous and low-land environments, proximity to the main town in the districts or large cities, border towns, etc. (see Table 1).

In-depth guided or semi-structured interviews were conducted with the three types of informants, namely, foreign women, employers and local agents (immigration specialists, mayors, local councilors, school teachers and other people with whom we had informal conversations and who proved to be good informants). A total of 78 interviews were conducted[5] in which we attempted to cover all possible situations and profiles until we had all the information we required on the research objectives. Participant observation was carried out in both public (streets, squares, bars, shops, etc.) and private spaces (private homes, council offices, etc.) and data were collected through kinship charts, and diagrams and sketches of the women's scenarios, migration routes and so forth.

3. Female migration and new ruralities

The foreign migrant population coming to rural areas in recent decades has entailed a social, economic and demographic turning point for communities that for many years had been immersed in a continuous process of population loss, economic decline and impoverishment of the social fabric and dynamics (García Sanz 2006). The crisis situation in rural areas is explained by the loss of economic competitiveness of agricultural incomes; the discrediting of the culture and rural and agricultural ways of life as compared to urban models; the isolation of some rural areas; the limitations of the labor market and the lack of opportunities, among other factors (Etxezarreta and Viladomiu 1997; Soronellas 2006 and 2012). However, at the beginning of the twenty-first century, the rural population is stabilizing, and in some areas, showing incipient signs of recovery due to a combination of factors that encourage populations to settle in rural areas.[6] These factors include European support for agricultural production; the opening up of lines of local economic development that offer new opportunities to the rural population (tourism, agri-food and craft industries), improved communications and conditions of access to basic services for rural populations; and also the crisis of the Fordist model of labor relations and of the precariousness and computerization of work (Camarero, Sampedro and Oliva 2012). The arrival of the foreign immigrant population, attracted by the demand for labor in the agricultural sector and new jobs in the rural service sector, has also contributed to positive demographic statistics in small municipalities, more accustomed to losing inhabitants than to receiving new neighbors (Oliva 2010).

[3] We follow the distinction normally used in demographic sources: rural municipalities (fewer than 2,000 inhabitants), urban municipalities (above 10,000) and intermediate municipalities (between 2,000 and 10,000); we focus principally on the first of these categories, namely, rural municipalities with fewer than 2,000 inhabitants (Roquer and Blay 2008).

[4] Data were collected from July 2010 to February 2011.

[5] In section 3.3 we provide a characterization of the women interviewed.

[6] The 600 catalan municipalities with less than 2000 inhabitants in 2010, staying a total of 362,761 residents, an increase nearly 60,000 people in 10 years: a constant annual growth rate of 1.77%.

Tab. 1 List and characteristics of the selected towns and villages.

Town	Total population	% immigration and main countries of origin	Foreign women over the age of 15	Economic structure	Geographical location
Prades	655	13% (Romania, Colombia, Argentina)	29	Rural tourism	Mountain
Vila-rodona	1,298	20.10% (Morocco, Portugal, Peru)	75	Intensive agriculture and industry	Lowlands. Close to main town in the district
La Morera de Montsant	159	18.24% (Bulgaria, Morocco, Czech Republic)	12	Agricultural innovation. Wine tourism	Mountain
Benissanet	1,263	24.31% (Morocco, Senegal, Romania)	101	Intensive agriculture	Lowlands. Close to main town in the district
Freginals	410	19% (Ukraine, Romania, United Kingdom)	25	Low-yield agriculture	Lowlands
Prat de Comte	201	12.9% (El Salvador, United Kingdom, Pakistan)	9	Low-yield agriculture	Lowlands
Les	1,011	27.24% (Bolivia, Romania, Algeria)	129	Shops and businesses Hotel and catering	Border Mountain
Llavorsí	390	13.88% (Brazil, Portugal, Chile)	25	Rural tourism and mountain activities	Mountain
Organyà	946	11.95% (Brazil, Portugal, Bulgaria)	48	Shops and businesses Hotel and catering	Mountain
Guimerà	332	11.45% (Romania, Morocco, Nicaragua)	13	Low-yield agriculture.	Lowlands
Vilanova de Bellpuig	1,197	10.44% (Poland, Romania, Ukraine)	30	Agricultural innovation Organic agriculture	Lowlands
Menàrguens	858	13.60% (Romania, Gambia, Guinea-Bissau)	28	Intensive agriculture	Lowlands

Source: the authors

We are therefore witnessing a process of repopulation in some rural areas that began in the last decade of the twentieth century (García Pascual and Larrull 1998; Esparcia 2002; García Coll and Sánchez 2005) and has continued in recent years (Roquer and Blay 2008 and 2012; Camarero et al. 2009; Bayona and Gil 2010).

With this *repopulation* has also come a certain process of new feminization in some rural areas that since the 1950s had seen many of their women leaving the countryside in search of economic resources and also seeking a new social role that would give them more space for participation and decision. The current arrival of immigrant women to rural areas offsets the endemic masculinization of many small municipalities, not only because their presence leads to a more balanced population, but also because they increase single men's chances of marriage, thereby favoring social reproduction in communities (Bodoque 2009).

Domestic rural-urban migration has also changed the demographics of non-urban municipalities and of the development of industrial capitalism itself. In the so-called 'urban exodus', populations have moved out of the cities to towns and villages in the surrounding areas (Morén-Alegret and Solana 2006). However, the urban-rural relationship is not limited to internal migration and the existence of a floating population; rather the development of industrial and capitalist society has created new consumer needs grounded in leisure and tourism. This economic diversification driven by rural development projects funded by programs such as Leader and Proder, has created the ideal economic environment for local populations to remain in the villages, but also to act as magnets for incomers: the foreign immigrant population, men and women who find life and job opportunities in the rural context. However, the jobs available to them are precarious, poorly paid, and unattractive to the local population: primarily male employment in farming or agribusinesses (Pedreño and Riquelme 2007; Reigada 2007; Gualda and Ruiz 2004; Arellano 2006) and hospitality or care sectors that have a significant demand for female labor. To these precarious working conditions must be added the difficulty of living and working in remote and often poorly connected areas. Despite these difficulties, they come to rural areas and remain there. What ruralities do they find on arrival? What are the towns like where they make their new lives?

Our findings show that the number and characteristics of immigrants arriving in a rural area are affected by its diversity. The recent growth of rural areas has depended particularly on the size of the municipality, its location and its economic structure (Solana 2008), all of which have conditioned a larger or smaller presence of different immigrant groups and their characteristics. For example, the geographical distribution by nationality

of origin encourages areas of concentration within each country (Pajares 2008; Fonseca 2008; Kasimis 2008) or regions within the country (Esparcia 2002). In the Catalan case, as well as a more or less well distributed presence of Eastern Europeans (mainly Romanians and Bulgarians) across the region, there is a clear concentration of EU immigrants on the coast, of Moroccans in the inland regions, Latin Americans in the Pyrenees, and Africans in the most agricultural inland areas (Bayona and Gil 2010; Solana 2005; Solé, Guirado and Solana 2012). This territorial distribution is conditioned by certain immigrant groups' specialization in particular tasks and by the way they behave in relation to work and residence. Green et al. (2009) note the differences between the types of immigrants in English rural areas according to seasonality of labor, higher or lower demand and the ability to cover the jobs in each case. Kasimis (2008) finds differences between typologies of immigrants and their relation to various economic activities in three different types of regions of Greece. From this literature we conclude that a classification of rural areas is needed *a priori* to guide the study of immigration within them.

3.1 The contexts of immigrant women's arrival

As we mentioned above, the new rural society can no longer be defined solely, and sometimes not even primarily, on the criterion that it has some agricultural activity. Today, many areas whose environment and population centers would clearly lead us to define them as rural are inhabited by people who have no connection with any type of agricultural activity. These include, for instance, mountain areas (in our case, the Pyrenean area) where the population has diversified its income options and where most people provide services to visitors and tourists (rural accommodation, sports activities, etc.); however there are also areas where the small remaining population is too old for active agricultural work. These are communities and areas that have specialized in the tertiary sector, that no longer have any agricultural activity but, paradoxically, take economic advantage of a rurality which, in order to appeal to visitors, must maintain an attractive agricultural image. We therefore find the curious circumstance of villages with no farmers, and where the local authorities must take on some agricultural work, such as maintaining pastures near the town or village, to maintain a fictional agricultural landscape that visitors find attractive. The fact is that the process of rural deagrarianization is indisputable, as is the expansion of the service economy in the social and economic activities of rural communities (Bonnamour 2001; Gómez 2001; Barrachina et al. 2009). Areas whose economies are now based on industrial production, with heavily built up industrial estates in the vicinity of their towns, have grown in the wake of industrial activity and urban-rural residential mobility – known as peri-urbanization or counter-urbanization (Ferrás 2007; Paniagua 2002). Paradoxically, these areas have intense or intensified agricultural activity, sustained on a part-time basis by workers from the industry or service sector, who retain ownership of the land inherited from their parents, the last generation of local farmers.

The new rurality has more to do with services and industry than with agriculture and raising livestock, although these primary activities continue to form part of the realities of the towns and villages. Our fieldwork shows that agricultural activities tend to be regarded as linked to the production of services more than to food production. The European discourse on the farmer as the most important asset in territorial management has caught on among sector professionals, local government and trade union representatives. In our interviews we found traces of this discourse, that of the farmer who produces a service for the community, who manages extensive agricultural lands, who constructs the beauty of the landscapes and who adds quality to the environment. Rural development promoted by governments in the last decade, funded by the CAP, has used this appreciation of the work done by those who stayed in rural areas and strived to convert and develop these services as a factor to attract visitors from urban and rural areas and create a service sector to drive local development (Alario 2001; García Sanz 2003; Foro IESA 2009).

However, it would be a mistake to think that this rural development model has transformed most local realities, for this is not the case. Population reproduction continues to be a significant problem in rural villages. Discovering the reasons for this situation is complex, but it is clear that not all villages have been able or willing to redirect their traditional agricultural economies towards the service sector or by adding quality to their agricultural production. Depopulation and the resulting lack of human capital in a position to set up new businesses (agricultural, industrial and service sector) is one of the biggest difficulties facing these communities. Villages and small towns need projects to halt the advance of depopulation and they need young women and men to create and take these projects forward; the arrival of an immigrant population is, therefore, the prerequisite for economic revitalization in rural areas (Stockdale 2006). Demographic data reflect this repopulation of rural areas (García Coll and Sánchez 2005; Morén-Alegret and Solana 2006; Roquer and Blay 2008; Bayona and Gil 2010), as we have found in our research.

In the areas we covered in the study, we observed different situations according to the relationship between the local development model (which depends on diverse factors ranging from the municipality's location in the territory, to whether or not it has strong public or private sector leaders) and the presence of an immigrant population, especially women. Local processes are highly complex but we identified four broad local development trends (or types of rurality), linked to the economic

activity in the town or village, with particular attention to sectors that generate employment.

The first group includes municipalities whose main economic activity is in the primary sector, and that have led some kind of transformation of traditional farming, allowing farms to continue and avoid the structural crisis in the sector. Within this type, we identified two different trends: specialization in intensive farming techniques, and development of new agricultural projects to differentiate agricultural production and achieve levels of quality (gastronomic, environmental or health) with which to increase the market value of the food they produce. The town of Benissanet illustrates this type; by focusing its agricultural activity on intensive fruit production it has managed to overcome the problem of depopulation and attract immigrant incomers. Women from Slovakia and Lithuania are hired in their own countries to work temporarily in the local cooperative warehouses preparing and packing fruit; Romanian women have also arrived on their own initiative, working in the hospitality sector, domestic service and care of the elderly, as have the Moroccans who find work picking fruit.

A second type of rurality is that of towns and villages where agricultural activity continues, supported by an industrial sector that contributes to the diversification and sustainability of the local economy, and that have good transport connections with urban and industrial areas. In the last decade of the twentieth century, Moroccan men came to work as agricultural laborers (vines and some fruit) in Vila-rodona, and over the years their families have joined them and settled in the village (161 Moroccan residents). The vast majority of Moroccan women are not incorporated in the labor market; only a few occasionally do seasonal fruit-picking work. The growth of the industrial zone has provided employment for the local population, while the foreign population continues to work in agriculture. Since 2005, Romanian and Latin American women have found work in the hospitality sector and domestic service.

The third rural type we examined is one in which the primary sector has virtually disappeared and that has developed a services sector, essentially for tourism. Municipalities with these characteristics are further away from urban areas in regions with a greater appeal to tourists, in the form of landscape, climate and cultural heritage, such as the villages of Les or Prades. Both these villages exemplify local economies based on the service sector that have attracted more female immigrants. Prades has interesting scenic and heritage sites that have given it a reputation as a center for leisure and relaxation; in the last 30 years the village has grown due to the construction of second homes, which has spawned businesses to meet the service needs of visitors, tourists and temporary residents. The business owners are local, but the employees working in them come from thirteen different countries. Finally, the fourth type corresponds to the rural model typical of the last quarter of the twentieth century: depopulated and with aging communities, where some traditional and marginalized farming persists but with no alternative rural development plan capable of halting the process. Neither the local administration nor the social and business community has pioneered new projects. Three of the municipalities analyzed fall within this type.[7] One example is Prat de Comte, where the main economic activity is still rain-fed agriculture; it has an ageing population and no public or private initiatives have been taken that would have allowed it to develop some tertiary or artisan-industrial activity. However, immigrants have also arrived to the town in recent years; the men are employed in agriculture (mostly Pakistanis and Moroccans) and the women find work caring for the elderly, one of the main employment options for foreign women in towns such as this. Accustomed to a declining population since the beginning of the twentieth century, the number of residents in Prat de Comte has grown in the last ten years due to the arrival of 24 foreigners who have settled there, although these new incorporations do not solve the long-term problem of reproduction of the community.

In summary, we have seen how agriculture calls for mainly male labor, but the tertiary processes of rural economies, mainly related to tourism, have favored the arrival in the villages of women working for local businesses and in hospitality. Moreover, in all types of rurality, we found foreign women employed in domestic and personal services, especially in caring for the aging population. Because of the transversal nature of this employment option, primarily female and widespread in rural areas, we explore it in greater detail in the next section.

3.2 The ageing population and care of dependents

The new rurality is adopting strategies for the care of older adults as a result of the 'care crisis' that is impacting at a global level and in response to social and demographic changes characteristic of small towns and villages: the aging population, the difficult access to specialized care, and the absence of a 'support generation' (people with the appropriate age and level of autonomy to attend to situations of dependency). Inadequate deployment of social services in rural areas reinforced the 'family-centered' Mediterranean tradition, in which provision and management of care falls to the family. Today, the presence of immigrant women has allowed the informal system of care for older people to expand and become widespread, replacing the care provision previously undertaken by the women of the family and the village, so that although care is taken out of the family-domestic context, the traditional principle of 'growing old at home' continues. The family is obliged to contract out the care of its older members, but it does so within the domestic space by hiring

[7] Freginals, Prat de Comte and Guimerà.

immigrant women. Below we outline the characteristic aspects of this activity in rural areas.

Families demand an affective rather than a professional relationship; they value the creation of an emotionally supportive environment, although in the context of a business relationship. They do not need a professional caregiver with specific training, but someone to take the place of the primary caregiver and who can take on the role of 'daughter' or 'wife'. Foreign women are required to carry out a task that supposedly requires no more than the life experience and ability to perform a role that they have presumably learned 'naturally' in their own country.

This model of care is based on hiring cheap, flexible labor and developing an employment relationship that is typically informal, arbitrary, asymmetrical and precarious (Castelló 2009). However, the everyday and employment realities of the foreign women who care for dependents are difficult and complex: they are unfamiliar with the context, the cultural, health and nutrition habits and the health care and social services systems. They do not always have the capacity to react in emergencies and they bear an intensely emotional responsibility that goes unrecognized by their employers. These working conditions place some women in a vulnerable position; however, these jobs and the invisibility of the rural environment give them a dual context of opportunity to begin their lives in a new country: first it allows them to live illegally while they obtain their residence and work permits; and second, despite being an uncertain occupation (the duration of the employment relationship depends to a large extent on the lifetime of the person being cared for), it is highly valued because it provides a fixed, stable income, unlike other temporary or irregular jobs. Their vulnerability and their need to work guarantee stability for the family that employs them.

In the next section we analyze the profile of women who have migrated to the rural areas of Catalonia and study the distinctive features of their incorporation process.

3.3 Who are the women that come to the towns and villages?

We begin by outlining the personal, family and migration profiles of the women who migrate to the towns and villages. We use their country of origin as a variable to classify this description, grouping the women into three areas of origin; this undoubtedly oversimplifies the analysis, but it does reveal certain patterns in the migration routes that we examined. Almost half (18) of the 38 women interviewed were from Eastern European countries. Romanian women were working in every employment sector, but particularly in the field of hospitality and retail services, in all twelve of the villages we studied. Most of them came from rural areas, agricultural-based economies and farming families. The women from the other Eastern European countries – Bulgaria, Moldova and Ukraine – had similar profiles, primary or secondary education (although two women from Moldova and Ukraine had a university education). The migration of these women is family based, they often arrived with their husbands; in some cases they came shortly after the migration of their spouse and less often, they migrated alone (organized in their home country), followed by other family members.

Latin American women make up the second largest group. We identified 11 women from 10 different countries,[8] a dispersion that shows how migration to Spain has offered a resource for people from Central and South American countries to improve their socio-economic position. Despite the diversity of background stories hidden behind so many different and distant areas of origin, of the eleven women, four were working in care of the elderly (living in the person's home) and two others had worked in the same sector, although they were unemployed at the time of interview. The data tentatively show that Latin American women have the least diverse job profiles and are the group with the largest proportion working in the personal services sector, one of the most precarious sectors. We found exceptions of women working in the services sector (cleaning tourist apartments, hospitality, and shops and businesses) and one local council family worker. Nine of these women had migrated alone, initiating their own migration plans (the others migrated with their families). In some cases, they led family migration chains consisting of groups of almost 100 people. Some of them had left their husbands and children behind, others were separated and the younger ones arrived, and remain, as single women. In general, women who head single-parent families, and therefore have little family support, take longer to bring their children to join them. Most of them come from urban or metropolitan areas, and some of those with levels of higher education talked of the shock entailed by life in the villages, especially the lack of amenities (shops and entertainment facilities) and limited means of transport.

We also interviewed seven North African women, six from Morocco and one from Algeria. In contrast to the stereotypical image of the immigrant woman, four of these women had arrived on their own, usually in the footsteps of their brothers who had previously migrated to the villages; one of the women had brought her husband and son to join her a few years after her migration. The other two women had come to join their husbands. At the time of the interviews, two were not working, two worked in domestic service paid by the hour, and the other three were working as a live-in carer, in hospitality and in fruit picking. Three came from urban areas, namely Nador, Casablanca and Tangier. Among the Moroccan women, especially those who were married and with children, we observed an explicit desire to move from the villages to the cities or towns where most members of

[8] Honduras, Nicaragua, El Salvador, Paraguay, Dominican Republic, Bolivia, Colombia, Argentina, Brazil and Peru.

their social of family networks lived, driven by the wish to leave behind the pressure of the stigma they felt in the local social environment (Aguilar 2013). In almost all the municipalities in the study, except in the Pyrenees where immigration from Morocco has not been very significant, we noted that Moroccan immigrants were the first to reach the rural areas of Catalonia (in the 90s); they were generally men employed in the agricultural sector who brought their families to join them a few years later. In the last ten years, with the arrival of other migrant groups to rural areas (Romanians, Latin Americans and sub-Saharan Africans, in that order) they have tended to leave the rural areas as they were displaced by the newcomers to the agricultural labor market.[9]

3.4 Distinguishing aspects of female migration to rural areas

The villages and the rurality shape an environment into which the women arrive that distinguishes their migration routes and, in particular, the ways they are incorporated into the local communities. These specific features include increased visibility of migration chains; movement around the areas near the local community and where labor markets are found; ease of access to information networks and resources; the possibility of being known and of becoming familiar with the environment and local networks; and finally, achieving what we call 'fragmented incorporations', characterized by the hurdles to incorporation in the local community. Below, we examine each one of these features.

First, we note the presence of small, very different nationality groups in localities relatively close to one another,[10] which although not numerically significant are sufficiently large to be noticeable in the population as a whole; this factor leads us to suggest that it is the size of municipalities that makes migration chains visible. These chains take many different forms: they are long, extremely complex and usually family-based since they are made up of various households in the same locality. We also found networks made up of several unrelated nuclear families from different areas of the same country of origin; these networks emerge to support their members during the time they take to settle more or less permanently, after which the chain loses its initial meaning. Except for specific cases, the women from Latin American countries form part of short individualized chains. They work in sectors related to the care of dependents, they come alone, with a small support network at the destination (those who started the chain) and sometimes they leave their children behind with relatives because of the time restraints of the type of work they do. These are the chains with the largest female presence.

> I worked in the supermarket and when my husband arrived, he didn't work in the supermarket but in another business my boss had and he's still there now. Then my brothers-in-law started to come and they began working in the restaurant because they said they were looking for people and there weren't many foreigners and there they told you if they could come… then one of my cousins came, then another cousin with her husband, then my sister with her husband (…) they asked me for advice and I helped them as much as I could, with the papers, I told them what steps they had to take, and they would phone me. (Bolivian woman – Les)

The women expressed a certain feeling of loyalty to the villages and areas where they live, arguing that in general the town or village met their personal and employment expectations from the first moment, since it is the place where they live with their family following reunification and/or where they work. They often live in a different town or village from the one in which they work, especially in the most mountainous areas with poor communications and closely linked to seasonal activities. In these cases the women travel as best they can from one place to another, depending on job opportunities and, in general, without moving out of the municipality. When the location does not meet their consumption needs, they spend their available free time traveling to shopping centers where they can browse a wider and cheaper range of products.

> My sister-in-law was here with us, my husband's sister. We got a call (in 2008) to come and work in the fields, here in Benissanet, the two of us. He stayed on working in the fields until last year and I've found a few houses where I go and clean. We're happy here and we're not thinking of moving away because we're building the house in Romania. With the money we earn here we're building the house and we'll see, for the moment we haven't decided to go. We've both got permanent jobs, we're not thinking of going at the moment. (Romanian woman – Benissanet)

A third distinguishing factor concerns the advantages of living in a small town that the women reported, specifically, the ease with which they can build the social capital that allows them to work. Despite the initial misgivings they aroused in the destination, they were able to establish good relationships with their employers and neighbors, and they became known for the results of their

[9] Most of the employers interviewed, and some of the local agents, described the aforementioned migratory sequence (Moroccan, Romanian, Latin American and sub-Saharan African immigration). To explain this ethnic-labor substitution process, they used stereotypes referring to the employment qualities of each group and, in general, the Moroccan workers were the most poorly valued. In only one of the villages did we observe the continual residence of Moroccan families who had arrived in the 90s, where local agricultural employers had won the loyalty of these workers.

[10] Some of these national groups, moreover, are not particularly representative of the wider Spanish immigration picture. The main countries of origin of the foreign population resident in Catalonia, according to National Statistics Office (INE) data for 2010, are Morocco, Romania, Ecuador, Colombia, United Kingdom, China, Italy, Peru, Bulgaria and Portugal.

work, the trust they generate and their complete availability for work. This is because the most widely available jobs in rural areas are done in harsh conditions for low wages, often without contracts, involving long, unsocial hours and instability. The immigrant population will take these jobs, which the local population is unwilling to do. Even foreign women who have attained some job security and quality of life continue to show their availability to the local population.

> As well as the restaurant, I clean in seven or eight houses. Not all the houses are regular. I have four I do every week for people from the town and the others are for people who come at the weekends or maybe once a month. I also do cleaning for the council (…) My husband works in the Scala Dei wine cellars. The first two years he worked in Passanant, then in Poboleda in the vineyards, and after that in Cornudella and la Morera, then he was unemployed for a year and the town council took him on, and then he started again in Scala Dei where he's now got a permanent job. He's never been short of work because when he has time he helps out in the vineyards. They come to the house looking for him. (Bulgarian woman – La Morera de Montsant)

Finally we observed that despite the immigrant women's availability, the trust placed in them, and their good labor relations, they and their families (when they had them) did not find incorporation into the local community any easier. Although the idea is prevalent that social integration of a foreign population is much easier and faster in villages than in cities, during the fieldwork we observed a significant division between the local and foreign populations. The immigrant women considered living in a small town to be positive because of the environment, quality of life, opportunities to work and accrue financial resources in general, and finally, because of the people. But they predominantly emphasized the opportunities the town offered to work and live in conditions that allow them to save money and follow through their migration plans. Their status as foreigners and as immigrants (having their family with them, or maintaining the family in their country of origin and sending their savings) condition their incorporation into the community. However, even when the migratory paths are regarded as irreversible (those affecting large family chains), there is no guarantee of incorporation into the local society because, among other reasons, they do not have the opportunity to cultivate social relationships beyond strictly labor relationships.

> I always say hello. If they answer, fine, and if they don't sometimes I feel sad when they look at me like that. A lot of them don't reply and they give you a look (…) but there are some good people too and they ask you what you do, where you live, if you like being here (…) That's normal. If I'm in my village in my country, when a lot of people come from abroad I'd also think, what's going on? They're going to take everything, we'll be left with nothing. Like here. (Moroccan woman – Vila-rodona)

In some cases, they have tentatively begun to participate (in associations, local events, etc.), but they find it difficult because their place in the labor market and their prestige as workers do not go hand in hand with their incorporation into the social fabric of the town. In the public sphere we observed the segmentation of the local society and the obstacles to incorporating new neighbors who, despite providing a solution to some of the difficulties these communities face, continue to be perceived as outsiders who are too different, and to a large degree, unrelated to the local community.

4. Some conclusions

Rural municipalities in Catalonia are witnessing a process of repopulation brought about by the arrival of immigrant populations from a wide range of countries who are contributing to develop and sustain new forms of rurality resulting from the process of deagrarianization. Rural development measures, promoted by the public administration systems, have turned municipalities into providers of services linked to tourism and the exploitation of natural and cultural heritage that attract men and especially women from abroad, and whose work is essential for the reproduction of communities. These women tend to be employed in the processing sector of agricultural production, but we found larger numbers working in tourism-related services (businesses, tourism, hotel and catering) and especially in care services for people. The aging of the population in small towns has created an employment sector specialized in the care and attention of the elderly in which foreign women find work. Specializing in the care of elderly people is common to all municipalities, regardless of their particular economic structure. The jobs available in rural areas are often more precarious (no contract, seasonal, etc.), especially those in the poorest rural areas, but also in the services sector. Therefore, the foreign population is forced to be highly mobile to take advantage of the employment opportunities in the regional labor market.

Immigrant women's incorporation in rural areas has some distinctive characteristics. First, in recounting their arrival in the towns and villages, the women's reconstruction of their migration chain evidences family reunification strategies that bring members of their extended families into the localities. It was relatively easy to identify the women who headed the migration process and reconstruct the workings of the chain. Second, these paths lead to a municipality that they do not always consider as their permanent settlement, nor necessarily live in, but is regarded as a hub from where they move to work, bounded by the geographical area, generally the municipal district. We found small residential displacements

between neighboring municipalities, and on few occasions the initial point of residence was abandoned. Third, the women exploited their social capital by establishing closer relationships with the local population and by cultivating relationships within the immediate area to maintain connections with the region and its resources. Working in the service sector (especially domestic service and care of dependents) allows them to accumulate some social capital in the community when contracting families are satisfied with their work. Finally, despite being known and being familiar with the social environment in the towns and villages, they find assimilation difficult in a local community that, while valuing their work, does not necessarily encourage their active participation in other aspects of community life.

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AUTOMATION OF GEOSPATIAL RASTER DATA ANALYSIS AND METADATA UPDATING: AN IN-DATABASE APPROACH

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ABSTRACT

This paper proposes a spatial data infrastructure (SDI) module for management of a continuous flow of geospatial images and related metadata. Examples of such flows are continuosly acquired map scans from the digitalization process of an old maps collection, or the satellite imagery retrieved through a receiving station. Storage of the raster data in a database is a key feature of the system, which enhances the usual tasks and usability of SDI systems. The analytical procedures deployed within the data store perform automated raster analysis and content-based metadata extraction. This functionality is illustrated with two experiments – improving the display of early map scans and snow and cloud detection from satellite images. Applications of the proposed approach and utilization of the prototype application by geographers and cartographers are discussed.

Keywords: SDI, image data, metadata, in-database, automation

1. Introduction

At the Faculty of Science of Charles University in Prague, huge amount of descriptive, statistical and geometric spatial data is used for research and education purposes. A Spatial Data Infrastructure (SDI) implements a complex framework of technology, geographic data, metadata and users in order to use spatial data in an efficient way. Recently, the amount of spatial raster data has grown significantly due to a new receiving station of satellite imagery and the advancement of the old maps collection digitalization. The increased pressure on human and technological resources unveiled, how far the current approaches and tools designed for vector data are unsuitable for raster images, that are much bigger in data volumes and more variable in storage formats. This implicates higher demands on management and administration of the data store mechanism.

1.1 Related work

Data and metadata records are two crucial components in any SDI. Metadata enable data discovery and access for users and provide information about the purpose, currency and accuracy of spatial data sets (Olfat 2013). However, the manual creation, update and authoring of images' metadata is considered as being monotonous, time-consuming, and labor-intensive tasks (Trilles 2012). That is why challenges arise regarding metadata collection, storage, updating and integration in metadata catalogues (Batcheller 2009; Grill 2009; Olfat 2013).

Therefore, there is a need for an automated administration of collected raster data and related metadata that is more efficient than current archiving approaches. The key idea to increase the effectiveness of existing SDI solutions is the application of analytical tools for raster data integrated within the archiving system. This shift of application logic is allowed due to newly introduced support to in-database storage of raster data by several database management system (DBMS) vendors (PostgreSQL 2013; Oracle 2013).

The effectiveness of this approach is multiplied by having all available data in one place within SDI, enabling the extrusion of regions in the images or intersection analysis using available vector data. It also performs the vital functions that make spatial data interoperable, i.e., capable of being shared between systems.

To increase the effectiveness of searching for the desired raster data, the content-based metadata of such an image are needed. Their creation and retrieval fills the gap between low-level information that can be processed by computers and high-level semantic information understandable and applicable by humans (Akrivas 2007; Zhang 2012). The application of analytical tools in a raster processing line can automate the generation of such metadata or image annotation.

To prove the functionality of the proposed solution and to demonstrate the potential usage two case studies are presented in this paper.

The **Floreo** (Demonstration of ESA Environments in support to FLOod Risk Earth Observation monitoring) research project and the existence of the receiving station for satellite data at the Faculty of Science were the motivation for an implementation of clouds and snow detection procedure. The receiving station continuously provides AVHRR/NOAA images. Variety of snow and clouds detection methods using the Advanced Very High Resolution Radiometer (AVHRR) data have been already

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Brůha, L. (2014): Automation of geospatial raster data analysis and metadata updating: an in-database approach
AUC Geographica, 49, No. 2, pp. 49–56

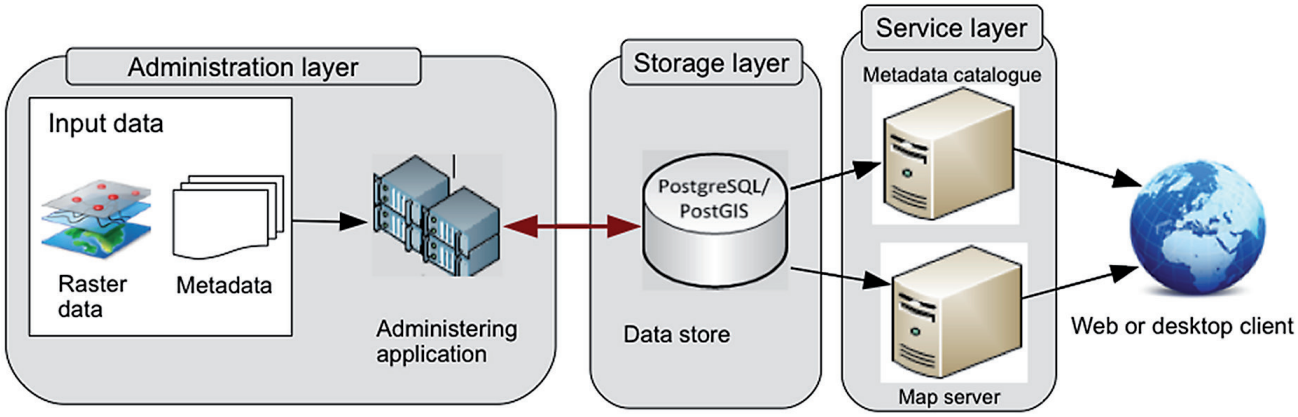

Fig. 1 Implementation architecture for automated raster data management.

reported. While it is relatively uncomplicated to separate snow-free land from snow-covered land using spectral characteristics, it is no easy task to discriminate between snow and clouds (Höppner 2002). The variety of works referred to extraction of snow or clouds from NOAA/AVHRR (Allen 1990; Gesell 1989; Saunders 1986; Simpson 1998; Voigt 1999).

The **TEMAP** (Technology for discovering of map collections) research project (TEMAP 2014) aims at applying the advancements in geospatial web technologies to facilitate the access to early maps for the end-user. The map collection of the Faculty of Science, Charles University in Prague contains tens of thousands of maps with more then 35,000 already digitized and catalogued. As an example of similar initiatives, the David Rumsey Map Collection (2014), can be mentioned. It contains more than 150,000 maps, of which 42,000 are digitized and georeferenced.

Solutions being developed within TEMAP project adapt and further extend the latest technologies for searching and distribution of digitized maps like MapRank (2013), enabling geographic searching by map location and coverage in Google Maps, or Georeferencer, designed for crowdsourced georeferencing for map collections (Fleet 2012).

1.2 SDI module for raster data management – implementation architecture

The initial work on SDI solution was introduced by Hettler (2012) to provide means for automatic management of continuously acquired raster data and metadata. The implementation architecture consists of several components, as depicted in Figure 1.

The administration layer provides an environment for the initialization and configuration of the solution for automatic raster data and metadata archiving and publishing. Technically, the administration layer is based on the Java application *MtdtRasPub*, which, in addition to controlling the raster data flow, constitutes the metadata record for each raster image from all available sources (World Files, raster headers, bibliographic records). Metadata records follow the ISO 19115:2003 standard, the current "best practice" standard defining the geospatial metadata format.

The storage layer, which includes the databases used to store data and metadata, is based on the PostgreSQL database platform. Within this layer, appropriate data structures for data and metadata are built in order to perform their automatic publication for the system's users.

The service layer manages the communication of the data store with the metadata catalogue and map server, employing for this sake the GeoNetwork opensource (GeoNetwork 2013) metadata catalogue and GeoServer (Geoserver 2013) map server. The web-based graphic user interface presents the data and metadata to user.

This SDI module for raster data administration provided the automation of raster data storage and distribution via the web user interface together with all available metadata. However, using such a solution for analytical image processing, the data must be first transferred from the data store to an external application. Thus, so as to fully exploit the advantage of storage of raster data in the database, an extension of this architecture is needed. Consequently, the next section presents the shift of image processing from an external application onto the storage layer and discusses the requirements for the deployment of an image processing functionality within the DBMS. Furthermore, case studies of a custom-made images' analysis functionality are presented, followed by a discussion on the potential usage of a solution for a broad geographic community.

2. In-database image analysis approach

The current usual practice is based on the out-of-the-database storage of raster data. In a relational database only the metadata describing the image are kept. For any processing or analysis, the raster data must be first transferred to separate processing and analytical software applications, as it is suggested in Figure 2. The analytical

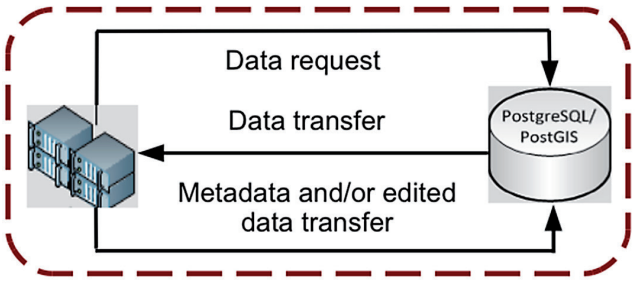

Fig. 2 Raster analysis in detached data storage and data analysis applications.

task can result in raster editing. In such a case, a new raster representation needs to be transferred back to the data store, causing extra data transfer overhead.

The advantage of keeping the data out-of-the-database, i.e., as *binary large objects*, appears in case the publication of stored raster data from the database system (like map service publishing) is the only objective of an application. The first performance evaluation results presented in (Hettler 2012) shows that the publication from a native PostGIS raster format is slightly slower than from the alternative binary raster storage, which usage however prevents from the employment of analytical tools.

In-database storage. The in-database strategy (Xie 2013; Obe 2011) employed by the solution for geospatial images proposed in this paper has several features to enhance the storage and analysis of big geospatial images.

The first feature is moving the image processing closer to the data to avoid moving large data sets from the databases to detached analytical software. The second feature is parallel processing provided by the database for the in-database raster format storage. The third feature is concurrent processing that enables leveraging the power of computer clusters to concurrently process numerous images (Xie 2013). In the Figure 3, the retrieval of results of an image analysis, which is performed on the database side, is depicted.

In-database image processing functions. There are countless of possible image analysis functions. Raster data processing and analysis involves a large set of operations, such as radiometric and geometric corrections, image transformation and mosaicking, image enhancement, pattern recognition and raster map algebra, to name a few (Gonzales 2006).

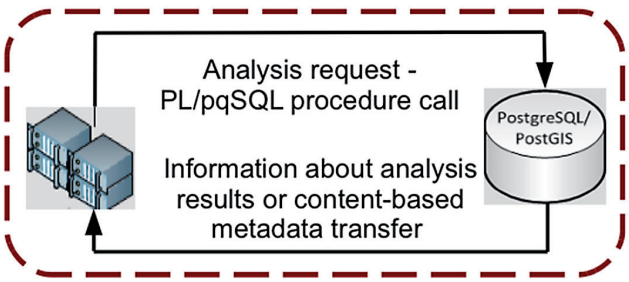

Fig. 3 The character of raster data stored in-database processing.

Database platforms with raster data support implement only core functions that are required by database management or that improve the effectiveness of data manipulation, such as image updates, processing or aggregation. These complement traditional GIS applications and can be reused by complex or custom-made analytical procedures deployed for a specific purpose, providing effective raster data manipulation for such developed procedures.

In order to fully utilize the effectiveness of in-database approach for analytical procedures over spatial raster data, the database platform is supposed to support the following key functionality:

- raster bands accessors,
- raster pixel accessors and setters,
- raster band statistics,
- map algebra over individual pixels,
- spatial indexing,
- datum definition and coordinate system transformation.

This allows for a basic analysis and moreover supports the development of custom-made functionality, providing procedural language. With respect to the architecture presented above, PostgreSQL with spatial extension PostGIS (PostGIS 2013) was chosen for the implementation of the proposed SDI enhancement. PostgreSQL offers this key functionality for raster data processing and also provides PL/pgSQL procedural language.

3. Experiment

Ongoing research projects like TEMAP, which aims to develop of technologies and procedures for discovering old maps collections, or FLOREO, which is concerned with snow detection from satellite images, provided the motivation and data for the tests of the proposed solution. Continuous flow of acquired very large raster data from the satellite images receiving station and from the digitalization of tens of thousands old maps required the greatest possible reduction of raster data movements for the sake of processing and analysis.

This requirement was met by employing the in-database approach and the development of specialized analytical functions within the data store. Implementation of this functionality is enabled through the procedural languages. The PL/pgSQL procedural language of the PostgreSQL database platform was utilized for these purposes.

3.1 Cloud and snow detection

The algorithm for snow detection introduced within the FLOREO project was designed based on the past work of Romanov (2000). The cloud detection part is adopted from the AVHRR Processing over Land Cloud

and Ocean (APOLLO), which was developed by Saunders (1986). The implementation of such procedures within the data store aimed at a retrieval of basic information about the snow and cloud coverage in the image. This information is utilized for two purposes. First, the automatic identification of such images appropriate for classification. Second, the automatic creation of content-based metadata to increase the effectiveness of the search in the metadata catalogue.

NOAA-AVHRR data. NOAA is a polar satellite that circles at an altitude of approximately 850 km. The satellite scans each place on Earth at least twice a day, with increasing frequency at places closer to poles. The Advanced Very High Resolution Radiometer (AVHRR) instrument on board of NOAA has 5 (or 6) wavelength channels. The channels are optimized to measure cloud and surface characteristics with minimum contamination from other atmospheric constituents. The channel specifications are presented in Table 1.

Tab. 1 AVHRR/3 channel characteristics.

Channel number	Resolution at Nadir	Wavelength (μm)
1	1.09 km	0.58–0.68
2	1.09 km	0.725–1.00
3a	1.09 km	1.58–1.64
3b	1.09 km	3.55–3.93
4	1.09 km	10.30–11.30
5	1.09 km	11.50–12.50

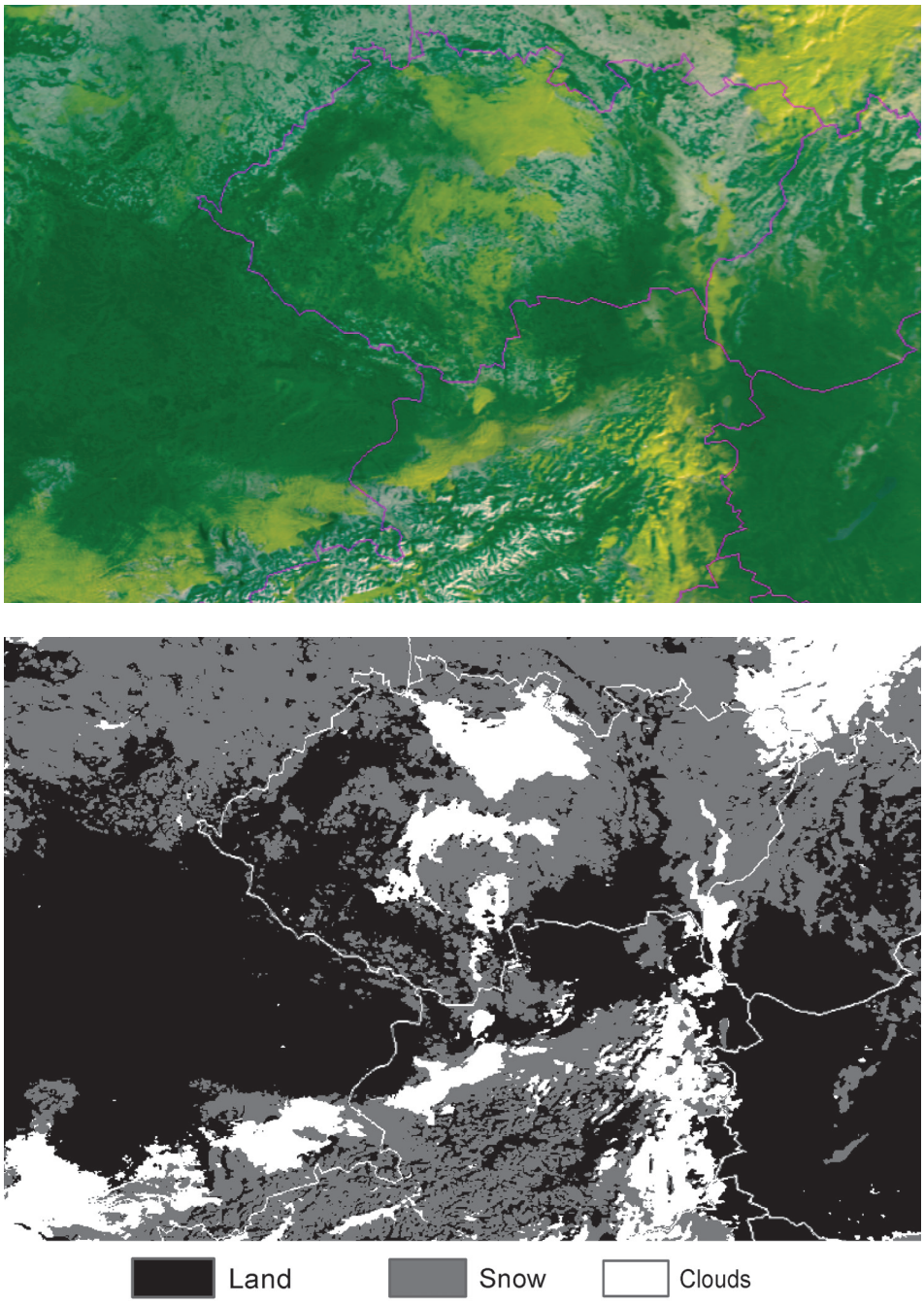

Fig. 4 The classification of the original NOAA image (a) into the categories of land, snow and cloud coverage (b).

The spectral signatures of snow and clouds can be very similar and depend on various environmental factors. The snow and cloud discrimination relies on threshold value estimates, like minimum possible surface temperature of snow compared to clouds, as determined by a histogram analysis of temperature and reflectivity. Threshold values are instrument specific.

Snow detection. The snow detection procedure is implemented based on a series of tests adopted from the algorithm developed by Romanov (2000). An image pixel is identified as snow by a threshold method, which tests if the signal in a channel or combination of channels corresponds to defined spectral characteristics in a cloud free atmosphere. The main tests for daytime are:

1. $NDSI > NDSIT$
2. $SI > SIT$

where SIT and $NDSIT$ are threshold values, $SI = R0.6/R1.6$ is a snow index, $NDSI = (R0.6 - R1.6)/(R0.6 + R1.6)$ is a normalized difference snow index and $R\lambda$ is the reflectivity in the spectral channel denoted by λ.

Cloud detection. The PL/pgSQL procedure for cloud detection follows the threshold-based approach of (Saunders 1986). The procedure tests the signal against the thresholds. The scene is marked as cloud contaminated if one of the following conditions for daytime is met (Roebeling 2003):

1. $T10.8$ (measured) < $T10.8$ (cloud free) – temperature threshold (Temperature test)
2. $R0.6 > R0.6$ (cloud free) + reflectivity threshold (Reflectivity test)
3. $T10.8 - T11.9 > T10.8$ (cloud free) – $T11.9$ (cloud free) + $S\text{-}T$ (Semi-transparency test)

$S\text{-}T$ is the semi-transparency threshold, $T\lambda$ denotes the equivalent of black body temperature in the spectral channel λ.

The original NOAA image, see Figure 4(a), classified into three categories – land, snow and cloud coverage, can be seen in Figure 4 (b). The content-based metadata describing the percentage of individual categories is the outcome from procedures, subsequently encoded within the ISO 19115:2003 metadata record.

3.2 Improving raster display

In image processing, the normalization is an image enhancement technique that improves the contrast in an image by stretching the range of pixel intensity values into a desired range of values (Gonzales 2006).

Implementation of a procedure for an improvement of raster display is motivated by the effort to increase the readability of early maps scans. The original documents faded out due to the long period of time since their creation, the character of the materials used and colouring techniques.

The PL/pgSQL procedure transforms an image I with intensity values in the range (Min, Max), into a new image IN with intensity values in the range ($newMin$, $newMax$). The linear normalization is performed according to the formula:

$$IN = (I - Min)(newMax - newMin)(Max - Min) + newMin.$$

The Figure 5 illustrates the outcome of the histogram stretching function. The implementation of such a procedure is straightforward and also computationally efficient. That is due to the optimized functions for raster data manipulation, editing and yielding of image statistics or image histogram. These functions are natively provided by the PostgreSQL Raster platform and are re-usable within other developed functions.

3.3 Metadata

GeoNetwork opensource metadata catalogue is employed by the proposed solution to provide means of description of various types of geographic data (vector or raster layers, map services, statistical data).

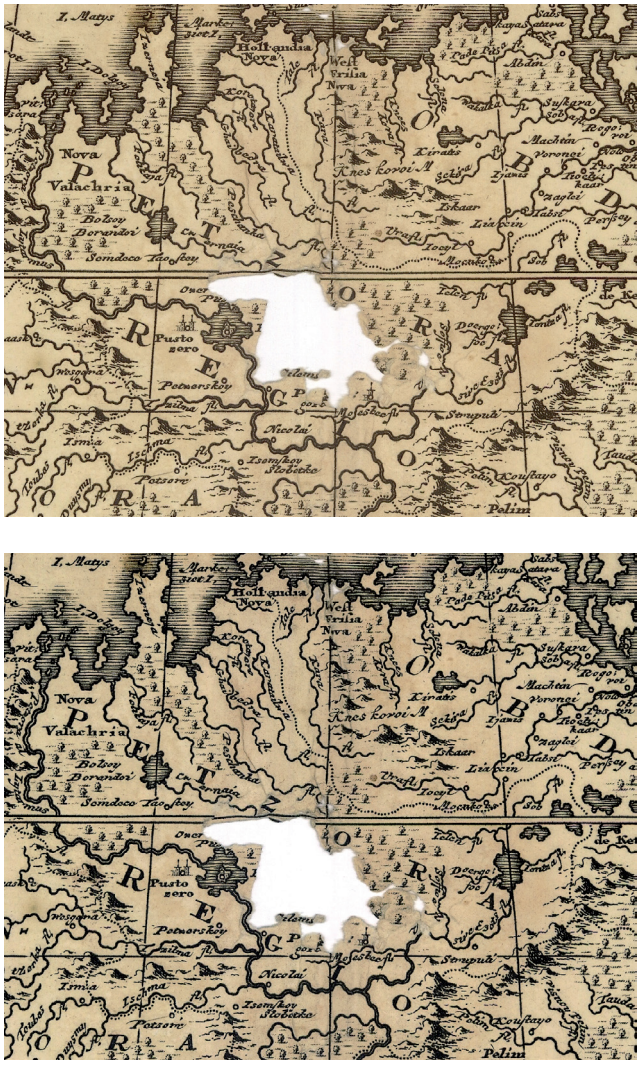

Fig. 5 The segment of an early map with some damages, changes of paper colouring and faded labelling. (a) Before and (b) after application of normalization.

The metadata document is formed within the administration application from available sources in accordance with ISO 19115:2003 rules. Only a small portion of elements is used following the GeoNetwork and INSPIRE (2014) recommendations on required or highly recommended elements to properly describe geographic data. The compliance of metadata with these rules is checked by GeoNetwork when metadata records are imported or updated. For this sake, the GeoNetwork's xml.metadata.insert service is employed. Three groups of metadata fields in a resulting metadata record can be identified based on the source of their origin.

Available descriptive metadata. Depending on the data source, the descriptive metadata can be retrieved from World Files, raster headers or bibliographic records. To carry this out automatically, the format of the source document must be known, i.e., a catalogued description of an old map in XML document following the MARC 21 standard. The cataloguing procedure itself follows the methodology described in Novotná (2013) facilitating the identification of the key corresponding fields in both standards – the source MARC 21 bibliographical standard and the target ISO 19115:2003 geo-informatical standard. The following fields are acquired by processing the source documents:

Title, Date, Date type, Abstract, Purpose, Descriptive Keywords, Language, Topic category, Scale Denominator, Temporal Extent, Geographic Bounding Box, Reference System Info.

System generated metadata. Metadata generated automatically by some components of the system like *Online resource linkage* (url of the source disseminated by GeoServer) or *Data quality info* belongs to this category. This category includes metadata fields, whose values are set to the system administration application by a person responsible for the dataset, like *Presentation form, Organization name, Role, Maintenance* and *update frequency*. Also, the values of fields like *Abstract or Purpose* can be determined using the objective of the specific satellite mission and further automatically set by the administration MtdtRasPub application for all images of the dataset.

Metadata as an analysis product. In the field *Supplemental Information,* additional information acquired through raster analysis is encoded. This refers to the percentage of cloud and snow coverage in satellite images and also to the original and new minimum and maximum intensity values of old maps scans. The unknown reference system or map scale of old maps can stand as another example. In this case such information cannot be retrieved from bibliographic document. Cartometric analysis of such an old map scan however can provide estimates of these parameters (Bayer 2014).

The assignment of metadata fields into the categories above is not strict and depends on the unique characteristics of datasets. The update of existing metadata records is enabled by the system and carried out on an 'as needed' basis applying the *metadata.insert* xml service. The unique identifier prevents from the creation of duplicated records. The updating of existing metadata is required to encode the analysis results.

4. Conclusions

An SDI module for management of continuous flow of raster data and related metadata was proposed. This module addresses the needs for the automation of raster data archiving, analysis and distribution.

System evaluation. The functional parts of the prototype system have been developed in cooperation with the researchers and end-users of provided services.

The developers of the metadata solution, along with map archivists and end-users, defined fields from bibliographic records, that would be relevant for both public and scientists working in fields of geography and cartography. Selected metadata elements provided sufficient map description and search capabilities within the SDI system.

Also, the role of content-based image description was proven to be the key for the effective management of satellite imagery. Due to huge data volumes regularly produced, older or unused images are moved to be archived on backup media like magnetic tape. The image description is then crucial in allowing the searching of archived images, whose display is not available on-line.

The analysis of snow and cloud coverage demonstrated the way of content-based metadata creation. Romanov (2000) presented evaluation of classifications for satellite-based snow products. Results of the method varied from 75% to 85% of correct classification depending on environmental conditions. The comparison of results obtained by manual processing with automatically acquired results fit into this range. Nevertheless, to improve the image search capabilities and to fully answer the needs of end-users, more complex analysis on snow and clouds characteristics and more detail placement of such phenomenon are necessary.

The presented experiments provided valuable results for related research projects. The retrieved metadata enhanced the search capabilities and presented information about the suitability of an image for further analyses (like the classification of snow characteristics). The normalization of old map scans improved the readability of such documents. The main contribution, however, inheres in proving the functionality of the in-database analysis approach followed up by the automatic content-based metadata creation which is a major open research problem, not only to metadata catalogue or SDI systems but in other fields too.

Future development. The introduced approach provides many opportunities for geographers of various specializations to facilitate the retrieval of information from huge rasters, share it and effectively search for available data within the SDI.

The extension of the automatic processing of old map scan is an example. With a reasonable amount of effort, analytical procedures for the determination of the level of damage of a historical document, like that in Figure 5, can be implemented.

As another example, the enhancement of a geo-referenced mosaic created by historical cartographers from early map series like the military survey (Molnár 2011), can be mentioned. The image histogram equalization would provide a unified appearance by removing differences in contrast between individual lists caused by different materials or archiving approaches. More advanced procedures may deal with automatic map field extraction for such map series.

Another related example of potential future development is the extension of proposed snow and cloud detection aiming at the automation of snow and cloud typology classification or land use classification within the data store.

As shown in Dang (2012) the in-database storage is also a promising approach for the effective distribution and visualization of data changing continuously in time and space. Examples of such phenomena are temperature, pressure, precipitation, snow cover, land use or population density.

Future steps in application development will aim at the implementation of additional analytical procedures: (a) the image histogram equalization for the sake of mosaicking, (b) the embedding of existing procedures on cartometric analysis into the SDI system and (c) the integration of the application with solutions for crowdsourced georeferencing.

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RESUMÉ

Automatizace analýzy rastrových geodat a aktualizace metadat v infrastrukturách prostorových dat

Nárůst objemu prostorových dat vytvářených a aktualizovaných v krátkých časových intervalech vyžaduje nové přístupy ke správě takových dat. Příkladem může být průběžné topografické mapování, pořizování družicových či leteckých snímků, či digitalizace archivních dokumentů obsahující prostorová data, jako jsou staré mapy.

Článek proto prezentuje modul infrastruktury prostorových dat (SDI) pro řízení datového toku prostorově referencovaných snímků a jejich metadat. Je představen metadatový model, který je automaticky vytvářen z dostupných zdrojů metadat jako hlavičky rastrových souborů, pomocné soubory nebo bibliografické záznamy. Metadatové záznamy jsou klíčovým nástrojem pro vyhledávání dat. Dostupné zdroje metadat však často postrádají dostatečnou charakteristiku obsahu snímku, jehož automatizovaný popis je úzce svázán s analýzou dat. Navržený systém proto integruje archivní a distribuční funkce s funkcemi analytickými a současně poskytuje významnou datovou interoperabilitu tak, aby umožnil práci s různými datovými typy a standardy.

Vzhledem k obrovským objemům zejména rastrových dat je též nutné navrhnout systém tak, aby byl minimalizován transfer dat. Použitý způsob uložení rastrových dat s využitím nativního formátu databáze využívá data uložená v rámci datového zdroje a analytické procedury implementované také v rámci datového zdroje. Tím se minimalizují transfery takovýchto dat z uložiště k analytické aplikaci.

Popsané řešení je demonstrováno na dvou případových studiích. První je získávání informace o podílu oblačnosti a sněhové pokrývky v družicových snímcích NOAA-AVHRR. Druhou úprava kontrastu ve skenech starých map pocházejících z mapové sbírky Přírodovědecké fakulty Univerzity Karlovy. V závěru jsou diskutovány možnosti užití navrženého řešení v široké geografické a kartografické komunitě.

A TYPOLOGY OF NATURAL LANDSCAPES OF CENTRAL EUROPE

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ABSTRACT

Landscape classification of Central Europe was carried out in order to define the spatial framework of environmentally homogeneous typological units. The output of such a classification would be used for further assessment of ecosystem services within the focus region. Classification was based on the cluster analysis of principal components, derived from a set of abiotic data – climatic and terrain variables and a soil database. Seven specific landscape types were defined within Central Europe. Regional distribution and environmental characteristics of particular units are described.

Keywords: landscape classification, principal component analysis, cluster analysis

1. Introduction

Landscape classification is one of the traditional topics of landscape ecological research. Over the last decades, European landscapes have been endangered by environmental changes and globalization, which can lead to their unification and loss of specific character (Mücher et al. 2010). As pointed out in the European Landscape Convention, diversity and richness of environment originating from different natural and cultural factors belong to European heritage (Council of Europe 2000). This convention appeals to protect all valuable landscapes, no matter if they are natural or strongly influenced by humans. Thus delimitation of landscape types has become more urgent. Typologies are used for identification of specific and valuable areas, for further evaluation of state and changes, or as a background for consequent studies of other characteristics. The practical utilization of typologies is also seen in miscellaneous policies and regional planning (Bastian et al. 2000).

Methods of classification have been progressively evolving in time. Holistic typologies were typically based on general perception of landscapes. Expert statement typologies set intuitive delimitation of classes based on an author's experience. They can be based on objective input data, but boundaries are created subjectively. Bunce et al. (2006) warns that these approaches often ignore areas hard to assign to some class. An indisputable benefit of these studies is that they include non-measurable or subjective variables, which are especially crucial for identification of cultural landscapes.

Today's studies tend to create objective classifications based on statistical methods with usage of GIS tools, so-called quantitative typologies. These techniques are supported by broadly available free digital datasets that can be used as inputs in classification. Thematic layers are mostly created within EU initiatives. Quantitative typologies allow authors to repeat procedures including the latest or updated data. An objective classification is also the only way how to objectively divide variables changing in gradients (for example climate variables) and get really comparable spatial units. Hazeu et al. (2011) unifie terminology, claiming that a classification of gradients is typically called a stratification. The term typology describes classification of well-marked units with specific character. The three most common procedures of quantitative typologies are: (1) the spatial overlay of thematic layers (Hazeu et al. 2006; Metzger et al. 2010), (2) the multispectral segmentation (Mücher et al. 2010), or (3) the cluster analysis (Kolejka & Miklaš 1986; Metzger et al. 2005; Chuman & Romportl 2010). All these methods can also be combined in complex multi-level typology (van Eetvelde & Antrop 2009; Romportl et al. 2013). The classification results in a map that synthetizes all input thematic layers.

National landcape typologies in Europe are quite common (eg. Bunce et al. 1996; Lioubimtseva & Defourny 1999; Chuman & Romportl 2010; Kolejka 2010; Kolejka et al. 2010; van Eetvelde & Antrop 2009). It can be said that most of the states have their national classifications. There have also been some attempts to classify the whole area of Europe. These studies (Metzger et al. 2005; Mücher et al. 2003, 2010) were developed mainly after ratifying of the European Landscape Convention in 2000, which also highlights an importance of landscape typology and requires its production.

1.1 International Landscape Typologies in Europe

The first international landscape typology was the World Map of Present Day Landscapes, which was co-ordinated for the United Nations Environmental

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Programme (UNEP) by E.V. Milanova at Moscow State University. This work is a synthesis of two maps: *Geographical Belts and Zonal Types of Landscapes of the World* (1988) and *Land Use Types of the World* (1986), both in scale 1 : 50,000,000, which together delineate more than 150 types. Satellite images, regional thematic maps and field surveys were used as data inputs (Wascher ed. 2009). According to Wascher ed. (2009), these maps are all coarse in scale, thereby causing a number of inaccuracies. Thus they rather are not being used these days.

Another classification named *Pan-European Landscapes*, covering the whole Europe in scale 1 : 25,000,000, was developed by J. H. Meeus for the Dobříš Assessment in 1995. This typology tries to create a framework for assessing relationship between natural and anthropogenic factors in the environment (Meeus, 1995). The author took into account six main criteria including climate, geomorphology, sustainability of management, wilderness, genuineness and also the most important variable, which was defined as "a scenic quality and visual characteristic of region" and reviewed in terms "enclosure or openness of the landscape". The study identifies thirty main types of rural landscape, but it excludes urban, industrial and mining areas, or intertidal flats, that according to Meeus's opinion don't represent European natural and cultural heritage (Lipský & Romportl 2007). Although his work is quite general and subjective, the question of classifying and assessing cultural landscapes is still actual (Wascher ed. 2005).

In the same time as Meuss' work, different approaches were used to develop other examples of supranational landscape classifications of Central Europe (Richling et al. 1996a,b).

Two contemporary landscape classifications were developed as part of ELCAI project (the European Landscape Character Assessment Initiative) (Wascher ed. 2005). One of the goals of this project was to create two independent typologies of natural and cultural environment. Both works attempt to use objective procedures, transparent methodology, and future implementation in European and national policies (Mücher et al. 2003).

The Environmental Stratification of Europe, also called the Climatic Stratification of Europe, was created by M. Metzger and his team in 2005. The resolution of this stratification is 1 km^2. This classification is principally based only on climatic data, which can generally express the biophysical conditions in Europe. These are climate continentality, mean monthly values of minimum and maximum temperature, precipitation, and percentage of sunshine for four or five representative months of the year. Further added data are latitude, slope and altitude derived from digital elevation model. The first run of cluster analysis showed a strong heterogeneity of landscapes in Southern Europe, which led to division of Europe into two parts analyzed separately in order to gain spatially comparable units (Metzger et al. 2005). This resulted in the identification of six main environmental regions and 84 strata called *EnS*. Until these days, the stratification has been used in a number of other typologies and studies (Hazeu et al. 2006; Mücher et al. 2010; Metzger et al. 2010; Van Eupen et al. 2012).

The European Landscape Classification (LANMAP) brings a complex typology of cultural landscapes. Mücher et al. (2010) present the newest version with improved methodology. As appropriate input data in this study were considered climate, altitude, parent material, and land cover/land use. Last mentioned variable is the only representative of the anthropogenic influence in the meaning of cultural structures in the environment. Climate data layer was obtained from Climatic Stratification of Europe in combination with Biogeographical Regions Map of Europe (Roekaerts 2002). Object-based image segmentation of thematic layers identified 350 landscape types at the lowest level of classification. LANMAP was later used for developing the Spatial Regional Reference Framework (SRRF) and for the analysis of landcover changes (Hazeu et al. 2011).

An overview of recent typologies in Europe wouldn't be complete without mentioning some more thematicaly oriented ones such as the Biogeographical Regions Map of Europe (Roekaerts 2002), the Spatial Regional Reference Framework (Renetzeder 2002 in Hazeu et al. 2011), the Agri-Environmental Zonation (Hazeu et al. 2006) or the Rural Typology (Van Eupen et al. 2012).

2. Materials and methods

Creating landscape typology consists of three steps, (1) selection of variables, (2) reducing number of variables and cluster analysis, and (3) a description of identified landscape types.

2.1 Study area and objectives

The Central Europe is the area of study represented by the states of Germany, Switzerland, Austria, Poland, Slovakia and the Czech Republic. Biophysical conditions in this area are very heterogeneous and so is the cultural tradition. We try to classify a natural landscape in order to identify relatively homogeneous units with the same environmental potential. This background can be used for consequent studies of state and development of landscape types under different socio-economical conditions. In case of Central Europe, it is typically diversity of political development and regional planning in states' history. We also want to build our own typology using modern objective methods and widely available free datasets. Such a new typology should be available in high resolution.

2.2 Input datasets

When selecting the most adequate input layers, the well-known functional hierarchy of landscape components based on a model by Klijn and Udo de Haes (1994)

Tab. 1 Input datasets, its resolution and sources.

Layer	Format	Resolution	Database	Source
mean temperature	raster	1 km^2	WorldClim v1.4	worldclim.org
mean precipitation	raster	1 km^2	WorldClim v1.4	worldclim.org
altitude	raster	1 km^2	GTOPO 30	eros.usgs.gov
soil coverage	vector	1 : 1,000,000	European Soil Database v2.0, SGDBE v4beta	eurosoils.jrc.ec.europa.eu

was considered. Abiotic components are followed by dependent biotic components and cultural structures stand on the top of this hierarchy. Our task was to create classification of natural landscape, which would exclude all layers reflecting some anthropogenic activity such as land cover or land use. We also intended to use broadly available and free datasets. These two conditions, eventually, strongly limited our possibilities.

For purposes of classification climatic variables from WorldClim v1.4 database, terrain variables from digital elevation model GTOPO30, and soil coverage data from Soil Geographical Database of Eurasia (SGDBE) v4beta were used. SGDBE is part of the European Soil Database v2.0 (Table 1).

Three main climatic variables were derived from the database. First of all, mean annual temperature was derived from database of particular mean monthly temperatures. The annual precipitation was deduced in the same way. The third climatic variable is an amplitude of temperatures as a difference between mean temperature of July and January. All layers were expressed in a raster format as well as the digital elevation model (Figure 1).

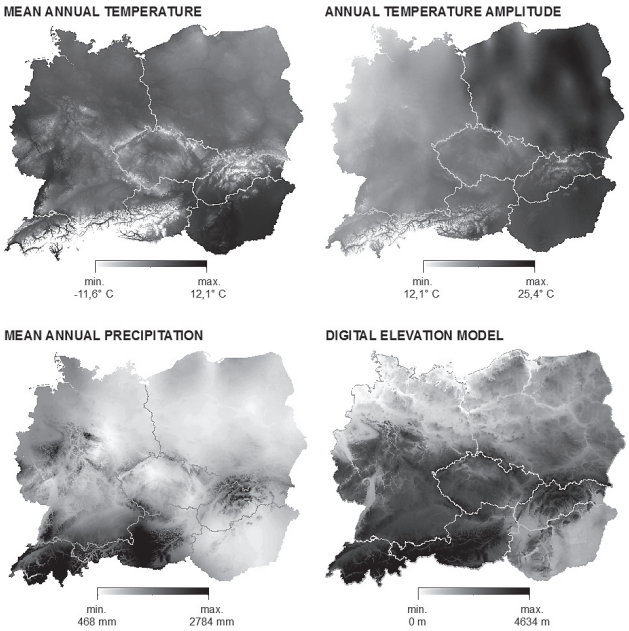

Fig. 1 Input raster datasets.

Soils were represented in a vector dataset (Figure 2). The soil coverage in SGDBE is classified by the Soil Typological Units (STU), which are grouped into the Soil Mapping Units (SMU) due to forming soil associations. A scale of geometrical dataset is 1 : 1,000,000, which makes STUs too detailed for delimitation, therefore SMUs were set as an effective units. Each SMU is assigned to World Reference Base (WRB) reference soil group. Thirty reference soil groups and six more categories (describing units without soil coverage like glacier, rock outcrop or town, and eventually category of unclassified units) are used in SGDBE. Twenty three of these categories appeared in our study area. This is a high number of variables for the cluster analysis. That's why categories were merged into ten groups according to description of their nature by Němeček et al. (2011). Non-soil classes were also reduced in four classes. An overview of the groups and the original classes is in Table 2.

Through all generalization we did in step above, there still remained considerable areas of unclassified units in Switzerland. A comparison with satellite imagery has shown that these areas belong to four classes of SMUs and represent intravilan, glacier, or rock outcrops. These findings pushed us to modify the database. SMUs 2, 5, 410018 a 410019 were added to the proper groups manually.

Tab. 2. Original WRB categories and generalized groups of soils.

Group	P1	P2	P3	P4	P5	P6	P7
WRB category in SGDBE	fluvisol	arenosol, leptosol, regosol	vertisol	chernozem, phaeozem	cambisol	albeluvisol, luvisol	gleysol, planosol
Group	**P8**	**P9**	**P10**	**P11**	**P12**	**P13**	**P14**
WRB category in SGDBE	solonchak, solonetz	histosol	marsh, unclassified	podzosols	glacier, rock outcrops	water body	town, soil disturbed by man

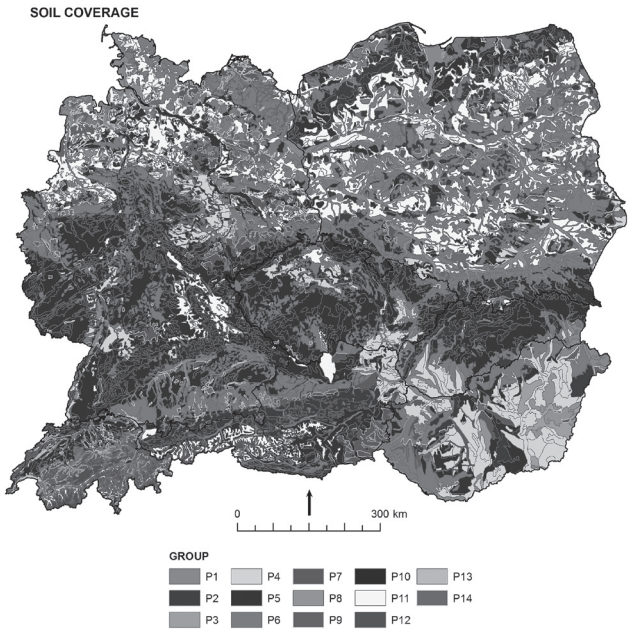

Fig. 2 Vector database of soils derived from SGDBE.

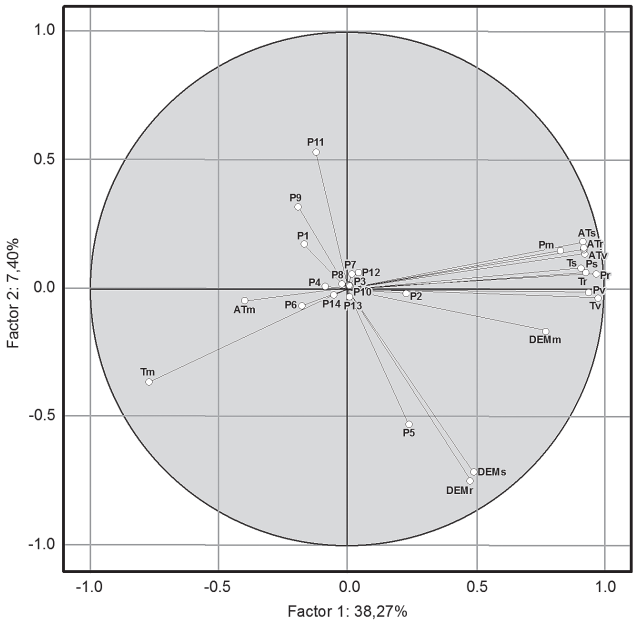

Fig. 3 Principal component analysis – projection of variables.

2.3 Classification

The input data were transformed into grid cells for purpose of analysis. This is a very common method to simplify data overlay and avoid slivers (van Eetvelde & Antrop 2009). A reference EEA grid with size of one cell 10 × 10 km was used. Resolution of input datasets didn't provide a proper information in small cells at the border of studied area. That's why cells under 1 km^2 and all the islands were excluded from the classification. Vector input datasets were expressed as a proportional area, which covers each category of layer in each cell. Raster datasets were transformed by the tool Zonal Statistics in ArcGIS 10.1 as basic statistical characteristics like mean, minimum, maximum, and first and third quartile of values in each grid cell.

Classification itself was the next stage. All processes were done in software Statistica 10. At first, number of standardized variables was reduced by Principal Component Analysis (PCA) that explained 67% of data variability. As the most correlated were detected climatic variables with exception of mean temperature and amplitude of temperatures (Figure 3). Results of PCA were used as an input in non-hierarchical cluster analysis K-means. Analysis divides all units into required number of clusters, and moves the objects to achieve the greatest homogeneity inside clusters and heterogeneity between them (Lepš & Šmilauer 2000). The final number of clusters is defined by user. In this case seven clusters were identified.

3. Results

Cluster analysis identified seven clusters (Figure 4). A short description of each cluster – natural landscape type – follows. One must be aware of high level of generalization, which was done at the first step for each grid cell and secondly for the whole landscape type. All of the values can be very variable within one landscape. The temperature and precipitation characteristic for each landscape are average values per year.

Type 1: The landscape of uplands and highlands of Central Europe. Average elevation is 400 metres above sea level. Temperature is around 7 °C and total received precipitation is 720 mm in average per year. Climate is relatively moderate. Cambisols represent the typical soil type. This landscape covers central Germany, almost

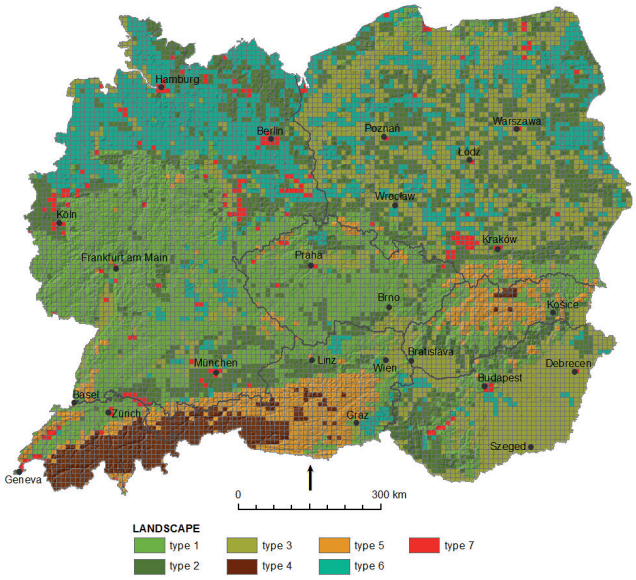

Fig. 4 Landscape typology of Central Europe – seven types of natural landscape.

Tab. 3 Statistical characteristics of raster datasets used in PCA.

Layer	Statistical characteristic of values in each field	Abbrev. in PCA projection
DEM	mean	DEMm
	standard deviation	DEMs
	range	DEMr
Amplitude of temperatures	mean	ATm
	standard deviation	ATs
	variation	ATv
	range	ATr
Temperature	mean	Tm
	standard deviation	Ts
	variation	Tv
	range	Tr
Precipitation	mean	Pm
	standard deviation	Ps
	variation	Pr
	range	Pv

whole area of the Czech Republic, and also lower parts of Switzerland, Austria and Slovakia.

Type 2: The average temperature in these piedmontan and hilly landscapes is 8 °C and annual received precipitations are around 600 mm. The mean elevation is 200 m and climate is relatively continental. Luvisols and albeluvisols are typical soils here. There are only small enclaves of this landscape spread in Central Europe, for example along the Danube, or the Rhine.

Type 3: The third landscape type of lowland landscapes is characterized by the lowest elevations above 100 metres above sea level. The amplitude of temperatures is the highest among all other types of landscapes, which shows a high continentality level. The amount of precipitation is, on the other hand, low – around 600 mm per year – and the average temperature is 8 °C. Chernozems and phaeozems, fluvisols, and solonchak or slanetz are typical soils for this type. These landscapes are situated mostly in the eastern part of studied area, in Hungary and Poland and West-Pannonian basin.

Type 4: The landscape of the highest mountain ranges in studied area. The mean elevation is 1800 metres, although a maximum is more than 3000 m. The amplitude of temperatures is typically low, which corresponds with high elevations. The mean annual temperature is around 2 °C and the precipitation exceeds 1320 mm per year. Only primitive soils occur here, like leptosols, perhaps even podzosols, but this landscape is dominantly covered by glaciers and rock outcrops. This landscape is typical for Alps in Switzerland and Austria and highest peaks of Tatras in Slovakia.

Type 5: This natural landscape is situated at average elevations of 900 m with vertically dissected terrain. The mean annual temperature is around 5 °C and received precipitation 1080 mm per year with high variability. Soils are either poorly developed or represented by cambisols. It's the second landscape of highlands in this typology, but it differs from the former in soil cover and vegetation. Harz, Jura, Schwarzwald mountains, and also almost the whole area of Slovakia and tops of mountains in the Czech Republic (like Krkonoše, or Hrubý Jeseník) belong to this category.

Type 6: The landscape of flat lowlands with mean altitude less than 100 metres above sea level with the average temperature around 8 °C and precipitation around 600 mm per year. Climate is moderate. Podzols and histosols, but also gleysols and planosols are typical soils of this landscape type. Regionally, this landscape occurs, for example, in the North German lowlands or Austrian Waldviertel.

Type 7: The last landscape type is characterized by the highest mean temperature, around 9 °C. The monthly receive of precipitation is about 600 mm per year, and elevations are very variable. Degradated soils, water bodies, and intravilans are being typical. It corresponds with the landscapes of industrial and mining areas, agglomerations and lakes. In details, capitals of states, lakes in Switzerland, or Balaton in Hungary, conurbations in Upper Silesia in Poland, or Rhine and Ruhr area in Germany can be mentioned.

4. Discussion and conlusion

Seven landscape types identified in cluster analysis of K-means have unique characteristics and correspond with main environmental gradients in studied area. The validation of typology in comparison with other existing classifications (Mücher et al. 2010, Kindler in Wascher ed. 2009) is a common procedure. Nevertheless, this step was not done in this case because Pan-European studies are rather too coarse.

Although actual objective method was used, there are a few disputable steps. First, it is a selection of input layers. The classification of natural environment is based on climatic, topographic, and soil coverage data. Unfortunately, there were no more proper datasets available, which is the reason why we didn't include, for example, geological layer, and therefore soil data has to be considered as an adequate substitute. Data availability followed by their subjective selection (Chuman & Romportl 2010) is typically being the main limitation in classifications. We are able to say that in this case there was no subjective selection because there were no more data available. On the other hand an absence of particular data doesn't mean that typology cannot be proceed. Haines-Young at al. (1992) classified landscapes of Wales using only satellite image and derived land cover mosaics. In any case, we suggest that for such a large area as in this study various detailed layers are needed.

The most controversial step is the manual intervention into the soil database SGDBE v4beta in which we

had to change some categories after comparing it with satellite image. However, it was necessary because of an inaccuracy in the database. These errors can be explained in methodology of SGDBE database at scale 1 : 1,000,000. As said in database metadata, "precision of the variables is weak" due to the estimation of soils over the large areas by expert knowledge instead of measuring local soil samples. We also put together WRB reference soil groups into the bigger groups according to their natural properties (Němeček at al. 2011). This procedure should reduce number of variables and eliminate the differences between national soil systems transformed into WRB categories in SGDBE. For example, Zádorová and Penížek (2011), who focus on harmonisation of Czech national soil system and the World Reference Base, describe in detail problems with transformation. Other European classifications, like Metzger et al. (2005), didn't include soil coverage into the Climatic Stratification of Europe because of the same problems we describe above. Mücher et al. (2010) generalized the European Soil Database and FAO Soil Map of the World (both representing parent material in LANMAP) into three classes, which probably eliminated all errors.

Cluster analysis is an objective method, but the number of clusters is set manually. This subjective step is unavoidable and has to be done in every cluster analysis (Bunce et al. 1996). However, different numbers can yield different results. According to Lepš and Šmilauer (2000), we have also tried to create versions with 5 and 6 clusters, but the results tend to be too coarse, hence we eventually decided to use classification identifying 7 clusters. Higher number of classes often leads to definition of unique landscape phenomenon rather than landscape types. Moreover, interpretation of more clusters can be problematic.

The landscape type number 7 corresponds with areas strongly influenced by man and areas with water bodies. This landscape was identified due to the dominantly absent soil cover. Although the goal of this study was to classify landscapes of natural environment, we decided to keep this class in typology. For example Mücher et al. (2010) excluded water bodies, agglomeration, and intertidal flat with a mask based on CORINE Land Cover layer. In this step he also solved the problem of missing soil data for these areas. In our case it wasn't necessary because the soil layer was available in accurate resolution.

The benefit of our work is in relatively high resolution of seven classes in grid of 100 km^2 which haven't been developed for this area of interest before. This approach allows us to respect regional specifics although we keep in mind there is still high level of generalization. We see an application of our work in future studies evaluating state and development of landscapes. It can be useful for strategic random sampling, evaluation of landscape fragmentation, or environment evaluation with ecosystems services approach.

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RESUMÉ

Typologie přírodních krajin střední Evropy

Krajina střední Evropy vykazuje vysokou heterogenitu přírodních podmínek, které determinují intenzitu a charakter jejího využití. Cílem předloženého příspěvku bylo zpracovat typologii krajiny podle přírodních podmínek prostředí tak, aby zachycovala hlavní environmentální gradienty v zájmovém regionu. Výsledkem klasifikace krajiny podle přírodních podmínek jsou opakovatelné homogenní jednotky, které představují jednotný prostorový rámec pro potenciální hodnocení stavu a dynamiky krajinných procesů. Metodický postup typologie krajiny je založen na několika návazných krocích: (1) výběr, předzpracování a standardizace vstupních dat charakterizujících abiotické poměry regionu; (2) dekorelace a snížení počtu vstupních proměnných pomocí analýzy hlavních komponent; (3) vlastní klasifikace krajinných typů s využitím klastrové analýzy.

Jako vstupní proměnné byly využity proměnné popisující klimatické poměry (průměrná roční teplota, amplituda teplot, průměrné roční srážky) odvozené z databáze WorldClim, dále nadmořská výška (databáze GTOPO30) a nakonec vrstva půdního pokryvu odvozená z databáze SGDBE.

Do klastrové analýzy vstupovaly již jen první tři komponenty z analýzy PCA, vysvětlující celkem 67 % variability původního datového prostoru. Výstupem je vymezení sedmi hlavních typů přírodních krajin, jejichž geografická distribuce jasně odráží hlavní environmentální gradienty střední Evropy.

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SOIL ORGANIC CARBON DENSITY AND STORAGE IN PODZOLS – A CASE STUDY FROM RALSKO REGION (CZECH REPUBLIC)

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ABSTRACT

The aim of this paper is the characterization of Carbic Podzols in the Ralsko region (Czech Republic) and their role in the soil carbon balance. The emphasis was put on soil carbon density and storage in the subsurface mineral horizons. Soil organic carbon density calculated for the studied podzol in the Ralsko region was 49.97 t ha^{-1}. More than 53% of this carbon is located in the subsurface horizons, below the depth of 30 cm.

The soil organic carbon density was visualised for all soil horizons. The reasons for spatial variability in soil carbon densities were sketched. Carbon density, besides other things, depends on the soil horizon's thickness which is very variable in the case of Carbic Podzols. Therefore, the horizon thickness and its course were visualised as well.

Keywords: Carbic Podzol, soil carbon density, visualisation, carbon sequestration

1. Introduction

There is an attempt to quantify the carbon stock and fluxes in the nature, and soils were identified as an important carbon sink, both agricultural and forest. Podzol is a global spread soil. It can be found mainly in boreal and taiga zone as a typical zonal soil type. Other podzols can be found on mineral-poor substrates in tropics and mid-latitudes as well as on glacial sediments. Podzols have high soil carbon stock under the surface organic horizons. This stock has high variability in its spatial distribution; the variation coefficient can be up to 146% (Batjes 2002).

Organic horizons are homogenous in terms of carbon content (Dégórski 2007; Liski and Westman 1997). Then the quantification of the soil carbon density in organic horizons is quite simple. However, the carbon density is underestimated by exclusion of mineral horizons deeper than 30 cm which can be rich in carbon as well. It is the case of chernozems, fluvisols and podzols. In some cambisols the soil organic carbon in mineral subsoil can be up to 47%, in podzols up to 75% (Rumpel et al. 2002).

2. Podzols

Podzols can be divided into two groups – zonal and intrazonal. Zonal podzols are typical for boreal and taiga zone and for higher altitudes and are determined by climate. Intrazonal podzols are not limited by climate condition and are typical for mineral poor substrates. In the Czech Republic, zonal podzols can be found in high altitudes with high precipitation. On the contrary, intrazonal podzols mostly occur in lowlands with sandstones. In the World reference base for soil resources (IUSS Working Group WRB 2007) the zonality or azonality of podzols is not distinguished. In azonal podzols the organic matter is transported prior to sesquioxides in contrast to zonal podzols (Němeček et al. 1990). Then, these podzols are called humic podzols, similarly as a Humods in the US Soil Taxonomy (1999) and Carbic Podzols in FAO WRB (2007). Czech soil taxonomy (Němeček et al. 2011) use the term "podzol arenický", with typical stratigraphy O-Ah-Ep-Bhs-Bs-C. Pedogenetic process is called podzolization. Organic carbon, Fe an Al ions are translocated from upper (elluvial) part of soil profile downward. Here the illuvial horizon is formed. The translocation is mostly determined by excess of precipitation in cold climate, which lead to percolation of water throw the soil (Schaetzl and Anderson 2005). But, as we mentioned previously, podsolization can be initialized not only by climate. The impact of vegetation and its acidic litter or geological bedrock is also very important. The iluvial Bs horizon can be subdivided into two horizons: Bhs and Bs according to prevalence of the organic matter or sesquioxides. In Bhs and Bs horizons, the content of organic matter can be more than 5% (Němeček et al. 2011). The irregular boundary between E, Bhs and Bs horizons called 'tonguing', as can be seen in Figure 1, is typical for a podzol profile.

As podzols occur in forested areas in most cases three throws have considerable influence on their stratigraphy. When a tree is uprooted, a pit and a mound are formed. In the pit the podzol stratigraphy is more developed than in the undisturbed area and in the mound (Schaetzl and Anderson 2005; Schaetzl 1990; Veneman et al. 1984). Herein, in consequence of accumulation organic matter in pits (Borman et al. 1995; Šamonil et al. 2010) a lower cation exchange capacity, lower pH and soil reaction are detected (Veneman et al 1984). Higher differentiation

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AUC Geographica, 49, No. 2, pp. 65–72

Fig. 1 Podzol stratigraphy, studied podzol profile with tonguing between Bhs and Bs horizons.

of the podzol stratigraphy is caused by concentration of runoff from precipitation and longer snow persistence in pits (Schaetzl 1990; Schaetzl and Anderson 2005). These facts lead to higher water percolation through the soil in pits and more intensive transport of organic matter from surface organic to subsurface mineral horizons. In other words, the process of podzolization is more intensive in pits.

2.1 Soil organic carbon and its density in soil

Soil organic matter in soil is a complex of organic remnants of microbial, vegetable or animal origin in various levels of decay (Nierop 1998; Schaetzl and Anderson 2005). Organic carbon represents 45–60% of soil organic matter (van Breemen and Buurman 2002). The soil organic matter composition is biased by input and decay of material from roots and by podzolization (Rumpel et al. 2002). Soil organic carbon is transported through the podzol profile in form of dissolved organic carbon which originates primarily in surface organic horizons (Rumpel et al. 2002).

According to Post et al. (1990) approximately two-thirds of the carbon reserves in forest ecosystems are preserved in form of soil organic matter. The spatial variability of these reserves is conditioned by bulk density, thickness of horizons, coarse fragments content and, of course, the amount of soil organic carbon. If talking about the vertical distribution of carbon reserves in the soil, the largest stock is in surface organic horizons. Soil organic carbon in these horizons is usually younger and more homogenous than in deeper horizons (Liski et al. 1997 in Degórski 2007) but because of the nature of podsolization process it is not a rule (van Breemen and Buurman 2002). The situation in mineral horizons of podzols is similar: the soil organic matter content is decreasing with depth with exception of the Bhs horizon. This horizon is enriched with carbon compared to adjacent horizons (Degórski 2007). The variability in the soil organic matter in podzol is considerable thanks to high spatial variability of horizons transition (e.g. tonguing).

Soil carbon stock is usually higher in regions with humid climate. Degórski (2007) analysed podzols of North and East Europe and found higher values of carbon stocks in northern and eastern parts of the area. Similarly, this was observed for podzols in Scandinavia (Liski and Westman 1995) and northern part of the USA (Michaelson et al. 1996).

2.2 Soil carbon quantification in the Czech Republic

Soil carbon quantification is quite common in the world, for example Batjes (1996, 2002) or Schwartz and Namri (2002). There were a few attempts to quantify the carbon stock in the Czech Republic. While the carbon stock in plant biomass is in interest of many studies (e.g. Forest condition monitoring, National forest inventorying project), the soil carbon quantification is quite overlooked. An exception is the CzechCarbo project which was aimed at the "investigation of the ability of the Czech landscape to absorb the carbon dioxide from atmosphere, accumulate this carbon and slow down the global warming process" (ÚSBE 2003–2007). Under the project, besides other aspects, the soil carbon in agriculture and forest soil was quantified.

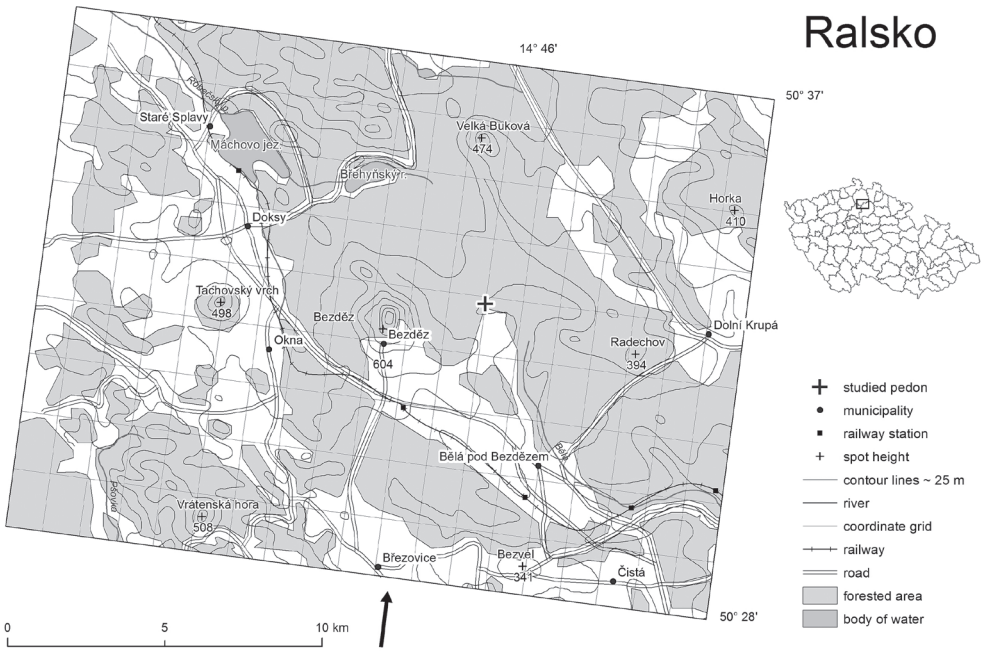

Fig. 2 Location of the studied podzol pedon.

The quantification of soil carbon in forest soil under the CzechCarbo project was carried out for the upper 30 cm, which is considered by Marek et al. (2011) to be crucial for the soil carbon balance. But the only output of this study is the map with charts of the soil carbon stock. The map does not represent the real soil carbon stock, due to exclusion mineral subsoil deeper than 30 cm. However, a considerable amount of carbon can be accumulated deeper than 30 cm: in case of podzols up to 66% according to Batjes (2002) or up to 75% according to Rumpel et al. (2002). Therefore, the aim of this paper is to make an attempt to quantify the soil organic carbon density in whole soil profile of podzol, not only for the upper 30 cm.

3. Methods and study area

Study area is located in the former army area in Ralsko region (Figure 2). Ralsko region is known as locality with well-developed Carbic Podzols. Studied pedon was chosen as representative of Carbic Podzol both in Ralsko and Czechia. Pedon was not obviously disturbed. Tonguing is frequent in locality.

The underlying bedrock is thick-bedded sandstone approximately 85–95 million years old (Chlupáč et al. 2011). The vegetation is represented by *Pinus sylvestris*, *Betula pendula, Vaccinium idaea, Vaccinium myrthillus L.* and *Calluna vulgaris*.

Soil samples for carbon and bulk density estimation were taken from centres of all horizons. More samples (7) were taken from Bhs horizon because of presence of the ortstein in this horizon. Soil organic carbon was estimated by modified Tjurin method.

Calculation of soil organic carbon density was taken according to Cienciala et al. (2006) for each horizon:

$$SOC = Cox \times BD \times T \times CF \times 10 \quad (1.1)$$

Where *SOC* is the final soil carbon density (kg m^{-2}) in horizon, *Cox* is the soil carbon content (%), *BD* is the bulk density (g cm^{-3}), T is the thickness of the horizon (m) and *CF* is the coefficient for estimation of coarse fragments (absent coarse fragments, *CF* = 1). Similarly, see Batjes (1996) and Schwartz and Namri (2002).

Dataset of soil carbon densities for each horizon was put into a grid by kriging by Surfer SW and then visualised. The course of the carbon in the soil profile (~ photography) was depicted as a diagram of soil carbon density in individual horizons and as a sum of all carbon densities in the soil profile. Also, the spatial variability of all horizons was visualised.

3.1 Visualization of the soil spatial variability

As is evident from Fig. 1, the course of the podzol horizons and their boundaries is very irregular and variable in space. This fact makes the carbon stock quantification more difficult because the horizon thickness is one of the criteria for carbon density calculation. For better understanding of the soil spatial variability, the visualisation of the podzol profile has to be done.

For the purpose of discovering the podzol spatial variability a set of photographs was taken. The soil profile was cleaned and then photographed. Then the soil profile was dug 10 cm away, cleaned and photographed again. This was repeated several times and the final set is comprised of seven photographs which cover around 230 × 60 cm area. The scheme can be seen in Fig. 3. Photographs were processed in Topol application, grid creation and 3D visualisation of studied profile was done in Surfer SW.

In order to determine the horizon thickness as accurately as possible we have to capture a spatial variability of

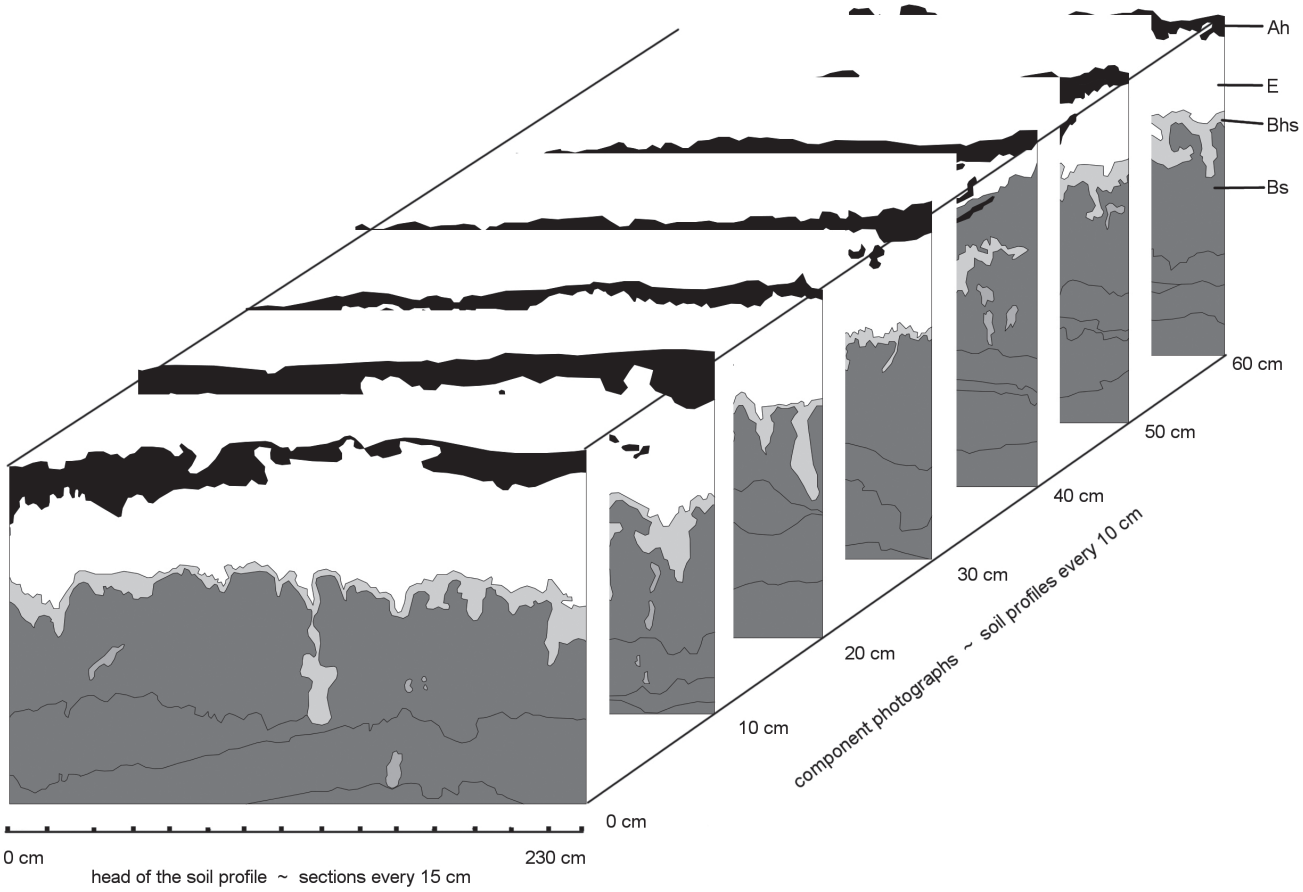

Fig. 3 The scheme of the mesh of 'boreholes' and photographs.

horizon transitions. For these purposes a mesh of fictive boreholes ~ sections was made. It comprises one borehole every 15 centimetres on each photograph (as can be seen in Figure 3). In nodal points the thickness of horizons was assessed and carbon density was calculated.

4. Results

Selected attributes of the analysed podzol pedon are summarized in Table 1.

Tab. 1 Selected characteristics of podzol horizons in Ralsko (*average value from seven samples for Bhs and two samples for Bs).

Horizon	Horizon thickness (m, average)	Horizon thickness (m, Median)	Bulk density [g.cm^{-3}]
Ah	0.109	0.096	1.053
E	0.301	0.308	1.353
Bhs	0.078	0.056	1.306*
Bs	0.712	0.728	1.438*

Figures 4–7 visualize the podzol horizon transitions. The most variable is Bhs/Bs transition (Figure 7). According our field observations, this deep tonguing is caused by tree roots. A lot of organic matter is accumulated around the roots and transported along them.

The second factor affecting the spatial variability of horizon transitions are pedoturbations, especially tree uprooting. This factor is mostly evident in Ah/E transition (Figure 5).

The E/Bhs transition (Figure 6) is less variable than expected. The copying of Bhs/Bs transition is not expressed in E/Bhs boundary.

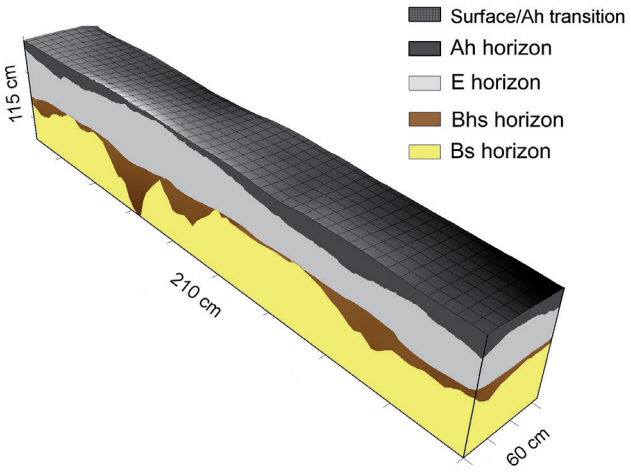

Fig. 4 Visualisation of the whole studied podzol pedon with all horizons. O (litter) horizon was discontinuous at the locality, hence it is included in Ah horizon.

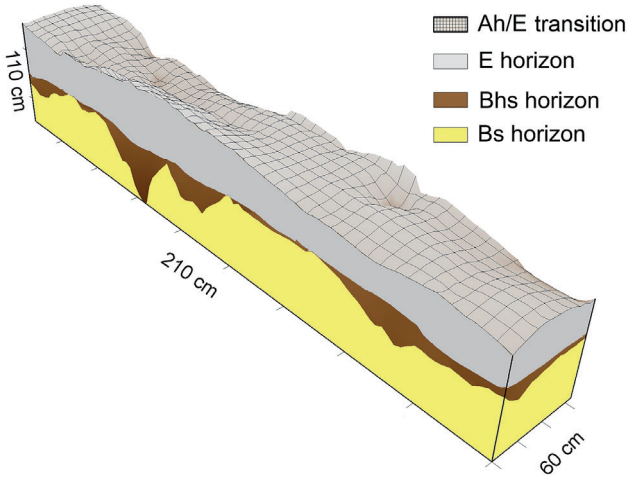

Fig. 5 Visualisation of the boundary between Ah and E horizons.

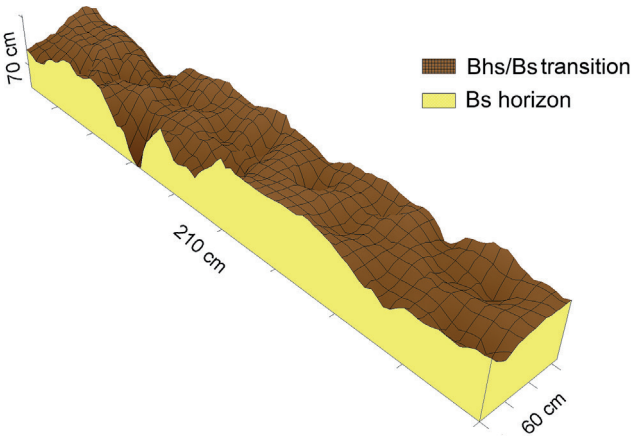

Fig. 7 Visualisation of the irregular boundary between Bhs and Bs horizons.

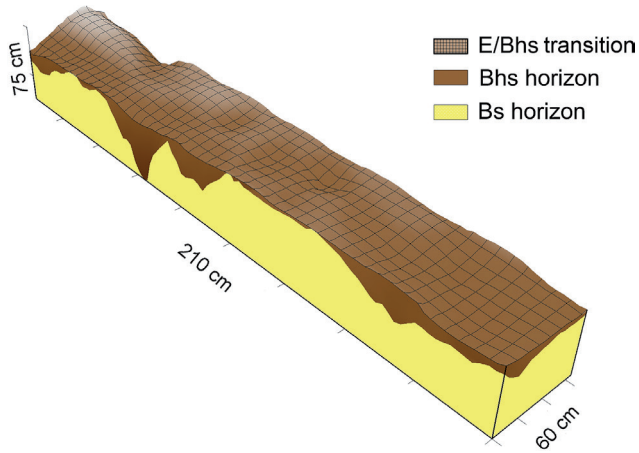

Fig. 6 Visualisation of the boundary between E and Bhs horizons.

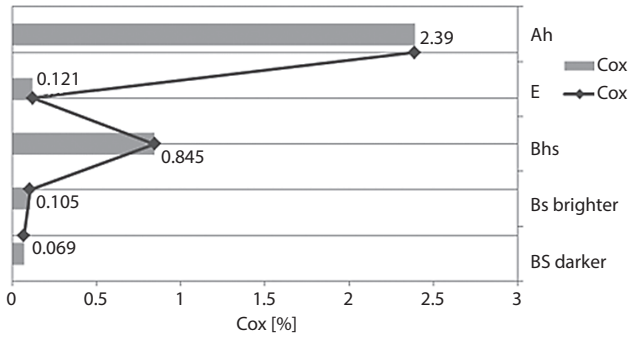

Fig. 8 The organic carbon content (Cox [%]) in the podzol horizons. For Bhs the average value from two samples is used (0.845%).

4.1 Soil organic carbon content

The course of soil carbon content is typical for podzol soils (Figure 8). The differentiation of Bs horizon according to organic matter content to Bs1 (darker, upper, more Cox) and Bs2 (brighter, lower, less Cox) is apparent. As a matter of interest, the carbon content in dark "veins" was estimated, as they were common in Ralsko (0.12% Cox).

4.2 The soil carbon density and its visualization

The soil carbon density characteristics in analysed podzol profile are summarized in Table 2. The total carbon density in whole soil profile is 4.997 kg m^{-2}. The most variable is the carbon density in Bhs horizon (0.088 to 4.238 kg m^{-2}). Soil organic carbon density calculated for whole podzol pedon in Ralsko ranges from 3.452 to 5.842 kg m^{-2}, with mean value 4.997 kg m^{-2}.

The course of the carbon densities in horizons is depicted in Figure 9. The carbon density depends on horizon thickness. First of all, carbon stock in the whole soil profile is determined mainly by carbon density in Ah horizon. But, where the tonguing is appearing (higher thickness of Bhs horizon), the total carbon density is considerably affected.

The soil carbon densities in studied podzol pedon were visualized. The carbon densities were calculated in nodal points for each horizon and then interpolated and

Tab. 2 Soil carbon density characteristics.

Kg m^{-2}	Mean	Mode	Minimum	Maximum	Skewness	Standard deviation	Variance
Ah	2.753	2.416	0.503	7.448	0.965	1.539	0.003742
E	0.494	0.565	0.072	0.835	–0.611	0.148	0.008157
Bhs	0.857	0.442	0.088	4.239	2.092	0.730	0.004378
Bs	0.894	0.903	0.417	1.089	–1.592	0.114	0.008215

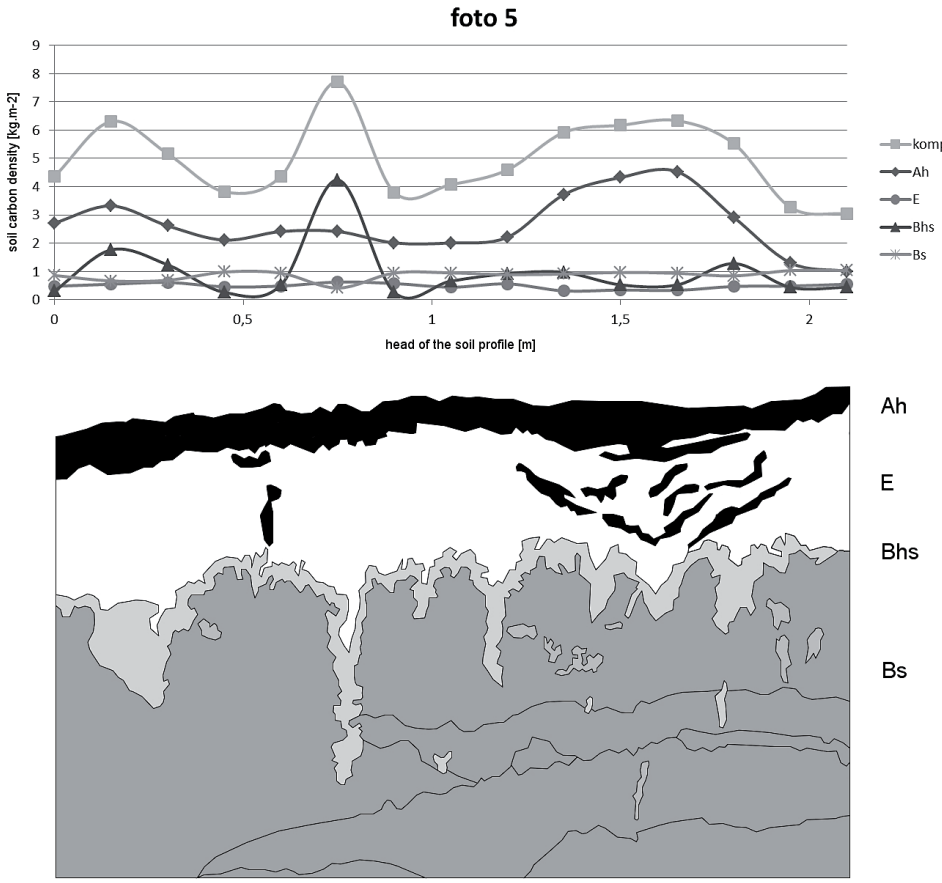

Fig. 9 The course of the soil carbon densities in each horizon and in the whole profile ('komplet'). Carbon stock in the whole soil profile is determined mainly by organic carbon from Ah. But, where the tonguing is appearing (thickness of Bhs horizon is higher), total carbon density is considerably affected.

visualised (Figure 10 and 11). The total carbon density was calculated and visualised as well (Figure 12).

For comparison with the work of Marek et al. (2011) the quantification of carbon densities below and above the level of 30 cm was done (Table 3). It is clear that the omission of subsoil below the 30 cm border can lead to inaccurate information about the soil carbon density.

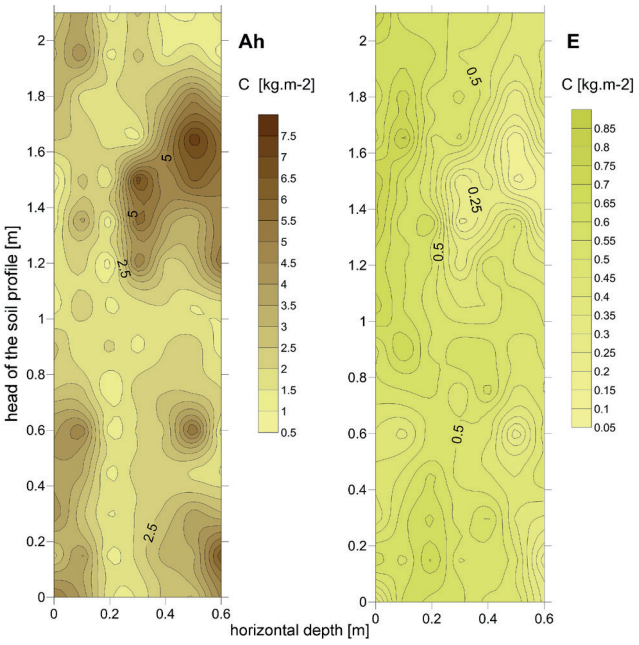

Fig. 10 Soil carbon densities in studied pedon in Ah and E horizons.

Tab. 3 The soil carbon stock below and above 30 cm.

Soil depth	Carbon density t ha^{-1}
Above 30 cm (Ah + E)	32.47
Below 30 cm	17.51
Loss by exclusion of subsoil	53%

5. Discussion

The soil organic carbon content in the podzol is decreasing with the depth, with the exception of Bhs horizon. The same trend was detected for example in works of Degórski (2007) and Mokma et al. (2004).

The soil carbon densities in entirestudied profile range from 3.452 to 5.842 kg m^{-2}. According to Degórski (2007), the carbon densities in the whole podzol profile range, on average, from 11.6 to 19.9 kg m^{-2}. The average carbon density of podzol in Sweden is 8.2 kg m^{-2} according to Ollson et al. (2009), who quantified the carbon density for the upper 50 cm of the soil. This is in accordance with the work of Fröberg et al. (2006), who analysed soil carbon densities in Swedish podzols as well. The carbon densities detected by Fröberg et al. (2006) were from 5 kg m^{-2} in well-drained podzols to 10.2 kg m^{-2} in poor-drained podzols. Batjes (2002), who quantified the carbon density in Central and Eastern European soils in the upper meter, gives 29.6 kg m^{-2} for podzols and 49.8 kg m^{-2} for carbic podzols, respectively.

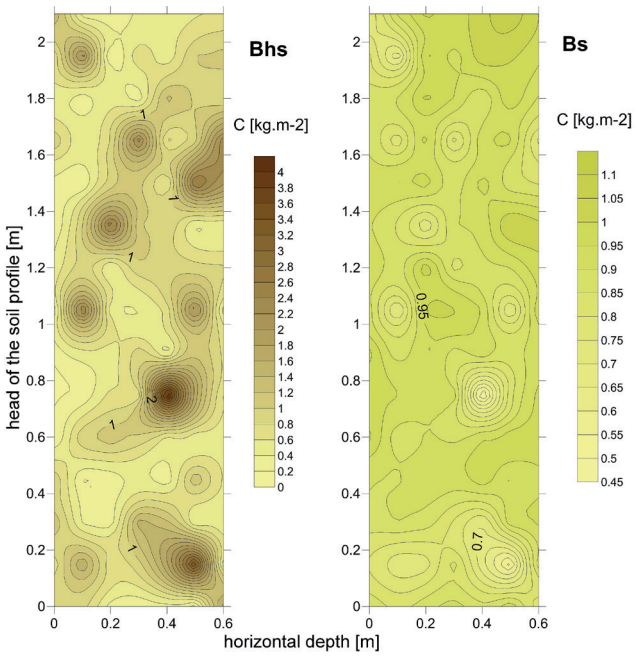

Fig. 11 Soil carbon densities in studied pedon in Bhs and Bs horizons.

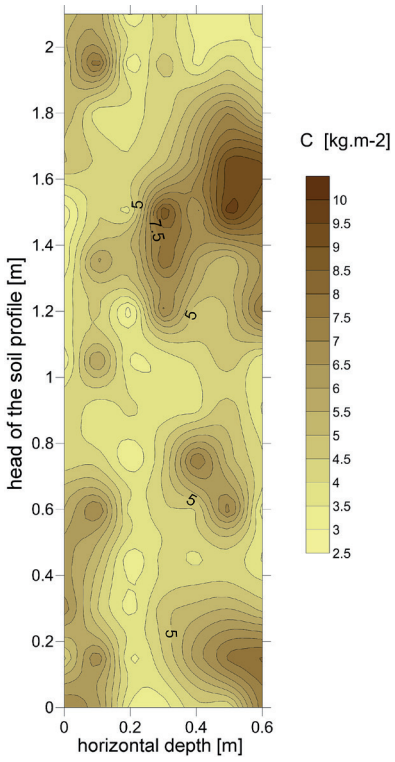

Fig. 12 Soil carbon densities in whole studied pedon.

However, there is no research in the Czech Republic focused on soil carbon quantification according to single soil type or group. Cienciala et al. (2006) found out the carbon density 7.22 kg m^{-2} in mineral soil, but various soils were classified together in one group (cambisols, podzosols, luvisols and gleysols). The result from National forest inventorying project would be convenient, but the data will not be published until the end of the project in 2014. The comparison with the Forest monitoring project data (2004) does not come into consideration either, because no surveys of this project took place on Carbic Podzols.

The comparison can only be made with the map of soil carbon density from Macků et al. (2007 in Marek et al. 2011). This map shows that the carbon density for podzols in Ralsko is about 5.1–6.0 kg m^{-2}. Another result in the work of Marek et al. (2011) quotes a value of carbon density in forest soils to 6.21 kg m^{-2} on average. But these values represent the carbon density only in the upper 30 cm of the soil. In comparison with these findings, the carbon density in the studied podzol is lower although the density is calculated for the whole profile. This can be caused by low or almost no thickness of O horizon in studied area. It is necessary to keep in mind that the results in the work of Marek et al. (2011) were taken in forest soils where the O horizon is usually rather thick.

6. Conclusion

The aim of this study was to accurately determine the soil carbon density in a podzol. For these purposes the profile of Carbic Podzol in Ralsko region was chosen. The horizon transitions were visualised, for better understanding of the specific podzol spatial variability. The carbon densities were estimated and visualised. The total carbon density in whole soil profile is 4.997 kg m^{-2}. The exclusion of the mineral or organic horizons below the 30 cm leads to shrinkage of the total carbon density up to 53%. The average carbon density is highest in Ah horizon, but a large amount can be found in Bhs horizons. It is a reason why mineral horizons cannot be excluded from carbon density estimation.

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RESUMÉ

Zásoby uhlíku v nížinných podzolech – případová studie z Ralska

Tato práce se zabývá nížinnými podzoly v Česku, s důrazem na sekvestraci uhlíku v jejich podpovrchových horizontech a jejich roli v uhlíkové bilanci půd. Pro tyto účely byla v ČR vybrána lokalita s arenickými podzoly, nacházející se v bývalém vojenském výcvikovém prostoru Ralsko. V této lokalitě byla spočítána zásoba uhlíku ve všech horizontech a byly analyzovány vybrané vlastnosti půdy ovlivňující tuto zásobu. Průměrná zásoba půdního organického uhlíku ve studovaném pedonu v Ralsku je 49,97 t ha^{-1}. Značná část této zásoby se přitom nachází v podpovrchových horizontech pod hranicí 30 cm (53 %).

Profil z Ralska byl dále zpracováván – proběhla vizualizace zásob uhlíku v jednotlivých horizontech a její průběh. Protože zásoba uhlíku v daném horizontu je závislá na jeho mocnosti, která je u nížinných podzolů značně proměnlivá, byla provedena trojrozměrná vizualizace průběhu horizontů v rámci půdního profilu z Ralska. Byly také nastíněny možné příčiny této variability.

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LOCAL DEVELOPMENT IMPLICATIONS OF PORK-BARREL: A CASE STUDY OF A CZECH DISTRICT

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ABSTRACT

The purpose of this article is to contribute to the study of parliamentary grants (also known as "pork barrel") through a case study focusing on the grant application process from the perspective of municipal representatives and the perception of the grants' development potential by inhabitants of such municipalities. Existing studies have considered the topic of parliamentary grant allocations at the national level. This article represents the first attempt to consider the issue of parliamentary grants in the regional context research concentrating on a sample of small municipalities with up to 1500 inhabitants within the Czech district of Žďár nad Sázavou. The study analyses the outputs of the author's survey of local mayors and ordinary inhabitants conducted within these municipalities in September 2013. The results of this research will contribute not only to the study of parliamentary grants, but also to the broader debate on various forms of subsidies. Furthermore, the study can generate insights into the larger issue of subsidies in Czechia, the distribution of which is often influenced by national politicians. It can also contribute to the broader discussion about the purpose and challenges to the current system of subsidies. The conclusion of this article offers possible solutions to some of these challenges.

Keywords: pork barrel, public subsidies, municipal budgets, regional development

1. Introduction

Parliamentary grants (a form of redistribution of public finances by MPs during the parliamentary negotiations over the national budget; known in international literature, along with subsidies provided by the individual ministries, by the term "pork barrel") have only marginal impacts on regional development when compared to large-scale processes such as globalisation and European integration (Blažek 2012), or institutional arrangements such as the system redistributing funds from the national budget (collected via taxation) to individual municipalities (Blažek 1996, 2002). However, all public funds need to be considered in order to gain a more complex insight into the issue of local and regional development (Martin, Minns 1995). The parliamentary grants represent a sizable financial resource (approx. CZK 3.5 billion annually over the period of 2003–2009), which used to be distributed according to unclear and personal or political criteria, rather than according to transparent rules reflective of some form of public interest (for more details, see Hána, Feřtrová 2014). Even though the distribution of parliamentary grants concluded in 2009, research of this issue remains highly relevant. The real impacts of the projects financed by the parliamentary grants can only really be observed and evaluated after a certain amount of time has passed. Moreover, the tendency of some MPs to politically influence the allocations of parliamentary grants may have continued in the current systems for the distribution of funds from ministerial subsidy programs. These funds then frequently end up being allocated to regions which used to be previously strongly supported by parliamentary grants (Hána 2013). The outputs of this research will therefore be useful for the study of other subsidies susceptible to political influences with similar purpose and comparable financial volumes (e.g. programs of the Ministry of Regional Development).

The topic of parliamentary grants has been addressed by several research papers written by Czech authors (Hána, Macešková 2010; Hána 2013; Hána, Feřtrová 2014) and also by a larger number of international studies (e.g. Johnston 1979, 1983; Fukui, Fukai 1996; Drazen, Eslava 2005; Golden, Picci 2006; Grossman, Helpman 2006; Finnigan 2007; Bardes et al. 2008). However, these research efforts are limited in certain regards and neglect several important aspects of the subject matter. This article intends to bring attention to one of the more neglected approaches to the study of parliamentary grants. It concerns the analysis of the views and opinions of municipal mayors on the application process of the parliamentary grants and the local inhabitants' (sometimes including the mayors as well) perceptions of the developmental impacts of the projects financed by parliamentary grants on their municipalities. The conducted analyses will answer the following questions: Was it reasonable to apply for a parliamentary grant? What were the advantages of parliamentary grants when compared to other forms of subsidies? What were their disadvantages? The analysis will also focus on the parliamentary grants' application process. Was the allocation of parliamentary grants the result of independent activity on the part of the MPs, or was the process primarily influenced by the acumen of

http://dx.doi.org/10.14712/23361980.2014.17
Hána, D. (2014): Local development implications of pork-barrel: a case study of a Czech district
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local actors regardless of their political affiliations, or further still, did the allocation of the parliamentary grants mostly come down to personal connections between local mayors and national politicians? The article also includes a discussion of the impacts of the parliamentary grants on the development of the concerned municipalities, which will answer the following set of questions: Was it meaningful to invest public resources into these grants, could they really contribute to the development of the recipient municipalities, for example by improving their visual character or by creating conditions conducive to further development?

The research took the form of a case study focused on the parliamentary grants distributed to municipalities within the district of Žďár nad Sázavou over the period of 2003–2009. This area was chosen for its peripheral character (Musil, Müller 2008), which promises observable impacts of the parliamentary grants on the development of the municipalities, which tend to operate with only limited financial resources. The regional quarters of parliamentary parties, located in the district (e.g. in the town of Žďár nad Sázavou), serve as political bases for several highly influential MPs. The study therefore comprises an in-depth analysis of a specific case featuring potential influence of these party bureaus on the activities of local mayors, which does not necessarily need to be fully generalizable (considering the current state of research on the given topic, this is a legitimate approach (Ženka, Kofroň 2012)).

The structure of this article reflects the declared objectives and the current state of research on the studied issue. The first chapter outlines the theoretical framework which forms the basis of this research. The next chapter introduces the regional context of the issue of parliamentary grants and presents the methodology of the research. The most extensive section of the article than analyses and interprets the acquired outputs in order to present the main research findings and provide a discussion of the results. The research is subsequently summarised in the final chapter.

2. Discussion of available literature on the topic of parliamentary grants

Parliamentary grants (and all forms of pork barrel in general) as a geographic, political, and economic topic have been frequently covered within both international (např. Johnston 1979, 1983; Fukui, Fukai 1996; Drazen, Eslava 2005; Golden, Picci 2006; Grossman, Helpman 2006; Finnigan 2007; Bardes et al. 2008) and Czech (Hána, Macešková 2010; Hána 2013; Hána, Feřtrová 2014) academia. In the majority of cases, however, these studies analyse the allocation of the financial resources distributed through these grants on the national level, while occasionally including a search for causal mechanisms (e.g. Johnston 1979; Golden, Picci 2006; Grossman, Helpman 2006; Hána, Feřtrová 2014) or the impacts of the grants on voter behaviour (Fukui, Fukai 1996; Drazen, Eslava 2005). Research conducted by Fukui and Fukai (1996), who employ several case studies of Japanese prefectures to document the entire system of grant applications starting at the local level all the way to the distribution of grants taking place at the national level, represents a notable exception.

The studies of Czech parliamentary grants have proved the significant role of these grants in the broader field regional politics (Hána, Macešková 2010), which includes all public policies with a regional dimension. However, their effects on regional development have not been explicitly addressed (Blažek 2003, 2006; Macešková 2009). Within this broader understanding of regional politics, the impacts of financial allocations might turn out to be much more significant than the stricter definition of regional politics (comprising "official" regional politics) would reveal (European Commission 2004; Macešková 2007; Sunley et al. 2005). The spatial pattern of the allocation of parliamentary grants has a distinct northwest-southeast gradient, with most funds being awarded to regions in the south eastern half of Czechia, such as the Žďár nad Sázavou district (Hána, Feřtrová 2014).

However, the study of selected cases of parliamentary grants and their impacts on municipal development should not be neglected. Unlike studies carried out on the national level, this approach enables a more detailed insight into the issue and a better understanding of some of significant spatial phenomena involved (Drulák 2008; Loučková 2010; Ženka, Kofroň 2013). Within the research on parliamentary grants, such case studies can bring attention to the views and perceptions their applicants and recipients have of the application process and the development potential of these grants. Currently, such information is hard to obtain and often merely filters through the media (e.g. Šašek 2009; Kedroň 2010). Nevertheless, this perception is significant, not only in relation to the parliamentary grants but to all subsidies distributed via political channels (Hána 2013). In order to fully grasp the role of public finances in the development of municipalities, it is necessary to understand the allocation of all public finances (Martin, Minns 1995), including the parliamentary grants, and the processes and political influences involved in their allocation.

In order to accurately select the type of parliamentary grants most suitable for in-depth analysis, it is necessary to subject them to a detailed classification based on their purpose (Hána 2010). This is achieved through a delineation of sectoral categories, which is partially based on methodology used by the IMF (2001). This categorization is summarized in Table 1.

The individual grants were then divided into the aforementioned categories on the basis of an expert analysis. For the study of the impact of parliamentary grants on municipal development, an evaluation of business infrastructure and business projects financed by the

Tab. 1 Parliamentary grant categories defined by purpose/sectoral classification.

categories	project type
education – nursery, primary	schools managed by the municipalities, including primary art schools and special schools; building repairs, repairs of facilities, including refectories and sports fields, utilised exclusively by the school
education – secondary, higher, further education	constructions or repairs of buildings and facilities used by secondary schools, vocational schools, colleges, universities, institutions of further education; congressional buildings, research facilities, sports fields, utilized exclusively by the institution
sport facilities, holiday and leisure activities	public sport facilities, holiday resorts, multifunctional buildings and facilities, playgrounds, tourist facilities, information centres
church and cultural buildings	cultural and church landmarks and facilities; reconstruction of churches, castles, chateaus, communal centres, memorials, cemeteries, libraries, theatres, cinemas
social services	reconstruction of senior homes, care homes, maternity centres
healthcare	construction and repairs of hospitals and other medical facilities, emergency and health service equipment
municipal facilities and visual character	construction and repairs of municipal buildings or other municipal property, such as municipal halls, municipal flats, furniture; equipment of firefighting squads and communal police, constructions or repairs of their buildings; investments into industrial zones, financial support for land-use planning
transport and technical infrastructure	construction of transport and technical infrastructure, pedestrian and cycling routes
environment and agriculture	management of public spaces, including parks, squares; landscape management, flood-protection measures; investments into agricultural facilities, refuse management
operating subsidies	non-investment expenditures, including subsidies provided to local clubs and organisations, co-financing of cultural and sports events
other	specific projects (e.g. reconstruction of a local courthouse), insufficient project description

Source: Based on IMF 2001: 83. Adjusted according to Hána 2010.

parliamentary grants would be the most obvious category of interest. However, these represent only a marginal (and not indicative) fraction of the set of allocated grants. The category of municipal facilities and visual character, which includes grants provided for business projects and business infrastructure, represented only 4.4% of the overall volume of parliamentary grants during the observed period (Figure 1). Moreover, such projects might have even been significantly financed from other sources, which would make the analysis of the development potential of parliamentary grants highly problematic.

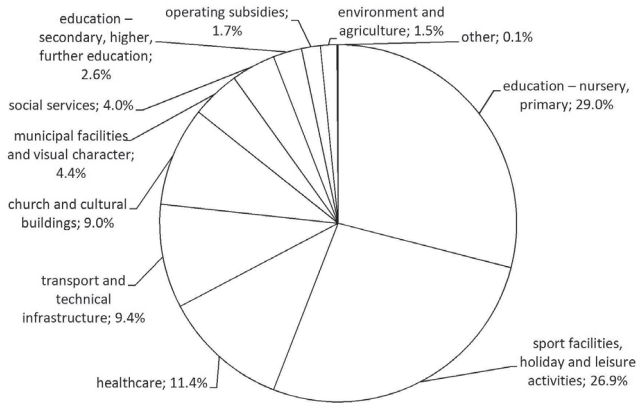

Fig. 1 Parliamentary grant categories in Czechia defined by sectors (2003–2009, in %).
Note: The categories are explained in more detail in Table 1.
Source: Chamber of Deputies 2002–2008. The author's calculations. Adjusted according to Hána 2010.

The figure reveals that two categories – nursery and primary education, and sport, holiday, and leisure facilities, make up almost 60% of all the parliamentary grants allocated in the given period. An analysis of the development impacts of grants provided within these dominant categories therefore plays the most significant role in answering the postulated research questions.

3. The development impacts of parliamentary grants in the Žďár nad Sázavou district

The objective of this article had laid out clear requirements which needed to be reflected in the research methodology. The methodology was selected according to relevant literature (Drulák 2008; Loučková 2010; Ženka, Kofroň 2013) in order to comply with the methodological approaches appropriate for the analysis of case studies. Data files on the successful amendments to national budget passed within the Chamber of Deputies, and henceforth available of its website (Chamber of Deputies 2002–2008), served as the primary data source. In order to successfully serve this purpose, however, they had to be converted into a convenient database of parliamentary grants (for more details, see Hána 2010; Hána, Macešková 2010; Hána, Feřtrová 2014). The district of Žďár nad Sázavou was selected as the primary region of interest, since it emerged as one of the most heavily subsidised regions (in respect to parliamentary grants) in the country (Hána, Feřtrová 2014), while also being considered a

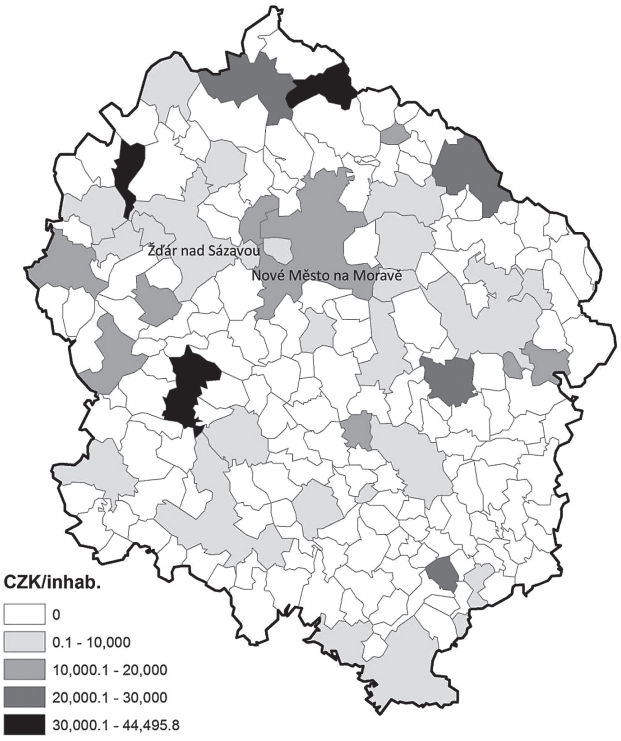

Fig. 2 The volume of parliamentary grants per capita received by municipalities of the Žďár nad Sázavou district (2003–2009, in CZK/inhab.).
Source: Chamber of Deputies 2002–2008; Czech Statistical Office 2009a,b. The author's calculations.

largely peripheral district (Musil, Müller 2008). Even relatively minor volumes of financial subsidies can therefore be expected to potentially trigger significant changes. At the same time, the district is home to certain local party organisations which gave rise to some very prominent MPs serving in the Chamber of Deputies. These organisations are primarily located in the town of Žďár nad Sázavou (comparison of MPs permanent residences, Hána, Feřtrová 2014). Figure 2 presents the financial resources (per capita) received by individual municipalities from the parliamentary grants.

During the observed period, 35 municipalities of the Žďár nad Sázavou district received a total of 77 grants ranging from CZK 250,000 to 22 million. The average financial volume of these grants reached CZK 6.2 million. The largest number of recipient municipalities, as well as the largest financial volumes, is concentrated in the northern part of the district. This area includes the towns of Žďár nad Sázavou and Nové Město na Moravě, which house the only party bureaus with active MPs within the district during the observed period. The extent to which this represents a decisive factor in the allocation of financial resources through the parliamentary grants therefore remains a legitimate subject for discussion.

A set of specific municipalities, mostly located in the vicinity of Žďár nad Sázavou, was selected for further analysis. Their selection was also guided by a limit on maximum population size (established at 1500 inhabitants), in order to make the potential impact of the grants on municipal development as visible as possible. This increased the relative impact of the grant when compared to the municipal budgets, primarily composed of financial resources provided by the national budget, which are allocated on the basis of population size. The budgets of smaller municipalities are therefore potentially strongly affected even by relatively small subsidies. However, close proximity to the town of Žďár nad Sázavou also entails a particular disadvantage, which needs to be respected during the formulation of conclusions. This drawback consists in the possibility that the levels of relative satisfaction with the municipalities' facilities on the part of their inhabitants might be affected by their easy access to the regional centre.

Figure 3 offers information on the volumes of parliamentary subsidies and the population size of the municipalities selected for further analysis. During the survey, respondents were assured of anonymity throughout the research, in regards to both the names and characteristics of the mayors and other respondents, and the names of the concerned municipalities. For this reason, no names are included in this study.

The sample comprises municipalities of different population sizes in order to adequately cover the scale all the way up to the limit of 1500 inhabitants. The sample mostly includes municipalities who received parliamentary grants worth less than CZK 10 million, it does, however, also include some municipalities which received significantly more generous subsidies. Therefore, the research operated with a sample of municipalities which allowed for a complex insight into the grant application process and for a detailed analysis of the development impacts of parliamentary grants on the studied municipalities. Figure 4 illustrates the sectoral distribution of the parliamentary grants received by the selected municipalities over the observed period.

In this figure, the category of nursery and primary education clearly dominates. Its share is larger than in

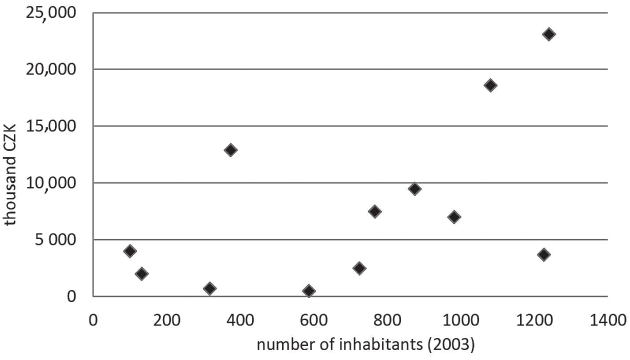

Fig. 3 The volumes of parliamentary subsidies matched with the population size of the selected municipalities in the district of Žďár nad Sázavou (2003–2009).
Source: Chamber of Deputies 2002–2008; Czech Statistical Office 2009a,b. The author's calculations.

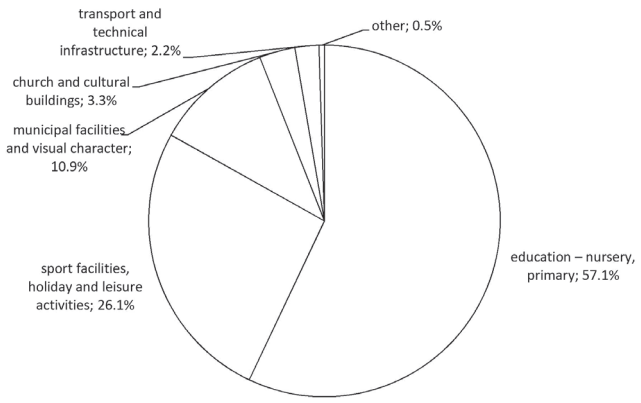

Fig. 4 Sectoral distribution of the parliamentary grants received by the selected municipalities of the Žďár nad Sázavou district (2003–2009, in %).
Note: The categories are explained in more detail in Table 1.
Source: Chamber of Deputies 2002–2008. The author's calculations.

the case of the national total. The sample therefore reasserts the importance of this category, as well as the importance of the category of sport, holiday, and leisure facilities, which remains in second place. The selected sample also shows a noticeable proportion of grants dedicated to municipal facilities and visual character, cultural and church buildings, and the construction of technical and transport infrastructure, which also largely corresponds to the general trends identified at the national level. Despite some (for the purposes of this article) rather insignificant differences, this classification enables us to analyse the benefits of the two largest categories of grants – nursery and primary education; and sport, holiday, and leisure facilities.

The empirical research which followed reflected two component objectives. The answers pertaining to the application process were obtained through the survey conducted among the mayors. The surveys asked the mayors to compare the institute of parliamentary grants with other sources of subsidies, including the administrative difficulty of the application process, and to provide an assessment of the importance of the activity and knowledge of the local actors in regards to the grant program and other forms of subsidies. Due to the pitfalls associated with any attempts at an objective assessment of the development impacts of the parliament subsidies, the impact was primarily studied through a survey among the inhabitants of the concerned municipalities. The survey asked them to state their satisfaction with public investments undertaken by their municipality, with emphasis placed on projects financed via parliamentary grants. In the case of these kinds of projects, perception of satisfaction serves as a suitable indicator of development. Some of these questions were also included in the survey conducted among mayors, in order to ascertain the views of such significant local actors on the development impacts of the projects financed through parliamentary grants, especially when compared to other municipal projects. The structure of the survey was largely influenced by available articles, dissertation and diploma theses (which include more detailed sections on research methodology) concerned with the outputs of similar research efforts (Susová 2009; Heřmanová 2010; Radová 2010; Ouředníček et al. 2011; Temelová et al. 2011; Vinterová 2011; Čejková 2012).

The survey was conducted in September 2013. It does not include a fully representative sample of local mayors or municipal populations across the entire region, it is, however, methodologically quite sufficient for the purposes and objectives of this article. The respondents were selected on the basis of the willingness of local inhabitants to participate and answer the postulated questions. The research took place in 12 municipalities, which received a total of 20 parliamentary grants over the course of the observed period. In order to provide useful comparison, the survey also included mayors from 7 municipalities which had not received any parliamentary grants.

10 questionnaires were completed by mayors from municipalities which had received parliamentary grants. 4 of these were members of local political parties or ran as independents, while 6 mayors belonged to a political party with parliamentary presence. 7 of the mayors had been holding the mayoral office when the municipalities received their parliamentary grants (a total of 14 grants), 5 of them had not and 2 of them have not answered the relevant questions, wherefore this information could not be ascertained. In terms of the 14 parliamentary grants received during the respondents' mandate, in 13 cases, the municipal board included members of some parliamentary party. Only one case involved a successful application made by a board comprised completely of independents or members of local initiatives. As for the municipalities which had not received parliamentary grants, 7 mayors completed the survey, all of whom are either independents or members of local political initiatives.

The survey of municipal inhabitants was completed by 81 respondents from municipalities which had received parliamentary grants. Women form the majority of these respondents (roughly 60%). The sample's age distribution roughly corresponds with the population structure of the municipalities, while it features a slightly higher share of inhabitants aged between 16 and 40. The survey was mostly completed by inhabitants who had been born in the municipality (about 40%), followed by persons who moved to the municipality with their families or through marriage (both groups reach about 15%). A similar portion of the respondents cited the attractive environment in the municipality as the principal reason for moving there, while a smaller portion cited employment or some other "urgent" cause. The article does not intend to generalise the outputs if this survey, it does, however, seek to provide an insight into the perceptions and opinions present among the inhabitants of the analysed municipalities, even though these might not necessarily represent the dominant opinions. Even so, the gathered views and

opinions are valuable for the study of the development potential of parliamentary grants and contribute to the discussion.

4. Parliamentary grants from the perspective of local mayors and inhabitants of the selected municipalities

Firstly, the analysis considered the responses of local mayors related to the grant application process. Among other things, the mayors compared the parliamentary grants with alternative forms of subsidies on the regional, state and European levels in terms of the administrative difficulty of the application process and their benefits to municipal development. The survey included mayors from municipalities which had received parliamentary grants, as well as from those which had not. The summary of the responses is outlined in Table 2. For the municipalities which had received parliamentary grants, responses were recorded separately for mayors who are members of local political initiatives and those who are members of parties represented in parliament. This is reflected in the structure of the following table. Initially, the analysis also distinguished the responses of mayors who had served in the mayoral office when the municipality received the grant from those who entered the office afterwards. Additionally, we also observed possible differences between the responses of mayors from municipalities whose boards did or did not include members of parties represented in parliament. However, in these two later instances, the responses differed to a very minor extent only.

Strikingly, the number of municipalities which have received a parliamentary grant is not matched by the number indicating the use of parliamentary grants provided by the mayors. From the 10 municipalities which had in fact received parliamentary grants by the time the survey was conducted, only 7 mayors confirmed the reception of these grants. Even though the survey included several mayors who had not been in office when the grant was applied for and received (wherefore they could have objectively argued that they had not used the given grant during their tenure), this does not satisfactorily explain such occurrence. Some of the mayors who attested that their municipality had not received a parliamentary grant had in fact already been in the mayoral office when the parliamentary grant was received. The possible reasons for not confirming the successful use of a parliamentary grant can include the somewhat controversial nature of these grants (which could have made the mayors unwilling to admit that they received them), or perhaps a low level of awareness of all the sources of municipal finances in case the grant application was managed by another member of the board. Mayors from both groups of municipalities (those who received parliamentary grants and who did not) appeared relatively unbothered by the specific administrative challenges of the grant application process. To the mayors of municipalities without parliamentary grants, the perceived difficulty of the application process seemed similar as in the case of subsidies distributed by the relevant ministries.

All responses indicate that regardless of whether they had also received parliamentary grants or not, all municipalities were most likely to succeed at obtaining the subsidies offered by the Vysočina region. The mayors attributed this mostly to the smaller administrative burdens (praised by all mayors without exception) this program entails when compared to state or European subsidies. In addition, the Vysočina region intentionally supports smaller municipalities (Kraj Vysočina 2013). This makes obtaining the subsidy a relatively easy task. The municipalities also frequently managed to secure subsidies from the Ministry of Regional Development, which, according to the mayors' testimony, have clear application requirements. However, when compared to the regional subsidies, the ministerial program is administratively much

Tab. 2 The share of affirmative responses to questions relating to the application for parliamentary grants, difficulty thereof, and the average rankings given to the individual subsidy programs by the mayors of selected municipalities in the Žďár nad Sázavou district.

	EU	MZ	MMR	PG	Region
used the program (municipalities with PG, %)	60.0	70.0	80.0	70.0	90.0
used the program (mun. without PG, %)	43.0	43.0	86.0	0.0	100.0
challenging procedure (mun. with PG, %)	60.0	30.0	30.0	10.0	0.0
challenging procedure (mun. without PG, %)	43.0	14.0	14.0	14.0	0.0
average rank (municipalities with PG)	3.6	4.1	3.3	3.8	3.0
– mayors from local parties	2.5	4.8	3.5	4.5	3.8
– mayors from parliamentary parties	4.3	3.7	3.2	3.3	2.5
average rank (municipalities without PG)	3.7	4.6	3.1	5.0	3.0

Note: EU = Structural Funds of the European Union, MZ = Ministerstvo zemědělství (The Ministry of Agriculture), MMR = Ministerstvo pro místní rozvoj (The Ministry of Regional Development), PG = parliamentary grants, region = subsidies provided by the Vysočina administrative region. Number of municipalities with PG = 10; without PG = 7. In the case that a mayor failed to rank any one of the sources of subsidies, it was assigned the value of 5.
Source: The survey and the author's calculations.

more challenging. The municipalities have also made use of the subsidies offered by the Ministry of Agriculture. A large group of municipalities had applied for subsidies from the EU Structural Funds; however, their mayors agreed that this is by far the most difficult subsidy to obtain. The application requirements and administrative procedures associated with the structural funds represent significant obstacles for the smaller municipalities who wish to apply for this form of subsidy. This serves to illustrate some of the problem Czechia seems to generally have with the use of EU Structural Funds. One of the mayors explicitly states that "the media report that Czechia is unable to successfully draw the European subsidies, yet they fail to inform that this is not fault of municipalities, which have prepared a large volumes of projects; the problem lies with the bureaucrats who make the subsidy programs so complicated that the finances become inaccessible" (translated by the author).

The rankings given to the individual forms of subsidies (Table 2) show that a surprisingly negative score (a high numerical value represents relative unwillingness to apply for them) was assigned to the parliamentary grants by mayors whose municipalities had received this form of subsidy. This implies that the mayors favoured other programs, be they regional, ministerial (Ministry of Regional Development), and even European, even though they consider them to be more difficult to secure. If, however, we separate the responses of mayors belonging to parliamentary parties from the answers provided by mayors backed by local political initiatives, we can observe a difference in attitudes. The mayors with affiliations to local parties assigned lower ranks (higher numerical value) to the parliamentary grants (they would choose to apply for them after they have exploited other options). Same holds true for subsidies provided by the Ministry of Agriculture and regional subsidies. On the other hand, mayors affiliated with local parties were much more inclined (expressed through a better ranking) to apply for subsidies from the Structural Funds of the EU. A question arises, whether mayors backed by parliamentary parties are perhaps more favourably disposed towards the programs to which they assigned higher priorities simply because their political connections (on both the regional and the state level) make it potentially easier for them to secure the subsidies they prioritised, either due to some direct political involvement of their acquaintances in the selection process or by an improved access to valuable information. One of the mayors whose municipality had not received the parliamentary grant it applied for offered his rather blunt account of the situation: "In small municipalities, the mayor's office is likely to go independent candidates, who have no political power, and no MPs, backing them up during the process" (translated by the author). The European funds are less likely to be influenced by Czech political connections, wherefore their subsidies are less sought after (than the available alternatives) by mayors with strong political connections, and more favoured by mayors from local parties, who are attracted by the potentially higher financial benefits to their municipalities.

The mayors of municipalities which had not received the parliamentary grants have resoundingly designated the parliamentary grants as their least attractive option. It is therefore likely that they have never even applied for them. The rank these respondents assigned to the subsidies provided by the Ministry of Agriculture is very close to the value given to these subsidies by the mayors who are members of local parties and come from municipalities which have received parliamentary grants. What exactly caused such convergence (perhaps a large degree of influenced exerted on these programs by national politicians) is a matter for further discussion.

It appears that the "reliance on personal contacts and political involvement of the mayor or other board members" (translated by the author), mentioned by one of the respondent mayors, is not limited to the allocation of parliamentary subsidies. Connections to regional or national politicians are crucial during most attempts to secure subsidies for small municipalities. These politicians can either directly help to secure the subsidy (especially in the case of parliamentary subsidies, but apparently also in the case of some ministerial subsidy programs (Hána 2013)), or they can provide the applicants with valuable information on the options and requirements of the given program. Except for one mayor, whose municipality managed to secure a parliamentary grant, all respondents emphasised the importance of the knowledge of the application procedures and the significant role of acquaintances who can help throughout the process. Even if it only benefits from a "mere" informational advantage, the municipality finds itself in a much more favourable position. The municipality is therefore largely dependent on contacts who can, according to one of the mayors, "provide timely information on the character of anticipated subsidy programs. The preparation of larger projects is a long-term process and requires the knowledge of the anticipated subsidy programs in order to effectively determine where to concentrate efforts" (translated by the author).

From the responses provided by the mayors, it appears that whoever had been given the chance to acquire parliamentary grants made use of it. Other forms of subsidies present the municipalities with ever increasing administrative burdens (this was asserted by all of the approached mayors, except for one respondent from a municipality without a parliamentary grant); moreover, there is no guarantee that an application will be successful, even though the municipality may incur considerable expenses in the process (about 30% of respondents voiced this concern). In order to tailor their projects according to the given requirements and to administer the application process, municipalities often find it necessary to hire external consultants, who tend to be rather expensive. Some mayors even mentioned the danger that municipalities might find themselves in debt while applying for subsidies. Ironically, subsidies might just be too expensive

for small municipalities. In contrast to this, parliamentary grants often came down to simply lobbying specific MPs with sufficient influence, and the only requirements placed on the municipality was that they comply with an inspection from the Ministry of Finance which inquired whether the relevant working permit had been secured (Slonková, Holub 2007; Pokorný 2009). Moreover, no institutionalised mechanism existed which would monitor the compliance of the project with the provided grant's original purpose (e.g. Kedroň 2010).

The close proximity to the town of Žďár nad Sázavou with the local party bureaus and permanent residences of several influential MPs (Hána, Feřtrová 2014) likely plays a significant role in this state of affairs. One inhabitant assessed the potential importance of this factor through her assertion: "I think that the fact that representative […] is a resident here confers a certain advantage" (translated and name removed by the author). The possible relevance of this factor must be taken into account during the discussion of outputs, since the information provided by respondents could have been different if we had chosen a different geographic area where to conduct the survey. The proximity to Žďár nad Sázavou might also prove to be a factor during the study of the impacts of parliamentary grants on the development of small municipalities.

The following section of this article concentrates on the comparison of the financial volumes received through parliamentary grants and the yearly budgets of the concerned municipalities, after which it analyses the responses provided by the inhabitants of the selected municipalities during the survey. For certain questions, these responses were supplemented by the responses provided by the mayors, who are also particularly noteworthy inhabitants. Figure 5 provides the comparison of annual municipal budgets and the financial resources provided by the parliamentary grants. In order to avoid distortions caused by exceptionally large budgets recorded in certain specific years (actually primarily caused by extraordinary revenues from subsidies), the parliamentary grants are compared to average yearly budgets of the given municipality over the period of 2003–2009. The data reflect the actual extent of municipal expenditures (not planned expenditures) without financial transfers to municipal funds or other accounts. These transfers would have unnecessarily inflated the values of the annual budgets, even though they are not in fact real expenditures (Rozpočet veřejně 2013).

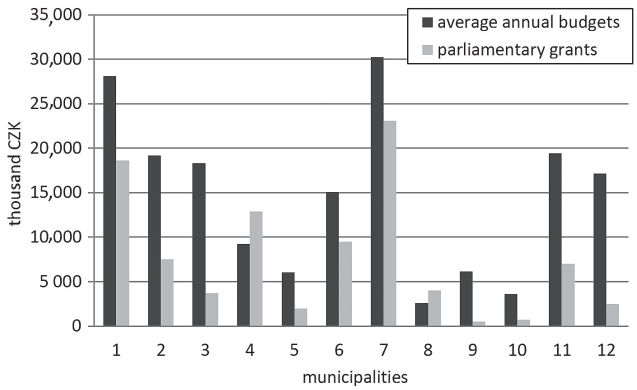

Fig. 5 The volumes of parliamentary grants contrasted with the average annual budgets of the selected municipalities in the district of Žďár nad Sázavou (2003–2009, in thsd. CZK).
Note: The average annual budget represents the average value of actual yearly expenditures, not including account transfers, made by the municipalities during the period of 2003–2009.
Source: Chamber of Deputies 2002–2008; Rozpočet veřejně 2013. The author's calculations.

The expenditures of the selected municipalities largely reflect their population size, which is the main criterion for the distribution of financial resources they receive from shared taxation (Act no. 243/2000). These allocations make up most of the municipal budget. Yet, outliers exist, which are caused by sudden increases in investments made by some municipalities in certain years. These investments are mostly financed by financial subsidies, which also include parliamentary grants. These tend to serve as major components of the municipal budgets. In certain cases, they even managed to exceed the size of the average annual budgets of the given municipality. In such cases, the parliamentary grants could have significantly contributed to the improvement of the municipality's situation (when compared to similar municipalities without this additional resource) by providing financial resources for some of the investments which would have otherwise remained unaffordable. Such boost can positively influence the relative satisfaction of the inhabitants with their municipal environment and provide the municipality with further advantages. The increase in relative satisfaction can in turn trigger other processes which positively affect communal life, such as increased micro-regional immigration (Ouředníček et al. 2011; Temelová et al. 2011), which eventually translates into increased population size and increased financial allocations from the national budget (Act no. 243/2000). How then, do the mayors and ordinary inhabitants perceive the buildings and facilities financed by the parliamentary grants?

One of the questions included in the survey did not explicitly ask about the parliamentary grants, but rather asked the respondents to identify all significant public constructions over the past 10 years, which they believed had had most positively improved the living standard of the municipality's inhabitants. Table 3 presents the types of constructions highlighted by the respondents (the share of the surveys which mention the given type). The public constructions highlighted by the respondents were categorised according to the sectoral classification of parliamentary grants introduced in Table 1. Table 3 then indicates the share of responses which acknowledged one of the 14 constructions financed through parliamentary grants.

Tab. 3 The types of constructions identified by the respondents as most positively contributing to the living standard in the selected municipalities of the Žďár nad Sázavou district over the period of 2003–2013 (in %).

	mayors	inhabitants
education – nursery, primary	55	61
sport facilities, holiday and leisure activities	55	47
church and cultural buildings	27	15
social services	0	3
healthcare	18	14
municipal facilities and visual character	36	35
transport and technical infrastructure	82	56
environment and agriculture	18	10
identified all parliamentary grants	86	59
identified at least one parliamentary grant	80	72

Note: See Table 1 for a more detailed description of the applied categories. Categories which did not feature any of the identified construction were removed from the table. Number of mayors = 10; number of inhabitants = 81.
Source: The survey and the author's calculations.

Not all types of public constructions took place in all of the municipalities during the observed period (e.g. social and care facilities, but also educational facilities). However, the surveys did not always include all of the constructions the municipality had procured. Many surveys of local inhabitants, as well as one survey completed by a mayor, did not include certain social facilities which had, in fact, been constructed in the respective municipalities. The share of responses identifying the specific types of public constructions can provide valuable insight into the relative importance of the individual types in terms of public satisfaction with life in the municipality. The table displays a strong convergence of opinion between the mayors and the other inhabitants. Both groups mostly highlighted educational, and sports facilities and constructions related to municipal infrastructure. This convergence could be due to a relatively small separation of municipal inhabitants from their political representatives, who very much engage in the municipality's daily affairs. The inhabitants then put slightly higher emphasis on the role of educational facilities than their mayors, who in turn show a higher preference for infrastructural facilities, which are vital for the improvement of living standards, yet have only a marginal impact on the municipality's exterior character.

It is worthy of note that the types of constructions identified as most valuable to the living standard by both the mayors and the inhabitants correspond with the types of parliamentary grants allocated to the municipalities during the relevant period (Figure 4). Furthermore, it reflects the general sectoral distribution of parliamentary grants throughout all of Czechia over the same period (Figure 1). A question arises, whether perhaps the parliamentary grants were intentionally dedicated to projects most popular among the inhabitants in order to secure voter support for the involved MPs. However, it is necessary to reassert that the data acquired during the research project are only fully applicable to the territory under observation and the selected sample of respondents, wherefore any projection of the results onto the national scale is somewhat speculative.

The share of responses identifying the constructions financed through parliamentary grants (or at least one of them) as positively contributing to the living standard clearly indicates the importance of such constructions to small municipalities. Mayors were more likely than other inhabitants to highlight these buildings as significant, which implies that they recognise the constructions financed through parliamentary grants as an important factor in improving the living standard in their municipalities. Undoubtedly, the mayors recognise the importance of these construction not only in terms of their direct impact on the wellbeing of the inhabitants, but also from a political perspective, since such popular construction projects are likely to increase their popularity. As an exception to the rule, mayors of two municipalities did not mention the projects financed by the parliamentary grants received by their municipalities. One of these municipalities received a grant which does not clearly specify its purpose, while the other municipality used its parliamentary grant for the reconstruction of its municipal hall, as well as for the reconstruction of other objects not included in the grant's description. These discrepancies might be the reason for not mentioning the projects in the survey.

Ordinary inhabitants were less likely to include the projects financed by parliamentary grants among the most significant municipal constructions. Nevertheless, 59% included all of them in their list and 72% of inhabitants mentioned at least one of them. This share is still relatively high. Ordinary citizens therefore also seem to consider the constructions financed through parliamentary grants as important elements of municipal life, although they sometimes have critical comments. In some cases, the inhabitants are dissatisfied with their implementation ("Surely, every construction benefits the municipality, however, some of them are not devoid of problems" (translated by the author).), in exceptional cases, they outright disagree with the construction altogether ("Instead of the hall, we could have had a new school" (translated by the author).). Table 4 records the responses provided by inhabitants regarding their satisfaction with the specific construction projects financed by the parliamentary grants. They indicated their level of satisfaction on a scale from 1 (completely satisfied) to 5 (absolutely dissatisfied). The results were separated for the individual types of constructions corresponding to the sectoral classification used in Table 1.

Tab. 4 Recorded satisfaction of the inhabitants of selected municipalities in the Žďár nad Sázavou district with the construction projects financed by parliamentary grants over the period of 2003–2009.

	average	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	No response (%)
education – nursery, primary	2.0	42	31	18	6	3	0
sport facilities, holiday and leisure activities	1.6	33	25	9	0	0	33
church and cultural buildings	2.3	18	46	27	9	0	0
municipal facilities and visual character	1.5	64	18	18	0	0	0
total	1.9	40	31	18	5	2	4

Note: See Table 1 for a more detailed description of the applied categories. The scale from 1 to 5 represents the relative satisfaction with the construction projects, when 1 is the most positive value and 5 the most negative.
Source: The survey and the author's calculations.

The overall level of satisfaction with the constructions financed by the parliamentary grants is relatively high. The inhabitants were most satisfied with the constructions contributing to the municipality's facilities and visual character and with constructed sports facilities (in this case, however, the survey is 4 expected responses short, since what an original grant document (Chamber of Deputies 2002–2008) described as a local "Youth centre" (translated by the author) apparently failed to register among the local inhabitants). On the other hand, the inhabitants were rather critical towards cultural and church (re)constructions (such as the reconstruction of a local community centre in one of the municipalities) and towards construction projects related to educational buildings, which the inhabitants consider among the most important municipal buildings (see Table 3). This importance is reflected in the attention the inhabitants give to these buildings and the expectations they have, resulting in more severe criticisms. Even in this instance, however, the level of dissatisfaction does not reach very high values, since most respondents rated the projects with marks ranging from 1–3, indicating their relative satisfaction.

Importantly, many inhabitants expressed their satisfaction with the construction projects financed by the parliamentary grants although they seldom used the produced facilities themselves: "I am glad that these building exist in the municipality, however I don't really frequent them myself" (translated by the author). The inhabitants often appreciate the reconstruction works because they improve the municipality's image, environment, and the public space in which they live: "It has not really affected my life personally, but I am satisfied with the renovation taking place in the municipality" (translated by the author). The inhabitants also frequently express their satisfaction with the existence of facilities which can be used by other members of the municipality. It can therefore be argued that the inhabitants are often pleased with the role the grants have played in the improvement of the communal environment and life, irrespective of any direct personal benefits to themselves: "A general reconstruction of the school took place, which improved the lives of the students and the teachers and helped the municipality to save money on energy" (translated by the author). Moreover, the respondents often allude to the fact that while they may not be using the concerned facilities themselves, their children probably will: "In the future, I plan to send my children here, wherefore I welcome any efforts at renovation" (translated by the author).

However, although positive perception of the parliamentary grants predominates, critical opinions have also been voiced. Frequently, the inhabitants are more favourably disposed towards projects with more immediate effects on their daily lives than is the case with the projects financed by the parliamentary grants. For this reason, the inhabitants of one municipality might end up valuing the construction of pavements and cycle tracks along busy roads above the constructions of a community centre or a playground, paid for by the parliamentary grants. Another example when the parliamentary grant failed to address the most desirable investments can be found in one municipality where the grant was used to finance the construction of a new sports hall and the reconstruction of an old elementary school. The inhabitants expressed criticism towards the reconstruction of the old school building, since they would have rather seen the construction on a new school: "The school building has been repaired adequately, however, if the municipality had decided to build a new school building instead or enlarging the old one, it would have been better" (translated by the author). They are even more critical towards the construction of the new sports hall, since the hall has only limited uses which do not quite justify the enormous expenses tied with its construction: "The hall primarily benefits the […] handball club. The municipality pours a lot of money in it" (translated and name of the municipality removed by the author). In some other cases, the inhabitants point out what they see as the ineffectiveness of parliamentary grants or the insufficient quality of some of the constructed buildings. An extension of a local nursery, constructed as part of a project financed by a parliamentary grant in 2007, for which the municipality hasn't yet found any use, can serve as an example: "Considering the reconstruction, the building should be used more effectively" (translated by the author). As another example, one respondent criticises what he sees as excessive costs of the reconstruction of a school refectory,

citing "very large reconstruction expenses relative to the number of lunches cooked in the refectory" (translated by the author). Criticisms also pertain to an insufficient insulation of the school building during the reconstruction. Some inhabitants even responded that the most significant municipal buildings were all built in the 1980s.

The collected data indicates that parliamentary grants can positively contribute to the character of the municipalities by improving the living standard of their inhabitants. The grants do not directly contribute to the economic development of the given municipalities, although they surely indirectly impact on the size of their financial allocations from the national budget by improving their image and fostering micro-regional immigration (thus increasing their population and revenues). Nevertheless, the type of development facilitated by the parliamentary grants has an impact on the relative levels of satisfaction the inhabitants feel in regards to life in their municipalities (at this point, it is necessary to reiterate the possible influence of the proximity to the town of Žďár nad Sázavou, since this regional centre can provide the surrounding municipalities with all necessary facilities in case they lack them themselves. As a result, inhabitants of the selected municipalities might be disproportionately concerned with other features of municipal life, such as improvements to the public space). Therefore, the parliamentary grants served a legitimate role and the inhabitants of the affected municipalities were, with the exception of some critical opinions, largely satisfied with the construction projects the grants helped to finance. The interviewed mayors attributed greater significance to the parliamentary grants than ordinary citizens, since they might also see them as political instruments. Political connections emerged as a key requirement for the acquisition of parliamentary grants. The mayors who had such connections at their disposal made use of them during the application process. In comparison to the parliamentary grants, other subsidies provided on the national or the European level turned out to involve excessive administrative burdens (from the perspective of the small municipalities). However, this system reveals itself to be quite unfair. In this manner, connections to national or regional politicians, who either help secure the grants or at least provide information on the application process, become the decisive factor in municipal development. This system seems to have lingered on even after the institute of parliamentary grants was discontinued, for example within the practice of certain ministries (Hána 2013). It therefore still applies that whoever does not possess such political resources finds himself/herself at a disadvantage.

5. Conclusion

Unlike previous studies, both international and Czech, which investigate the allocation of parliamentary grants on the national scale only; this article endeavoured to introduce the perspective of mayors and inhabitants of smaller municipalities and their views on the developmental impact of parliamentary grants. The article therefore serves as a first attempt to use such approach towards this issue which stands at a significant intersection of the fields of geography, politics, and economics.

The research took the form of a case study of the Žďár nad Sázavou district. In terms of spatial distribution, most funds were concentrated in the vicinity of the towns of Žďár nad Sázavou and Nové Město na Moravě. This later finding also triggered the discussion of the presence of local party organisations which are home to some influential politicians and their possible influence on the grant allocation process. The survey among mayors and inhabitants of municipalities took place in 12 municipalities with under 1500 inhabitants, which had received parliamentary grants (and in 7 municipalities without parliamentary grants), across a number of population size categories. It is necessary to assert that in light of the current lack of research done on this topic, this study does not aspire to complete generalizability, but rather represents a significant analysis of a specific case of the local impacts of parliamentary grants and the way they are perceived by local actors.

The survey produced a number of interesting outputs, which can be summarized by a set of several propositions. The results of the survey among mayors indicate that personal acquaintance of local politicians with politicians at the national level is the primary factor in the process of grant allocation, supplemented by a possible influence of the political membership of the mayor and of significant members of the executive board. If the municipal representatives had a line of access to politicians, it was meaningful to apply for parliamentary grants, if this was not the case, municipalities would be better off looking for other sources of subsidies. For small municipalities, however, other forms of grants tend to be difficult to obtain, often even expensive (in case they have to hire external experts), and there is no certainty of success. Parliamentary grants are free of most of these difficulties. An application for a parliamentary grant also has the potential positive impact of galvanising the local actors. Experience with the grant application process can improve the confidence of the local representatives and their capacity to succeed with any further applications in the future. However, during the application process, local representatives were primarily guided by their political acquaintances, who either secured them the grants outright, or provided them with information on the running grant initiatives. This interconnection between local actors and politicians on the national level, however, could also have led to the creation of clientelist networks (see Dvořáková 2012a,b), which can be used by the local actors in order to secure further grants or to promote their interests. A question arises, whether this reflects the very purpose of local administration, since municipal representatives become dependent on politicians operating on the state

level. We could discuss that the clientelism among state and local politicians can also disproportionately alter voter behaviour during communal election. In this case, such elections would be favourably disposed towards people with connections to state politicians, not to those who might have the best capacity to promote the development of the municipality, manage its affairs, and unite the community.

The parliamentary grants turned out to have significant effects on the development of individual municipalities, since they often exceeded their yearly budgets and were frequently used to finance some of the public buildings deemed essential to public well-being by the local mayors. In addition, aside from a few exceptions, the buildings whose construction was financed by the parliamentary grants were perceived very positively by the local inhabitants. The parliamentary grants had a large impact on a general improvement of the environment and the image of the affected municipality. In some instances, they even helped the municipalities to save money, which they would have otherwise had to spend on the same constructions or reconstruction, and which therefore could have been devoted to other projects. The municipalities further benefit and save money in the long run through improved technologies frequently used during such reconstructions (e.g. new thermal insulation of the local school). The fact that these benefits have been provided to only a small selection of municipalities, chosen primarily due to personal or political connections of their mayors and not according to some generally acceptable criteria, however, remains highly contentious.

Even after the practice of parliamentary grants has been concluded, research on this topic can still provide valuable insights. The presented research should be followed by a series of further case studies in different regions, which could offer different outputs or point towards regularities occurring in typologically different territories. Research continued in such manner could then attempt to generalise some of the achieved outputs. The issue of the development potential of the parliamentary grants could be then discussed within the field of cultural geography. One of the interesting questions arising from this study is whether the relative satisfaction of the inhabitants with the public buildings financed by the parliamentary grants, even though many of them do not use these buildings themselves, is influenced by their identification with the municipality and its community. The outputs of this research can also be potentially used in an analysis of some ministerial subsidies (e.g. those distributed by the Ministry of Regional Development), which also seem to be influenced by political factors (Hána 2013). The parliamentary grants had significant development potential in the form of an improved public environment of the targeted municipalities. It can therefore be argued that the similarly oriented ministerial subsidies could have meaningful effects, however, only in the case that do not overwhelm small municipalities with administration and application requirements beyond the personal and financial capacities of such municipalities. Such overload forces the municipal representatives to exploit all alternative avenues in order to secure these subsidies, or at least to obtain some form of informational advantage, including the personal-political channels. Any system which distributes grants and subsidies on the bases of personal political connections is essentially unjust.

The outputs of this article can also contribute to the general discussion on subsidies, their purpose, advantages and drawbacks, as well as their significant vulnerability to political pressures and the creation of clientelist networks within Czech politics. The Czech system of (both state and European) subsidies suffers from some serious problems. Some of them could be remedied by a general simplification of the grant application process (inspiration could be taken from the system of subsidies provided by the Vysočina region, which is praised by local mayors for its administrative simplicity). Alternatively, many municipal representatives (including some of those who completed this survey) call either for a complete abolishment of the system of state subsidies and transfer of resources into the pool of shared taxes which is used to finance local governments, or its replacement by a system of local taxes administered by the municipalities themselves. This way, municipalities would receive smaller financial benefits then if they were granted the previously available subsidies; however, they would still obtain additional financial resources they could use for the improvement of their communal environment and public well-being. Municipal officials would no longer be burdened by excessive administration associated with the majority of the subsidy programs, which is often beyond their capacity. They would also become fully independent from national politicians, which is more conducive to the proper function of local government. Technically, such solution would be relatively simple; however, it would require a complex social and political agreement and commitment.

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RESUMÉ

Porcování medvěda z pohledu procesu žádosti o poslanecké dotace a jejich rozvojového potenciálu: případová studie okresu Žďár nad Sázavou

Cílem článku je přispění ke studiu poslaneckých dotací (známé jako porcování medvěda) případovou studií, která je zaměřená na výzkum procesu žádosti z pohledu představitelů obcí a jejich lokálního rozvojového potenciálu z pohledu obyvatel obcí. Dosavadní studie se zabývaly především celostátní perspektivou na alokaci prostředků z poslaneckých dotací (doplněných o hledání podmiňujících faktorů či důsledků ve volebním chování obyvatel), tento článek tak představuje první pokus o studium poslaneckých dotací v lokální perspektivě. Pro tuto případovou studii byly vybrány obce okresu Žďár nad Sázavou do 1500 obyvatel, ve kterých byl pohled představitelů a obyvatel obcí zjišťován dotazníkovým šetřením v září 2013. Výsledky této studie jsou v odborné diskuzi významné nejen z hlediska studia poslaneckých dotací, ale také studia dalších (např. ministerských) dotací. Mohou však také přispět do celospolečenské diskuze o smyslu a problémech dotačního systému v Česku, jehož prostředky jsou rozdělovány pod vlivem celostátních politiků. Závěr článku pak nabízí možnosti, jak těmto problémům předejít.

REGIONAL PRODUCT LABELLING AS PART OF THE REGION FORMATION PROCESS. THE CASE OF CZECHIA

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ABSTRACT

Regional product labelling can be described as a part of 'alternative food networks' since both of them share the idea of 're-connecting' spatially and socially separated production and consumption. This article situates the issue of regional products in the broader context of region formation. It aims to the factors essential for the implementation of a labelling scheme in a given region in order to cast light on the relationship between regional labelling and the process of a region's institutionalisation. By analysing a set of 22 labelling schemes of the Association of Regional Brands we seek to find answers to the following questions: Which regions have been introducing regional labelling schemes and what do they have in common from the geographic point of view?; What is the place of a regional product label in the process of the region's institutionalisation? Data on individual regions obtained through an analysis of electronic and printed sources was confronted with specialised literature and thematic maps. We studied spatial characteristics as well as features determining a region's place in the process of institutionalisation. The most striking common features of regions, which are decisive factors in the implementation of a labelling scheme, include the rural character and a certain degree of problem occurrence the motivate regional stakeholders to overcome those difficulties, but do not impede further development. Another important factor is an attractive natural landscape. Labelling schemes become involved in the institutionalisation process both at its early and later stages, having part in building the identity of a region.

Keywords: regional products, labelling schemes, region formation, regional identity, region, regional development

1. Introduction

1.1 Regional product labelling schemes, regions and their formation

Regional products can be understood as products associated with a particular, relatively bordered territory – with the region of their origin – constituting a deliberate component of their quality (Winter 2003). Beside agricultural products or foodstuffs, consumer goods and services are concerned as well. Local product labelling schemes are designed to guarantee – usually by way of certification – a direct link between a particular product and a particular region, allowing the producer to use a label representing this relationship.

The issue of regional products has a markedly interdisciplinary character and its different aspects are studied by many scientific disciplines including geography. Regional products are most intensely studied by geography of consumption (Feagan 2007), namely in connection with commodity chains, and by rural geography (Winter 2003), which looks into the impacts of regional labels on the development of rural areas. Tourism geography, on the other hand, deals with regional products in relation to the development of tourism particularly in rural areas (Williams 2009). Geographical aspects of the use of labels and logos are studied by territorial marketing and branding (situated at the interface between geography and economy; see e.g. Anholt 2010), and by the emerging field of branding geography (Pike 2011).

In Western Europe and North America the interest in regional products began to grow in the early 1990s; this subject has thus been part of academic debates for three decades. In Czechia, however, it constitutes a relatively new phenomenon. That is why regional products and their labelling have so far received little attention from academic circles. The existing studies deal primarily with rural development (Lošťák, Kučerová 2007). In the field of geography, one of the rare undertakings is Spilková's and Fialová's research (2013) focusing on regional product labelling schemes in the context of rural tourism development. Little attention has also been paid to the significance of regional product labelling for the process of constructing the region labels are attached to. Hence, in this article we relate the subject of regional product labelling to the formation of regions and regional identity. By researching selected labelling schemes we try to find out whether regional product labelling constitutes an integral part of this process. The subsequent analysis of the regions' character aims at evaluating the potential of individual regions for the implementation of a regional product labelling scheme, from the perspective of both spatial characteristics and the process of region and regional identity formation, and at unveiling the relationship between labelling schemes and regional institutionalisation. The study thus attempts to answer the

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subsequent questions: Which regions have introduced regional labelling schemes and what do those regions have in common? What is the place of a regional product label in the process of the region's institutionalisation?

The treatise is divided into five sections. The first one deals with the conceptualisation of terms in the fields of regional product labelling schemes and region and regional identity formation. The following section presents the methods employed, including the choice of model labelling schemes integrated in the Association of Regional Brands (ARB) and provides a description of the latter. The third section presents the most interesting results of the analysis of the selected labelling schemes. It is divided into two parts: one analysing spatial aspects of the examined labelling schemes (and regions) and the other examining their relation to the institutionalization process. The two concluding sections discuss the results obtained and draw conclusions.

a) Regional product labelling schemes

Regional product labelling schemes can be seen as part of alternative food networks (AFN). Yet classifying labelling schemes (not only for regional products, but also for e.g. organic food) as an AFN is quite controversial. Some authors term labelling schemes as 'weak' alternatives that fail to fulfil the main idea of the AFN. In contrast to 'strong' alternatives, which permit direct consumer-producer relationships, the former ones have a tendency towards commercialisation – they can easily be used or even abused by grocery store chains (Watts et al. 2005; Goodman, Goodman 2007). However, labelling schemes and AFN share some basic attributes (Fonte 2010b). Primarily, it is the idea of 're-connecting' spatially and socially separated production and consumption while 're-localising' production, i.e. restoring the link between production and its location (Fonte 2010b; Watts et al. 2005; Renting et al. 2003). It is all about creating alternatives to conventional food supply chains which lead to alienation of production from a particular place.

Likewise, regional product labelling schemes represent a new approach to the traditional use of the link between product, i.e. product quality, and its place of origin. The place of origin played an important role in product labelling as far back as in the period of industrialisation (Tregear 2003). Despite divergent attitudes toward product origin in the era of dynamic growth of international trade, it has remained important till today. Even though globalisation was expected to wipe out the diversity of places it has rather amplified the existing differences among them (Lury 2011). Nowadays, place embodies one of the qualitative aspects of production. This is best represented by regional product labelling schemes. The region of origin and its uniqueness thus become the very essence of product quality and a guarantee thereof while being a source of competitive advantage (Renting et al. 2003; Ilbery et al. 2005; Wiskerke 2009).

b) Region and regional identity formation

The relation between regional product labelling and a given region is closely connected with the region's image and with regional identity in general. Image is a factor determining quality. Besides, the ways of using the image for the purpose of product branding are largely influenced by social construction of space. In order to 'ensure' product quality, any particular place must have a widely perceived positive value. By contrast, the fact that a region is presented by way of labelled products has an impact on its image in the eyes of both local and non-local inhabitants (Williams 2009; Lee et al. 2005). Building the quality of regional products is implicitly intertwined with regional identity.

Regional product labelling may therefore be understood as an integral part of the process of region and regional identity formation in terms of the theory of regional institutionalisation introduced by Anssi Paasi (Paasi 1986, 2003). Paasi understands regions as social constructs that penetrate into spatial and mental structures of each society through the process of institutionalisation comprising four notional stages. The first phase consists of spatial shaping of regions, i.e. accepting boundaries that are not necessarily tangible. The second stage is characterised by the process of symbolic shaping during which regions acquire other symbols apart from their name (e.g. specific products). In the third stage the region takes an institutional shape; newly established institutions help solidify the existence of the emerging region (starting from voluntary associations and ending with self-governments). The supreme phase of the institutionalisation process rests in the region's anchoring in spatial structures of the society (mostly by acquiring certain administrative or self-governing powers) and in its perception as a consolidated unit among its inhabitants as well as outside the region. The region forming process is accompanied by a simultaneous formation of regional identities, i.e. "collective narratives about who and what 'we' and 'our region' are and how these differ from others" (Messely et al. 2014, p. 319). Apart from people's sense of belonging to and identification with a particular region ('regional consciousness') regional identity is also constituted by the region's image in the minds of local inhabitants and residents of other regions alike ('image of region'). However, regional identity might not be understood as an implicitly positive concept, since it is frequently used particularly in the context of regional development (Semian, Chromý 2014; Süssner 2002). Besides several positive implications (i.e. acting as a driving force for regional growth), it may also inspire ultimately negative self-delimiting initiatives turned against other regions. Regional identity as a 'manipulable and power-laden concept' (Messely et al. 2014, p. 319) may even become a means for struggling for power both at the inter-regional and intra-regional level (Paasi 2003; Siwek 2011; Siwek, Bogdová 2007).

The region as a social construct is not stable over time; it can disappear just as easily as it appeared. The

Tab. 1 Types of Czech regions regarding the region's and its regional identity's formation.

Type of regions	Examples of ARB regions*
1. Regions with newly acquired autonomy but no traditional identity	Vysočina
2. Regions with strong regional identity but no autonomy	Haná, Podkrkonoší, Górolsko Swoboda, Beskydy
3. Regions with lost identities	
3a. Regions that experienced a change of their traditional character due to industrialization or agricultural intensification in the 19th century	Polabí
3b. Regions important for the formation of Czech national identity and losing their significance after the constitution of independent Czechoslovakia in 1918	Kraj blanických rytířů
3c. Regions that lost their identity carrier due to the displacement of German speaking inhabitants after World War II	Šumava, Krušnohoří, Českosaské Švýcarsko, Krkonoše, Broumovsko, Orlické hory, Jeseníky, Znojemsko, Moravské Kravařsko
4. Regions with new identities	
4a. Frontier regions with a new wave of colonisation after World War II	Šumava, Krušnohoří, Českosaské Švýcarsko, Krkonoše, Broumovsko, Orlické hory, Jeseníky, Znojemsko, Moravské Kravařsko
4b. Hinterlands of large cities with a massive inflow of new residents due to suburbanization after 1989	Zápraží
5. Regions searching for their new identity, often intentionally built for distinct purposes	Toulava, Polabí, Prácheňsko, Železné hory, Kraj blanických rytířů, Moravská brána, Moravský kras

Sources: Chromý, Janů 2003; Chromý et al. 2009; elaborated by the authors.
* For explanation see following sections.

institutionalisation process is a dynamic process (Paasi 1986, 2013; Raagmaa 2002; Zimmerbauer 2011) that mirrors not only social changes but also political interests and power practices (Kučera 2011). Empirical studies of Czech regions (Chromý 2003; Chromý, Janů 2003; Chromý, Kučerová, Kučera, 2009) have made it possible to identify several types of regions depending on the way of their formation and the formation of regional identity. The issue is not just about institutionalisation, but in some cases also about 'de-institutionalisation'.

Regions falling into the first-type group (1) acquired autonomy prior to forming their regional identity; some of their areas must first cope with much older identities. The second type (2) includes regions with traditionally present regional consciousness both within and beyond regional boundaries. However, they do not constitute autonomous units. Typical examples are ethnographic and cultural regions. The third category (3) encompasses regions whose regional identity is lost for one or more reasons (for the three subtypes see Table 1). The next group (4), which overlaps to some degree with the previous one, comprises regions where entirely 'new' identities have formed following substantial population changes caused by migration (for two subtypes of these see Table 1). The last group (5) consists of regions that are 'searching' for their identity. Key stakeholders are only striving to find common elements that could serve as a basis for the newly built regional identity. Frequently, new identities are built on reminders of older regions and their distinctiveness (see type 3). This group comprises a broad array of regions including regions intentionally built for economic, marketing or other purposes.

2. Research

2.1 Selection of case study labelling schemes

In Czechia about fifty labelling schemes have been identified operating at different scale levels: from supranational (the EU labelling scheme), national (the product's origin is specified at state level) and regional to micro-regional (Kašková 2013). The interrelations between regional product labelling and the formation of regions and their identities can be studied best at the micro-regional level. The main reason is that bottom-up initiatives take part in the implementation of regional labels exactly at this level. This is crucial for evaluating the role of such schemes in the institutionalisation process because they best reflect the importance of regional identity in the process of labelling implementation.

For the purpose of our analysis labelling schemes associated in the Association of Regional Brands (ARB) were selected out of more than 30 micro-regional initiatives operating in Czechia (Kašková 2013). The reason was that the ARB's uniform rules facilitated side-by-side comparison of those schemes in all examined regions. Moreover, they cover Czechia's entire territory in a relatively equal manner, giving us the possibility to compare how labels function in different geographical conditions (for the overview of ARB member regions see Figure 1).

2.2 The Association of Regional Brands

The regional labelling project was born in 2004 as an initiative of the Czech Office of the Regional Environmental Centre. Its original goal was to support the

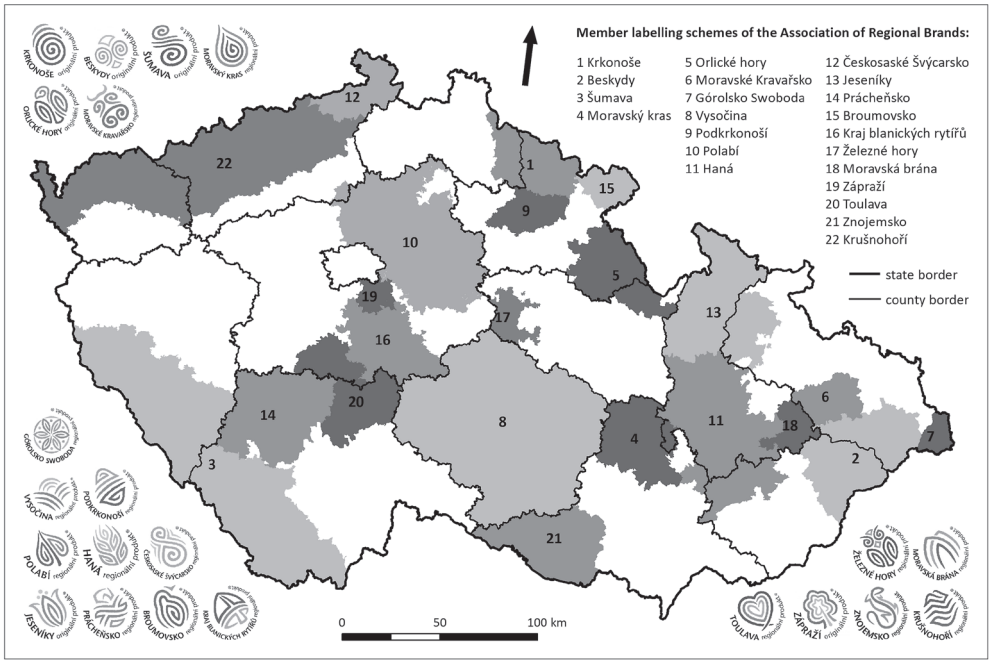

Fig. 1 Regional labelling schemes associated in the Association of Regional Brands (1. 7. 2013). Sources: ArcData Praha 2006; ARZ 2014.

development of the Natura 2000 system of protected areas (Kažmierski 2006). In order to help extend the offer of products and facilitate sales promotion of regional products in the tourism sector (Kažmierski 2006) the sphere of the labelling schemes' impact was delimited according to the existing touristic regions (defined by the Czech Tourism agency) that encompass broader surrounding environs of protected areas.

The 2005–2006 period saw the emergence of first three regional labels: 'Krkonoše Original Product', 'Šumava Original Product' and 'Made in Beskydy'. The launching of the next label, 'Moravský Kras Regional Product', was initiated by the Moravský Kras Local Action Group[1] (LAG), which asked to get involved in the project. In a similar manner, four more labels had gradually been launched owing to the initiative of various institutions. In 2008, the Association of Regional Brands was founded to group the existing eight regional labels. In the following years, the ARB had successively been joined by sixteen additional labels (ARZ 2014).

As the number of regions involved in the labelling project increased their character progressively began to differentiate; they were no longer identical with Natura 2000 areas. Certification has successively been extended from the original labelling of foodstuffs and hand-crafted items (Kažmierski 2006) to also embrace services and most recently even exhilarating experience (ARZ 2014). While the purpose of the initial projects was to draw attention to potential values of protected natural areas (Kažmierski 2006), their focus has gradually shifted more toward regions disadvantaged in one way or another (Čadilová 2011). The range of project goals and motivations has thereby substantially broadened. Nevertheless, making regional labels visible, i.e. conceiving regional labelling as part of regional marketing, continues to be the general purpose of the ARB (ARZ 2014).

Even though the ARB coordinates the whole labelling framework at the nationwide level, individual labelling schemes remain independent and are managed by regional establishments. ARB's particularity resides in the use of a uniform visual style (including a logo, a website and promotional materials) which resolves the problem of fragmentation of regional product labelling (Ilbery et al. 2005; Wiskerke 2009) while making it easier to convey positive customer experiences from one region to another (see logos in Figure 1).

2.3 Research methods

All the ARB's 22 member regions active by the beginning of July 2013 (further referred to as 'ARB regions') were examined through research and analysis of available materials obtained primarily from the ARB (online presentations of ARB and individual regions; printed publications). The selection of characteristics most suitable for the evaluation of ARB regions was based on the comparison with thematically relevant studies (e.g. Ilbery et al. 2005; Messely et al. 2009). The chosen characteristics can be divided into two groups; the first one is constituted by spatial conditions whereas the second one involves attributes relevant for the determination of a region's position in the process of institutionalisation.

The first group incorporates geographic position of regions in the sense of the traditional West-East gradient in socio-economic development and their position in

[1] Local Action Groups constitute a tool for EU's rural development policies based on cooperation at the micro-regional level (LEADER+ program); they assemble representatives of public administration, business sector and non-profit sector with the aim to implement own development strategies (Perlín, Kučerová, Kučera 2010).

the hierarchical system of settlements (e.g. Hampl 2005; Novák, Netrdová 2011; Hampl, Gardavský, Kühnl 1987), scale level, i.e. the size of regions, and their natural environment. The location of the regions was then examined in relation to population density, types of rural areas (Perlín, Kučerová, Kučera 2010; Chromý et al. 2011) and population stability (Chromý, Kučera 2009; Čermák 2009). The aforementioned data allowed us to deduce the degree and types of problems that ARB regions face.

The second group involves the typical elements defining a given region (e.g. natural conditions, dominant landscape types, cultural features). What was also taken into account was the labelling scheme's own presentation consisting of its name, logo and its verbal and pictorial representation (see e.g. Kučera 2012). Additionally, we studied the type of subjects that initiated the introduction of a labelling scheme, or those who are in charge of it at present. Internet presentations, various publications (Čadilová 2011; Kažmierski 2006) and press releases published by the ARB and its members provided us with information concerning the nature of individual subjects and their scope of activities at different scale levels. Based on the above-mentioned characteristics the examined regions were categorised according to the typology related to the institutionalisation process (Chromý, Kučerová, Kučera 2009; Chromý, Janů 2003; see Table 1).

The thereby obtained data were confronted with the second major source in the form of specialised literature relevant to the subject matter. In the majority of cases ARB regions do not precisely match with administrative units. Thus, the most suitable method was to compare the ARB's regional map with relevant thematic maps. In particular, we used maps contained in the Landscape Atlas of the Czech Republic (Hrnčiarová, Mackovčin, Zvara et al. 2009). The data were subsequently entered in a table of ARB regions. Its assessment made it possible to reveal common features among the given group of regions as well as their mutual relations. Finally, an interview with the ARB's chairwoman and national coordinator, Kateřina Čadilová (realised in July 2012), served us to interpret the results of our research.

3. Results

3.1 Association of Regional Brands: Spatial attributes

Although there are no significant differences among the examined ARB regions in terms of **geographic position** (see Figure 1), the remarkable differentiation of their **position in settlement and regional hierarchy**, i.e. their relations toward core areas, deserves attention. A vast majority of the regions are situated beyond regional capitals (of self-governing NUTS III regions) and encompass smaller cities. Three regions containing a regional capital are a case apart, just as the Zápraží region, which is located in the immediate hinterland of Prague, belonging to the Prague metropolitan area (Ouředníček 2009). Nearly all of the regions lie on the borders of self-governing NUTS III regions, some of them even extend beyond these borders. Thus, ARB regions cannot be considered as metropolitan areas (Hampl, Gardavský, Kühnl 1987). By comparing several studies addressing periphery delimitation in Czechia from multiple perspectives (see e.g. Musil, Müller 2008; Hampl 2005) we were able to identify a certain degree of peripherality in nearly all examined regions even though the degree varies significantly. Peripheral regions clearly identified by several researchers include Jeseníky, Znojemsko and Vysočina. By contrast, regions showing no signs of peripheral areas (e.g. Zápraží) are rather exceptional. Moreover, the regions studied are relatively strongly diversified in terms of their **area**. Most of them (approximately 2/3) have an area of no more than the size of an average district (i.e. approximately 1000 km^2). In the Czech context they rank among smaller territories corresponding with the micro-regional level. Only a few regions may reach the size of a NUTS III region.

Given the low **population density** of ARB regions (density values above the national average are rare and never apply to the entire region) we can classify them as predominantly **rural areas** (Chromý et al. 2011). This constitutes one of the primary attributes of ARB regions. However, we can discern three types of rural areas according to the typology of rural space in Czechia (Perlín, Kučerová, Kučera 2010). They are as follows: (1) predominantly economically weak rural areas with a low potential for development (e.g. Toulava, Vysočina); (2) recreational rural areas that include non-development areas mostly used as second-home locations (e.g. Jeseníky, Šumava) and touristic areas with a high development potential (e.g. Krkonoše, Beskydy); (3) rural zones with a good infrastructure and a good potential for development (e.g. Zápraží, Moravská brána).

An important characteristic that might affect the development potential as well as the process of regional identity formation in the considered regions is the temporal **continuity of settlement**. More than one-half of the examined regions were affected by the post-war displacement of German inhabitants (Chromý, Kučera 2012; Kučera, Kučerová 2012; Šerý, Šimáček 2012) and their recent population can be described as *alochthon*. Similarly, regions affected by suburbanisation processes, e.g. Zápraží and Polabí, are relatively unstable. By contrast, Vysočina, Górolsko Swoboda, Beskydy, Moravský kras and Toulava are numbered among continuously settled regions with *autochthon* population.

Departing from the above mentioned characteristics three groups of ARB regions can be discerned according to the **extent of problems** they encounter (see Figure 2). Relatively problem-free regions (showing problems merely in one of the assessed areas) are the most numerous. More than one problematic sphere (e.g. alochton population, economic weakness) were identified in roughly one-third of the examined regions. This

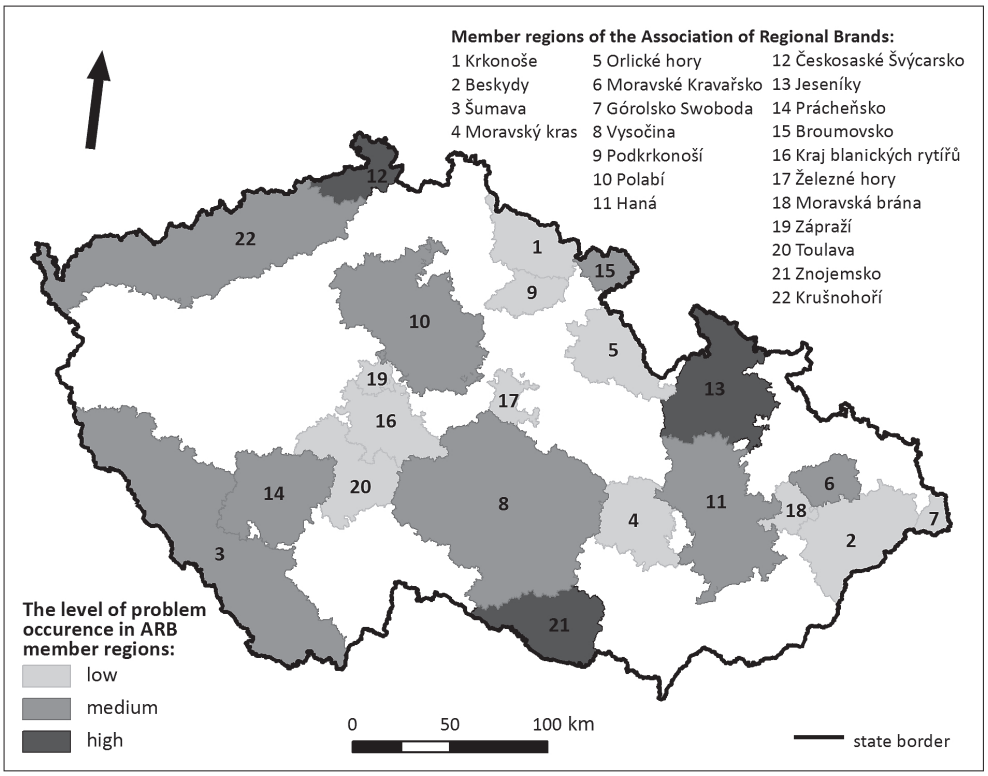

Fig. 2 Level of problems of member regions of the Association of Regional Brands in 2013.
Sources: ArcData Praha 2006; ARZ 2014.

second group is, however, quite heterogeneous. It encompassed the largest regions highly differentiated in terms of their problems which needn't necessarily concern the entire region (e.g. unemployment). The smallest group is composed of regions facing substantial problems in the majority of the monitored categories, yet there are only three of them (Českosaské Švýcarsko, Jeseníky, Znojemsko). Aside from their low potential for development and alochthon population, high levels of unemployment and economic weakness rank among the identified disadvantages of ARB regions.

A significant factor which also affects the formation of regional identity and image is the **natural character** of a region (Chromý, Kučerová, Kučera 2009; Chromý, Semian, Kučera 2014). Approximately one half of ARB regions are situated in mountainous areas (given the country's relief this comports largely with border areas) and even the reminder of the regions offer particularly attractive natural features. Nearly all regions cover one of the protected natural areas or at least a part of it (Kučera, Kučerová-Kuldová, Chromý 2008). Thus, attractive natural and landscape conditions can be viewed as another common feature of ARB regions.

3.2 Association of Regional Brands: Region a regional identity formation

Partly based on the above mentioned assessment of the regions we attempt to analyse the process of constructing these regions and their regional identities. Firstly, we attempt to isolate the crucial element defining a given region and expressing its uniqueness, i.e. the region's identity (Paasi 2003). As an easily graspable property such an element might form the basis for individual identification with a particular territory (Chromý 2009). In this sense, we were particularly observing natural features, landscapes and cultural-historical background (Chromý, Kučerová, Kučera 2009; Fitjar 2010; Paasi 2003). However, these elements cannot be simply drawn from the 'given characteristics' of the regions. They are much more dependent on the selection and way of using these characteristics by distinct actors. Thus, in order to get closer to real fundamentals of regional identity, these externally obtained types of definitions were confronted with an analysis of the regions' own presentation and the results of Spilková's and Fialová's research (2013) conducted among certified manufacturers.

The largest and most clearly identifiable group of ARB regions is defined on the basis of **significant natural units** (9 regions). These regions usually cover mountain complexes whose names they bear (e.g. Krkonoše, Železné hory). This proportion becomes yet more remarkable when the regions' own presentation is taken into consideration. Only three regions do not mention any specific landscape or nature in their presentation (ARZ 2014). A similar tendency, albeit less distinctive, was affirmed by the survey among certified producers (Spilková, Fialová 2013). Nearly 75% of them consider valuable natural and landscape features to be the main attributes of their region. The group of **regions with distinctive cultural character** (5 regions) is not as homogenous as the first one. The 'cultural element' (e.g. popular customs or a

specific dialect) is seldom the only one typical feature of the given region. **Prevailing agricultural character** (including agricultural landscape) is decisive for a single region (Polabí) and constitutes an important element in the case of two others. Delimiting regions on the basis of their **administrative borders** is equally exceptional; this group includes merely two regions, Vysočina – a self-governing region (NUTS III), and Znojemsko – a district area.

By far the most interesting, and the most heterogeneous group, comprises four regions sharing one important feature – all of them are **newly delimited**. Whereas the previous groups point to regions that might have already acquired their territorial and symbolic shape, this last batch of regions seems to be at the very beginning of their individual institutionalisation processes. However, merely one of them, Toulava, lacks any other characteristic feature; this region has been delimited as a new touristic destination simultaneously with the introduction of its regional labelling scheme. The Zápraží region, which seems to follow a similar path, nonetheless builds upon its former activities (e.g. publishing a magazine of the same name). The region called Kraj blanických rytířů, too, carries on its former activities, using the name by which it has been known as a touristic destination. More important, though, is that it takes inspiration from the historical region 'Podblanicko' (Jeřábek, Vařeka, Woitsch 2009). The last region, Prácheňsko, on the contrary, bears the very name of the historical county (Burda, Jeleček 2009) even though it covers a much smaller area today.

An analysis of the key **stakeholders in the field of labelling schemes** allows us to look into another stage of the institutionalisation process: the formation of institutions. Within the group of stakeholders engaged in the creation of regional labelling schemes our research concentrates on those subjects that initiated the introduction of individual schemes, and on entities that presently coordinate it; both of them are crucial for the functioning of regional labelling systems (Frisvoll, Rye 2009). All of these entities are non-governmental and non-profit organisations. They can be divided into four clearly discernible groups. The largest group (1) consists of LAGs; the next group (2) includes subjects similar to regional development agencies. The third group (3) is composed of subjects focused on the implementation of environmental projects. The last and at the same time the least homogenous group (4) embraces civic associations either set up to manage a particular labelling scheme, or originally designed for another purpose.

A closer look on the structure of institutions shows that in terms of **scale level** new labels do not always have their origins at the micro-regional level. The initial impulse for the introduction of the regional labelling project came from the Regional Environmental Centre with a nationwide scope of activity, i.e. from above, even though their founders strived to engage as many local stakeholders as possible (Kažmierski 2006). This implies that the institutional shape of these regions might have been rather weak at the time of introducing the label. In many cases the labelling scheme was launched as one of the first projects of a LAG. This refers to the use of labelling schemes as a way of solidifying not only the territorial and symbolic shape of the LAG's region, but also its own position.

Departing from the above-presented analysis we can finally ascribe ARB members to the **types of regions in relation to region and regional identity formation** (Chromý, Janů 2003; Chromý, Kučerová, Kučera 2009; for the types and list of regions see Table 1), which helps us identify the links between labelling systems and the process of institutionalisation. Most ARB regions (9) rank among regions where the sense of regional identity got lost in the aftermath of post-war displacement of their German population (type 3c). The alochthon character of the population affects the activity of local inhabitants and regional stakeholders (Pileček, Jančák 2010). With the arrival of new inhabitants, however, the regions acquired a new identity, mostly linked to their natural characteristics and dominant landscapes (Šifta, Chromý 2014). This region type matches considerably with the naturally attractive mountainous areas. Respondents participating in Siwek's and Bogdová's survey (2007) even classified some of the mountain areas (e.g. Krkonošsko, Šumava, Krušnohoří) as ethnographic regions, i.e. regions with a distinctive identity. In this perspective, the above-mentioned regions fall into the category of regions re-settled after World War II which have developed a new sense of identity (type 4a).

The second largest group comprises seven 'new' regions many of which have been purpose-built (most often they coincide with areas where LAGs are active) and which continue their quest for identity (type 5). This group largely overlaps with the above mentioned 'newly delimited regions'. Such regions frequently try to build upon former territorial units, either completely extinct or almost forgotten; three such regions can be discerned within the set of ARB member regions: 'Prácheňsko' (which builds on a historical region), 'Kraj blanických rytířů' (revitalising the former Podblanicko region), and 'Polabí' (developing ancient farming traditions of the region). In terms of spatial aspects, the second group ranks among relatively small inland regions which had not suffer any population displacement.

A much smaller group includes four regions that have not yet attained the final phase of the institutionalisation process even though their conception in the minds of their inhabitants is relatively consolidated (type 2). The most explicit example is the region 'Haná', which figures among ethnographical regions most frequently evoked by respondents (Siwek, Bogdová 2007) and is depicted on the map of ethnographical regions (Jeřábek, Vařeka, Woitsch 2009).

The remaining two regions are specific, each of them belonging to a different category. Vysočina is an

administratively delimited region with a certain level of autonomy which entered the fourth stage of the institutionalisation process prior to accomplishing the earlier stages and building its regional identity (type 1). Zápraží is a suburban region with a high inflow of new residents that creates its new identity (type 4b).

4. Discussion

Which regions have been introducing regional labelling schemes and what do they have in common? The analysis of the 22 labelling schemes grouped in the ARB revealed just a few common characteristics that could be described as typical for all of the examined regions. From the geographical perspective, rural character has been identified as a common feature. Thus, together with a naturally attractive character of the regions it can be concerned as an important factor determining the regions' engagement in regional labelling. Another common feature is a certain level of problem occurrence, even though most of the examined regions are not highly problematic. The difficulties we could identify do not represent an insurmountable obstacle to development. Getting involved in regional labelling schemes can thus be understood as an effort to overcome many of the problems.

While striving to define common characteristics of the regions in order to answer our first research question, our analysis revealed that the group of ARB labelling schemes can be better described as 'splitting into two halves'. These two smaller, relatively clearly defined groups of regions exhibit common features in more aspects. Simultaneously, this division helps us to answer our last research question: What is the place of a regional product label in the process of the region's institutionalisation?

The first of these two groups encompasses mountainous borderlands of high natural value and attractive landscapes (Kučera, Kučerová 2012). These regions developed new identities after the arrival of new inhabitants into depopulated areas; their identities are thus based on natural characteristics. Together with several culturally delimited regions (11 in total) they constitute a **group of regions with relatively distinct identities** (see Figure 3). Considering the institutionalization process, these regions already exhibit a relatively clear territorial, symbolic, and in some cases even institutional shape. Hence, the labelling scheme is employed to stabilize these shapes and to invigorate the region's identity and its acknowledging. However, there are still substantial differences among the regions in this group.

The mountainous region **Šumava** situated along the border with Austria (see Figure 1) has got a vital regional identity based on its natural beauty and a landscape rich in 'dense woods and meadows interwoven with gills' (ARZ 2014). It is known as a serene touristic destination and acknowledged by the Czech population as a clearly defined region (Siwek, Bogdová 2007). However, its traditions and cultural identity was partly lost due to the displacement of its German inhabitants after World War II. The introduction of a labelling scheme is aimed at restoring these lost, particularly handcraft traditions, and at supporting regional consciousness of local inhabitants that seems to be weaker than 'outward' acknowledgement. Similarly, this new institution buttresses the institutional power of the region that is divided into two administrative regions. **Podkrkonoší** is an example of a 'culturally defined region'. However, its identity based predominantly on specific architecture, traditions and agricultural production seems to be acknowledged, in contrary to Šumava, more by its own inhabitants than people outside the region. Thus, the initiators of the labelling scheme attempt at 'strengthening the region's image' (ARZ 2010, p. 1). In order to enhance the outlines of the region's symbolic shape they focus on the tradition of fruit-growing (which matches with the original function of the labelling scheme; ARZ 2014). Simultaneously, the labelling scheme is seen as a tool to preserve regional traditions, traditional production and handcrafts by encouraging local producers.

The second group is formed by smaller regions located in inland Czechia. Most of them lie in stagnating rural areas and their population can be described as autochthon. LAGs are the predominant key stakeholders in these regions which continue to develop their identity, often building on the image of older regions while striving to deepen regional consciousness among resident and non-resident populations. Together with the remaining regions (11 in total) they represent areas **with a lower rate of regional identity** (see Figure 3). From the institutionalisation point of view these regions are rather at the beginning of their institutionalisation process. Frequently, labelling rules are used as a tool for delimitating a clearly bordered region; through the label itself as well as the certified 'typical' products symbols are established or reproduced; the role of the labelling scheme coordinator is to induce the establishment of a new institution or to secure the position of a recently launched one. These newly formed regions, i.e. the key actors pushing the institutionalization process of these regions, though, very often have to deal with older identities. According to the chosen strategy, labelling schemes serve as tools either for reviving these identities (see Prácheňsko, Kraj blanických rytířů and Polabí mentioned above), or for their suppression.

The region **Toulava** represents a case of an entirely new region which is at the very beginning of its institutionalisation process. Toulava is situated in a peripheral area on the border between two regions. The original idea of establishing a new region might have helped the area get acknowledged by the new law concerning touristic destinations and, among other things, receive appreciable subsidies (ARZ 2014). Since the labelling scheme for this particular region is being created simultaneously, it takes part in all of the institutionalisation stages. It helps

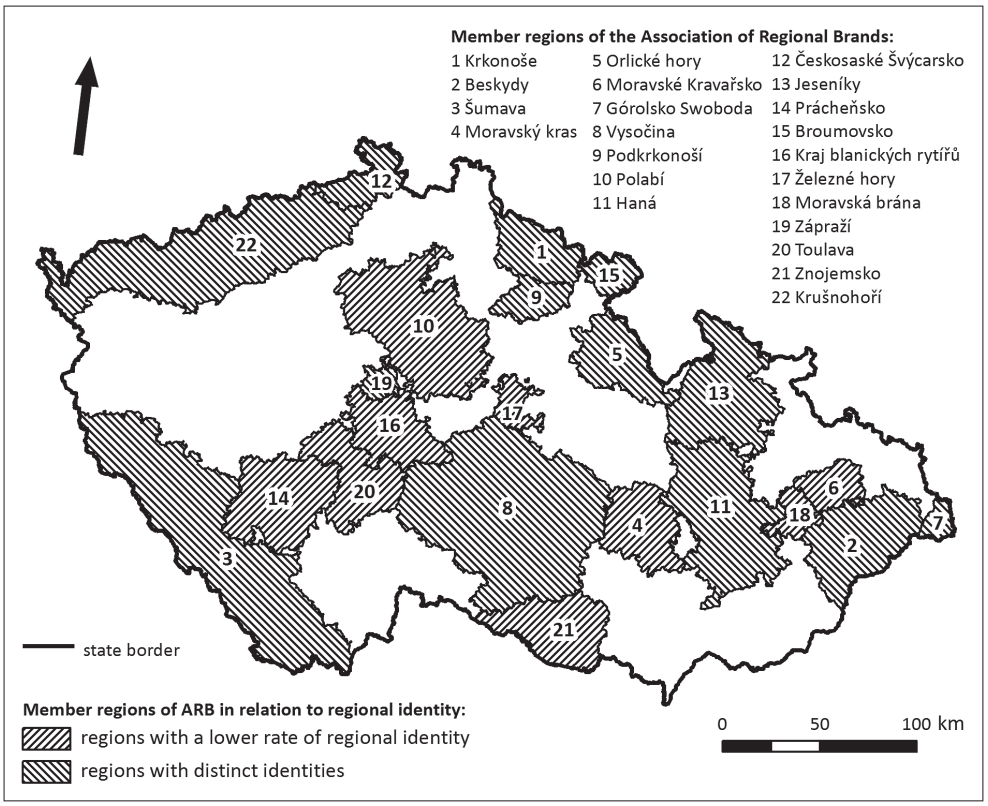

Fig. 3 Member regions of the Association of Regional Brands in relation to regional identity.
Sources: ArcData Praha 2006; ARZ 2014.

outline the region (the area where products are certified), reproduces the chosen symbol of the region (a 'heart' in Toulava's case) and consolidates the position of the leading institution (LAG) which initiated the region's creation. To avoid the problem of older identities still present in the territory the initiators opted to suppress them. An example of this is the very name of the region (and of the related labelling scheme) that arose from a public competition and has no connotations regarding older names established in the area.

The interconnection between regional product labelling and the institutionalisation process is clearly evident in the case of all of the examined regions. Regional product labelling schemes are engaged in the initial phases of institutionalisation. They play a part in the definition of the regions' spatial form, in the acquisition of their symbolic shape and its reproduction, as well as in establishing and consolidating regional institutions. Additionally, labelling schemes are active in enhancing the embeddedness of a particular region in the minds of people living both within and outside the region and participate in the supreme stage of the institutionalisation process. It is obvious that labelling schemes can also be launched in regions that either lack regional identity or have difficulty finding it. In these cases, the 'institutionalising' role of labelling schemes is particularly visible. However, their importance ought not to be overestimated. Labelling schemes are just one of a whole array of sociospatial processes contributing to the construction of regions, serving as tools that miscellaneous actors use to construct regions.

5. Concluding remarks

Our research affirmed a close relationship between regional product labelling and the formation of regions, and hence the formation of their identities. At the micro-regional level, labelling schemes take a direct part in forming a new region, being involved in all phases of its institutionalisation including the development of regional consciousness and image. As such regional product labels can become suitable tools for supporting the emerging relation of local inhabitants to their own region on the one hand, and for creating a positive image externally on the other hand. This can further contribute toward regional development, even though the importance of regional product labelling schemes should not be overemphasised in this sense. Moreover, it is necessary to take into account the negative effects of excessively emphasised regional identity.

This article embodies an 'outward' perspective on regions, assessing ARB member regions on the basis of data mostly acquired through an extensive research. In any research to follow it is therefore necessary to enhance the analysis of regions with a perspective 'from the inside', namely by examining the standpoints of key stakeholders directly involved in both implementation and operation of labelling schemes in individual regions (particularly with regard to their motivations and exercise of power), as well as the perspectives of engaged producers and targeted consumers. Their experience could help us cast more light on the background and the interdependencies revealed by the above-presented research of

micro-regional labelling schemes. Broadly speaking, it could also deepen general knowledge of regions, the process of their forming, the role of power in this process, and the meanings that different stakeholders in the field of regional formation attribute to their own region.

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RESUMÉ

Značení regionálních produktů jako součást procesu formování regionu. Příklad Česka

V Česku se v posledních letech objevila řada systémů značení regionálních produktů, které garantují místní/regionální původ produktu a zároveň jeho kvalitu. Značení regionálních produktů lze chápat jako součást tzv. alternativních potravinových sítí, s nimiž sdílí ideu „znovu-propojení" prostorově i sociálně oddělené výroby a spotřeby. Zároveň je lze vnímat jako nové pojetí využití spojení mezi produktem, resp. kvalitou produktu a místem jeho původu. Článek zasazuje téma značení regionálních produktů do širšího kontextu formování regionu a regionální identity. Opírá se přitom o koncept institucionalizace regionu Anssi Paasiho. Cílem článku je odhalit faktory podstatné pro zavedení systému značení v daném regionu a osvětlit vztah mezi značením regionálních produktů a institucionalizací regionu. A to prostřednictvím analýzy 22 systémů značení, resp. regionů sdružených v Asociaci regionálních značek (ARZ). Hledá odpověď na otázku, které regiony zavádějí systémy značení,

co mají tyto regiony společného z geografického hlediska a jaká je jejich pozice v procesu institucionalizace. Údaje o regionech jsou získány analýzou elektronických zdrojů i tištěných publikací ARZ a následně konfrontovány s odbornou literaturou a tematickými mapami. U každého regionu jsou sledovány prostorové charakteristiky a charakteristiky určující pozici v procesu institucionalizace.

Z výzkumu 22 systémů značení je zřejmé, že mají jen několik základních společných rysů. Z geografického hlediska je společným znakem, a tedy zároveň faktorem zapojení regionů do systémů značení, jejich venkovský charakter. Typická je určitá problémovost; nejde však o silně problémové regiony a identifikované potíže nepředstavují nepřekonatelnou bariéru pro rozvoj. S jistou mírou opatrnosti lze konstatovat, že ve sledovaných regionech existují vnitřní zdroje rozvoje, tj. aktéři schopní participovat v sítích. Typické prvky, jimiž se regiony vymezují a které představují podstatu jejich identity, jsou nejčastěji přírodní prvky a krajina.

Soubor zkoumaných regionů lze rozdělit na dvě skupiny, které vykazují mnohem více společných znaků. První z nich je skupina pohraničních horských regionů. Patří sem přírodně hodnotné oblasti, ležící při státní hranici, s identitou získanou po příchodu nových obyvatel do vysídlených oblastí a založenou na přírodních znacích regionu; sem lze zařadit například Šumavu. Spolu s několika kulturně vymezenými regiony, např. Podkrkonoší, tvoří skupinu 11 regionů s poměrně zřetelnou identitou, které se nacházejí v pokročilé fázi procesu utváření regionu. Druhá skupina se skládá z menších regionů, ležících ve vnitrozemí Česka, stabilních z hlediska vývoje osídlení a spadajících do nerozvojových venkovských oblastí. Klíčovými aktéry jsou zde místní akční skupiny. Zčásti se snaží navazovat na starší regiony, ale v zásadě teprve hledají svou identitu a usilují o zakotvení regionu ve vědomí obyvatel; typickým příkladem je region Toulava. Spolu se zbývajícími regiony (celkem 11) se jedná o oblasti, které stojí teprve na počátku procesu institucionalizace.

Propojení s procesem formování regionu a regionální identity je tedy zřejmé u všech zkoumaných systémů značení, jde však o různé fáze tohoto procesu. Systémy se zapojují do počátečních fází institucionalizace, kdy pomáhají formovat prostorový a symbolický tvar regionu (např. vymezením území působnosti značky a výběrem jména a znaku pro region). Zároveň ale mohou přispívat i k upevňování pozice regionálních institucí (zavedení značení posiluje význam instituce) a zejména zakotvení regionu ve vědomí obyvatel ve vrcholné fázi institucionalizace. To odpovídá nastíněnému rozdělení souboru regionů na dvě skupiny. Výzkum potvrdil úzký vztah mezi značením regionálních produktů a formováním regionu, tedy i regionální identity. Systémy značení na mikroregionální úrovni jsou často přímo součástí utváření nového regionu. Mohou se tak stát i vhodným nástrojem jednak pro podporu formování vztahu obyvatel k vlastnímu regionu a jednak pro utváření pozitivního image regionu navenek. To může dále přispět k rozvoji regionu, ačkoli význam značení regionálních produktů v tomto smyslu nelze přeceňovat a je třeba zohlednit též negativní efekty přílišného důrazu na regionální identitu.

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REVIEW ARTICLE: METHODS OF FRACTAL GEOMETRY USED IN THE STUDY OF COMPLEX GEOMORPHIC NETWORKS

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ABSTRACT

Fractal geometry methods allow one to quantitatively describe self-similar or self-affined landscape shapes and facilitate the complex/holistic study of natural objects in various scales. They also allow one to compare the values of analyses from different scales (Mandelbrot 1967; Burrough 1981). With respect to the hierarchical scale (Bendix 1994) and fractal self-similarity (Mandelbrot 1982; Stuwe 2007) of the fractal landscape shapes, suitable morphometric characteristics have to be used, and a suitable scale has to be selected, in order to evaluate them in a representative and objective manner.

This review article defines and compares: 1) the basic terms in fractal geometry, i.e. fractal dimension, self-similar, self-affined and random fractals, hierarchical scale, fractal self-similarity and the physical limits of a system; 2) selected methods of determining the fractal dimension of complex geomorphic networks. From the fractal landscape shapes forming complex networks, emphasis is placed on drainage patterns and valley networks.

If the drainage patterns or valley networks are self-similar fractals at various scales, it is possible to determine the fractal dimension by using the method "fractal dimension of drainage patterns and valley networks according to Turcotte (1997)". Conversely, if the river and valley networks are self-affined fractals, it is appropriate to determine fractal dimension by methods that use regular grids. When applying a regular grid method to determine the fractal dimension on valley schematic networks according to Howard (1967), it was found that the "fractal dimension of drainage patterns and valley networks according to Mandelbrot (1982)", the "box-counting dimension according to Turcotte (2007a)" and the "capacity dimension according to Tichý (2012)" methods show values in the open interval (1, 2). In contrast, the value of the "box-counting dimensions according to Rodríguez-Iturbe & Rinaldo (2001) / Kolmogorov dimensions according to Zelinka & Včelař & Čandík (2006)" was greater than 2. Therefore, to achieve values in the open interval (1, 2) more steps are needed to be taken than in the case of other fractal dimensions.

Keywords: fractal, drainage patterns, valley network, fractal dimension

1. Introduction

1.1 Introduction and objectives

Fractal aspects of complex nonlinear dynamic systems are ubiquitous in the landscape and in its studied phenomena (Table 1). Many natural features of the landscape have the appearance of a fractal; an example may be drainage patterns and valley networks or coast lines. Methods of fractal geometry have a mathematical basis which can be successfully applied in geomorphology. The behavior of complex natural phenomena, such as drainage systems, is at the forefront of research (Mandelbrot 1982; Voss 1988; Turcotte 1997, 2007a, 2007b; Bartolo & Gabriele & Gaudio 2000; Rodríguez-Iturbe & Rinaldo 2001; Saa et al. 2007; Stuwe 2007; Khanbabaei & Karam & Rostamizad 2013). Fractal dimensions and other fractal parameters in geomorphology are mainly used to quantitatively describe the topography of landscape fractal shapes and to build models of their development (Xu et al. 1993; Baas 2002).

In geomorphology, methods of fractal geometry were first applied in the study of the lengths of coastlines and the shape of drainage patterns and faults (Mandelbrot 1967; Robert 1988; Nikora 1991). Currently, fractal parameters have been used in geomorphology (Table 1): 1) while studying the spatial distribution of objects with different sizes (from microscopic to macroscopic objects); 2) while describing objects of intricate shapes (e.g. coral reefs, valley networks, mountains, caves, sand dunes); and 3) while studying processes and their areal distribution (e.g. erosion, chemical and mechanical weathering). Fractal geometry thus provides a way to quantitatively describe self-similar or self-affined landscape shapes, enables new approaches to measurements and analyses, and allows the holistic study of natural objects in various scales and a comparison of analysis values of different scales (Mandelbrot 1967; Burrough 1981).

When characterizing the fractal shape of complex geomorphic networks it is necessary to know and understand the basic concepts of fractal geometry, such as the fractal dimension, hierarchical scale, fractal self-similarity or physical boundary of the system. This work is based on a review of international and national literature in order to: 1) define and evaluate basic terms of fractal geometry which are applicable to the fractal shapes of complex geomorphic networks; and 2) define and evaluate certain methods of determining the fractal dimension of

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Tab. 1 Use of methods of fractal geometry in natural science (according to De Cola and Lam 2002a, 2002c).

Use of methods of fractal geometry in natural science			
Discipline	**Object of study**	**Discipline**	**Object of study**
Astronomy	Shape of Moon impacts; shape of galaxies	Botany	Shape of tree branches and roots
Geology	Thickness of layers of sedimentary rocks	Anatomy	Shape of vascular and nervous system, description of air sacks
Meteorology	Shapes of clouds, transfer of air temperature and water vapor	Ecology	Extension and concentration of pollution
Hydrology	Shape of drainage patterns, water surface	Landscape Ecology	Description of land cover
Geomorphology	Land surface, the extent of surface erosion	Cartography	Shape of coast and shoreline of lakes, map generalization

complex geomorphic networks. From the complex networks emphasis is placed in this research on drainage patterns and valley networks.

1.2 Definition of a fractal

The term fractal was first used by B. B. Mandelbrot (1967), who defined it as a set, whose fractal dimension is greater than its topological dimension (Table 2). The difference between the fractal and the topological dimension thus indicates the level of segmentation of a given object. The more the fractal dimension differs from the topological dimension, the more segmented an object is (Mandelbrot 1967). For example the shapes of drainage patterns or valley networks are made up of lines (topological dimension = 1), which are put on a plane (topological dimension = 2). The fractal dimension of the drainage patterns therefore describes to what extent the lines fill in the space on the plane and reach the values in the open interval (1; 2). The more the drainage pattern fills in the drainage basin, the more its fractal dimension approaches the value of 2 (Turcotte 1997).

Tab. 2 Definitions of terms of fractal geometry.

Author	Definition
Dimension	
Tichý (2012)	A dimension is a fundamental characteristic of geometrical shapes, which when scaling remains unchanged. A dimension can be generally expressed as: $N = k^D$ where k is the reduction ratio, N is the minimum number of reduced shapes that can cover the original shape, and D is the dimension. In other words: A) if a line is reduced k-times, then to cover the original segment $N = k^2$ new (reduced) lines are needed; B) if a rectangle is reduced k-times, then to cover the original rectangle $N = k^2$ new (reduced) rectangles are needed; C) if a cuboid is reduced k-times, then to cover the original cuboid $N = k^3$ new (reduced) cuboids are needed.
Initiator	
Horák & Krlín & Raidl (2007)	An initiator is the part of the shape, which is, under the construction of a fractal, replaced by a generator.
Generator	
Horák & Krlín & Raidl (2007)	A generator is the shape that under the construction of fractal, replace initiator, i.e. which forms the overall shape of the fractal object.
Topological dimension, also called the Lebesgue covering dimension	
Čech (1959); John (1978)	The topological dimension of n-dimensional Euclidean space is N. It is an integer dimension, which describes geometric objects. The topological dimension of a point = 0, the topological dimension of a line or curve = 1, the topological dimension of an area = 2. The topological dimension determines the minimum number of parameters needed to accurately determine the position of an object in the given space.
Fractal dimension, also called the Hausdorff–Besicovitch dimension	
Hausdorff (1919 in Mandelbrot 2003); Baas (2002); Tichý (2012)	A fractal dimension indicates the segmentation level of an object using a non-integer dimension. The shape of a valley network is formed by lines embedded in the plane, and the fractal dimension describes to what extent the space on the plane of the line is filled, thus reaching values in the open interval (1, 2).
Affine transformation	
Rodríguez-Iturbe & Rinaldo (2001); Turcotte (2007a)	Affine transformations include scale changing, i.e. resizing, rotation and displacement of the field, in which the fractal shape is captured.
Hausdorff measure	
Turcotte (2007a)	A Hausdorff measure is any number in the open interval $(0, \infty)$ for each set of R^n, which has the role of a generator, i.e. forms an overall shape of a fractal object.

1.3 Definition of landscape shapes forming complex geomorphic networks

Landscape shapes, which are characterized by fractal geometry methods, include shapes forming complex geomorphic networks on the landscape, e.g. drainage patterns (Horton 1945), valley networks (Babar 2005), patterned ground polygons (Washburn 1979), or morphotectonic networks of lineaments (Kim et al. 2004). As watercourses join into drainage patterns, so the system of mutually interconnected valleys forms the valley networks, i.e. the system of linear depressions, each of which extends in the direction of its own thalweg (Davis 1913; Goudie 2004). The basic units of the drainage patterns are therefore watercourses, and the basic units of valley networks are thalwegs. The shapes and density of drainage patterns and valley networks are the result of the geomorphological development of the whole area and reflect the influence of the lithological-tectonic base (structure) and erosion on the formation of the landscape (Stoddart 1997).

Six basic shapes of valley networks have been distinguished (Howard 1967; Fairbridge 1968; Demek 1987; Babar 2005; Huggett 2007): 1) dendritic networks (they are often formed in areas with a low vertical division without the influence of structures); 2) parallel networks (they are often formed in areas with a considerable inclination of slopes or by the aggradation of large rivers; 3) trellis networks and 4) rectangular networks (they occur in areas with a dominant influence of continuous – folds and discontinuous – faults tectonic deformations); 5) radial networks (formed, for example, on volcanic cones); 6) annular networks (formed by destruction of vaults of sedimentary rocks).

1.4 Morphometric characteristics of complex geomorphic networks

Complex geomorphic networks can be presentable and objectively evaluated by morphometric characteristics. These characteristics describe hierarchical relations of units within the network and allow for a correlation between the sizes of several networks (Table 3) (Horton 1945; Babar 2005; Huggett 2007). For example, morphometric characteristics are commonly used in:

1) hydrology to describe drainage patterns (Horton 1945; Strahler 1957);

Tab. 3 Morphometric characteristics of valley networks according to Horton (1945), Turcotte (1997) and Mangold (2005).

Morphometric characteristics of valley networks		
Name	**Calculation**	**Definition**
Number of order X valleys n_X		It has been determined as the number of all order X valleys in the valley network.
Valley network density *D*	$D = L / P$	It has been determined as the ratio of the total lengths of thalwegs *L* to the valley network area *P*.
Frequency *F*	$F = N / P$	It has been determined as the ratio of the number of valleys *n* to the study area *P*.
Bifurcation ratio of valleys *Rb*	$Rb = n_X / n_{X+1}$	It indicates the rate of valley network branching. Where n_X is the "number of valleys of the given order" according to the Gravelius ordering system (Gravelius 1914) and n_{X+1} is the "number of valleys of one order higher" in the given valley network.
Total length of order X valleys t_X		It has been defined as the sum of lengths of all order X valleys in the valley network.
Total length-order ratio of valleys *T*	$T = t_{X+1} / t_X$	Where t_X is the "total lengths of valleys of the given order" according to the Gravelius ordering system (Gravelius 1914) and t_{X+1} is "the total length of valleys of one order higher" in the given valley network.
Average length of order X valleys l_X	$L_X = t_X / n_X$	Where t_X is the "total length of valleys of the given order" according to the Gravelius ordering system (Gravelius 1914) and n_X is the "number of valleys of the given order" in the given valley network.
average length-order ratio of valleys *Rr*	$Rr = l_X / l_{X+1}$	Where l_X is the "average lengths of valleys of the given order" according to the Gravelius order system (Gravelius 1914) and l_{X+1} is the "average valley length of one degree higher order" in the same network.
Fractal dimension of valleys *F*	$Fd = ln(Rb) / ln(Rr)$	Where *Rb* is the "bifurcation ratio of valleys" and *Rr* is the "average length-order ratio of valleys".
Valley junction angle		It express the angles at which the subsidiary (order X + 1) valleys run into the main (order X) valleys projected on a horizontal plane.
Frequency of valley junction angle *H*	$H = U / P$	It has been determined as the ratio of the number of valley junction angle *U* to the valley network area *P*.
Homogeneity of order X valleys		It has been defined by comparing the lengths of the longest and the shortest valleys of the given order. This characteristic is based on the analogy of homogeneity of the polygon lengths of the patterned ground. The valleys of a given order are homogeneous if the length of the longest order valley does not exceed three times the lengths of the shortest valley of the same order. If the valley network is not "homogeneous", it is designated as being "variable".

2) geomorphology to describe valley networks (Table 3; Turcotte 1997; Babar 2005), morphotectonic networks of lineaments (Ekneligod & Henkel 2006), or to describe patterned ground (Washburn 1979);
3) botany to describe leaf venation (Zalensky 1904);
4) transport geography to describe transport communications (Kansky 1963).

The most commonly used morphometric characteristics (Table 3) are based on the number of valleys, which are of course affected by hierarchical ordering – network order. In order to describe drainage patterns and valley networks, absolute and relative models of determining the network order system have been used. The absolute model, also called the Gravelius ordering system of drainage patterns (Gravelius 1914), describes the network away from the river mouth to the river springs (Figure 2A). The network is formed by the main/primary (order X) watercourse, into which the subsidiary/secondary (order X+1) watercourses flow, and into these watercourses later flow the tertiary (order X+2) watercourses, etc. (Gravelius 1914). After the watercourse division (order X), a watercourse of a higher order (X+1) begins from two watercourses above the river mouth, which has: A) a shorter length; B) a lower rate of flow; C) a greater angle towards the watercourse in front of the river point. By contrast, a watercourse of the same order (X) remains a watercourse which has: A) a greater length; B) a greater rate of flow; C) a smaller angle towards the watercourse in front of the river point (Gravelius 1914).

Relative models of network ordering systems describe the network away from the river springs to the estuary. 1st order watercourses are parts of the watercourse from the river springs to the first node, i.e. the confluence of watercourses in the network. The most commonly used relative network order systems are:

1) Horton ordering system of drainage patterns (Horton 1945), where by joining two watercourses of the same order X the watercourse below the node obtains the order X+1 (in the direction from the river springs to the estuary), and at the same time the watercourse above of the node (in the direction from the river springs to the estuary) changes from order X to order X+1 which has: A) a greater length; or B) a smaller angle against the watercourse in front of the node (Figure 2B);
2) Strahler ordering system of drainage patterns (Strahler 1957), where by joining two watercourses of the same order X the watercourse below the node (in the direction from the river springs to the estuary) obtains the order X+1, and where by joining two watercourses of different orders the watercourse below the node takes the number of the higher order of the watercourse above the node that is not increased (Figure 2C);
3) Shreve ordering system of drainage patterns (Shreve 1966), where an addition of orders occurs (Figure 2D) by the joining of two watercourses, i.e. the order of each watercourse within the network indicates the total number of river springs within the network above this watercourse (in the direction towards the river springs).

2. Methods

Technical publications dealing with general fractal geometry and the application of its methods in various fields of science were selected to define and evaluate the basic terms of fractal geometry. The terms of fractal geometry were defined for an example of drainage patterns and valley networks and subsequently the views by various authors on the river or valley networks were compared.

Various methods of determining the fractal dimension of networks were defined based on research of drainage patterns and valley networks. For each method the conditions of use were described and subsequently their advantages and disadvantages compared to the other mentioned methods were evaluated. To evaluate the fractal dimension calculations using regular grids the "fractal dimension of drainage patterns and valley networks according to Mandelbrot (1982)", the "box-counting dimensions according to Rodríguez-Iturbe & Rinaldo (2001) / Kolmogorov dimensions according to Zelinka & Včelař & Čandík (2006)", the "box-counting dimension according to Turcotte (2007a)" and the "capacity dimension according to Tichý (2012)" were applied to the schematic valley networks according to Howard (1967).

3. Results and discussion

3.1 Definitions of terms of fractal geometry

3.1.1 Self-similar and self-affined fractal

This is a large group of fractals, which is in particular used to describe and illustrate natural objects. The mathematical definition of self-similarity in the two-dimensional space is based on the relation of points F and F′, where F(x, y) is statistically similar to point F′(rx, ry), and where r is the affine transformation (Table 2; Turcotte 2007a). The self-similar fractals are isotropic, i.e. they have, in all respects, the same properties and the values of fractal parameters are logically not dependent on the orientation of x and y axes (Mandelbrot 1982, 2003; Rodríguez-Iturbe and Rinaldo 2001). Self-similar fractals are resistant to affine transformations, i.e. no matter how the cutout area, where the fractal landscape shape is displayed, will extend/diminish, rotate or shift, the fractal shape remains the same.

The mathematical definition of self-affinity in the two-dimensional space is based on the relationship of points F and F′, where F(x, y) is statistically similar to point F′(rx, r^{Ha}y), where r is an affine transformation and Ha is the Hausdorff measure (Table 2; Turcotte 2007a).

Self-affined fractals are not isotropic (Mandelbrot 1982, 2003), i.e. they do not have the same properties in all respects (Mandelbrot 1982, 2003) and the values of fractal parameters are dependent on the orientation of the x and y axes (Rodríguez-Iturbe and Rinaldo 2001). Self-affined fractals are not resistant against affine transformations, i.e. if the cutout of the area, in which the fractal landscape form is displayed, will increase/decrease, rotate or shift in any way, the fractal shape will change.

The authors' views on the shape of drainage patterns or valley networks differ in the world literature. Mandelbrot (1982) describes the drainage patterns as self-similar fractals by using Horton's laws (Horton 1945). Voss (1988) adapts the measurements and designates the drainage patterns as self-affined fractals. Kusák (2013) in his fractal analysis of the valley networks in the Ethiopian Highlands divides the shapes of valley networks into two groups: 1) the shapes defined by the relationship of the main valley and subsidiary valleys connected to it, i.e. dendritic, trellis and rectangular valley networks that meet the definition conditions of self-similarity; and 2) the shapes defined on the basis of mutual relation of several major valleys, i.e. parallel, radial and annular valley networks that meet the conditions of the self-affinity definition.

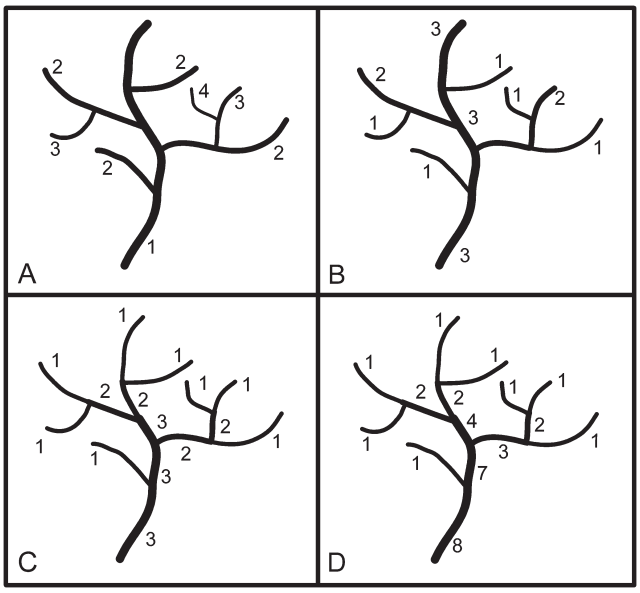

Fig. 1 Ordering systems of drainage patterns. Note: A – Gravelius ordering system of drainage patterns (Gravelius 1914); B – Horton ordering system of drainage patterns (Horton 1945); C – Strahler ordering system of drainage patterns (Strahler 1957); D – Shreve ordering system of drainage patterns (Shreve 1966).

3.1.2 Hierarchical scale, fractal self-similarity, physical limits of the system

At the beginning of each landscape research it is necessary to determine the scale to which the given shapes are described. When the map scale is increased (decrease in the size of pixel/picture element, decrease in the study area), a greater number of smaller shapes is shown on the map, e.g. cirques, etc. Such shapes are independent of each other and have a non-hierarchical scale (Bendix 1994).

Complex geomorphic networks consist of constantly recurring characteristic shapes, so called fractal self-similarity (Mandelbrot 1982; Stuwe 2007). The fractal shape can be divided into parts, each of which is (at least approximately) a copy of the whole shape. Fractal landscape shapes are thus defined in any resolution without giving the scale and their shape remains the same at any magnification or reduction (Baas 2002; Farina 2006). So the shapes in the given scale are affected by the whole of the superior scale and they alternatively influence the sub-whole of the hierarchically interior scale. According to Bendix (1994) the scale-independent shapes have a hierarchical scale. Self-similarity can in practice mean that when illustrating river drainage patterns without giving any scale, the flow of e.g. the Amazon is not recognizable from any other water course (Figure 1). Tarbotton

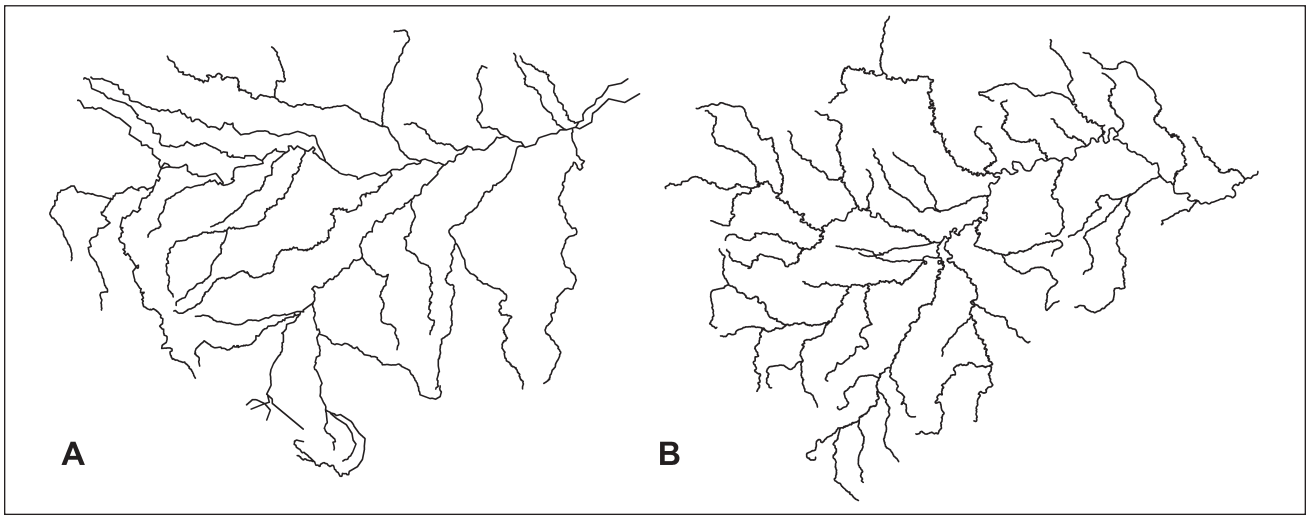

Fig. 2 Fractal self-similarity of drainage patterns. Note: A – Amazon drainage pattern (drainage basin 6,915,000 km^2); B – Berounka drainage pattern (drainage basin 8,855.47 km^2).

(1996) terms this property of fractal landscape shapes as the scale independence, Turcotte (1997, 2007a, 2007b) terms it as the scale invariance.

When measuring the length of a coast line it holds true that the length of the coastline increases with a more detailed scale (Mandelbrot 2003), i.e. the so-called Richardson effect (Zelinka & Včelař & Čandík 2006). In a mathematical sense, the geometrical structure in fractals is repeated up to infinity, i.e. the coastline would reach an infinite length at an infinitely large scale. With the fractal structure of landscape shapes there are certain boundaries that cannot be overcome, so called physical limits to the system. For example, according to Tichý (2012) the ratio between the largest and the smallest part of a fractal (self-similar) landscape shape is a maximum of 500 : 1. However, figure 2 shows that the ratio between the shape of the Amazon's drainage pattern and that of the Berounka is approximately 781:1. Due to the physical limits of the system, i.e. the limit that cannot be overcome in the landscape, geomorphology uses the fractal dimension of a final line (sensu Mandelbrot 2003).

3.2 Fractal dimension of drainage patterns and valley networks

3.2.1 "Fractal dimension of drainage patterns and valley networks according to Turcott (1997)"

Turcotte (1997, 2007a, 2007b) studied the use of fractals to describe the landscape and on the basis of bifurcation ratio Rb and the length-order ratio *Rr* (Table 2), he compiled a formula for calculating the fractal dimension *D* of drainage patterns and valley networks:

$$D = ln(Rb) / ln(Rr).$$

The value of a fractal dimension indicates the extent to which the area is filled with watercourses or valleys. Increasing the value of the fractal dimension of drainage patterns of the order X + 1 means that the number of watercourses of the order X + 1 has increased or that the length of watercourses of the order X + 1 has increased, and the drainage patterns therefore fill the study area to a greater extent. The fractal dimension of drainage patterns and valley networks are different in various regions (due to the influence of the structural bedrock, tectonic activities) and even within a single region when changing the scale (Burrough 1981; Sung et al. 1998; Sung & Chen 2004).

However, Phillips (2002) describes the inaccuracies of the "fractal dimension of drainage patterns and valley networks according to Turcotte (1997)". The formula for calculating the fractal dimension is based on the bifurcation ratio and length-order ratio, which are based on the first and the second of Horton's law (Horton 1945). Horton's laws describe drainage patterns as self-similar fractals, i.e. he gives the same values of bifurcation ratios and length ratios between all orders. Real drainage patterns, however, are not self-similar (Voss 1988; De Cola & Lam 2002b). According to Phillips (2002), Horton's laws are more mathematical abstractions than the real state of the drainage patterns. Phillips (2002) conducted an analysis of the drainage patterns in the southern Appalachian Mountains with 30% of the drainage patterns having $Fd < 1$; 36% of the drainage patterns having $1 < Fd < 2$; and 34% of the drainage patterns having $Fd > 2$. The "fractal dimension of drainage patterns and valley networks according to Turcotte (1997)" is therefore not limited by an open interval (1; 2). Although the "fractal dimension of drainage patterns and valley networks according to Turcotte (1997)" is not limited by the open interval (1; 2), it is recognized in the world literature as a universal method for calculating the fractal parameters of drainage patterns and it is used most in geographic studies (e.g. Sung et al. 1998; Sung & Chen 2004; Turcotte 2007a, 2007b).

3.2.2 Determination of dimensions through the use of regular grids

Turcotte (2007a) studied self-affined fractal shapes and in determining the fractal dimension of shapes he overlaps these shapes with a regular grid, where each cell in the regular grid has dimensions *r* and *h*. Turcotte (2007a) gave an example of a self-affined fractal structure, where in the first step, the original shape of the line (indicator), which can be overlapped by just one cell, is divided into four lines (generator) that can be overlapped by four cells of a regular grid (Figure 3A, 3B). In the second and third

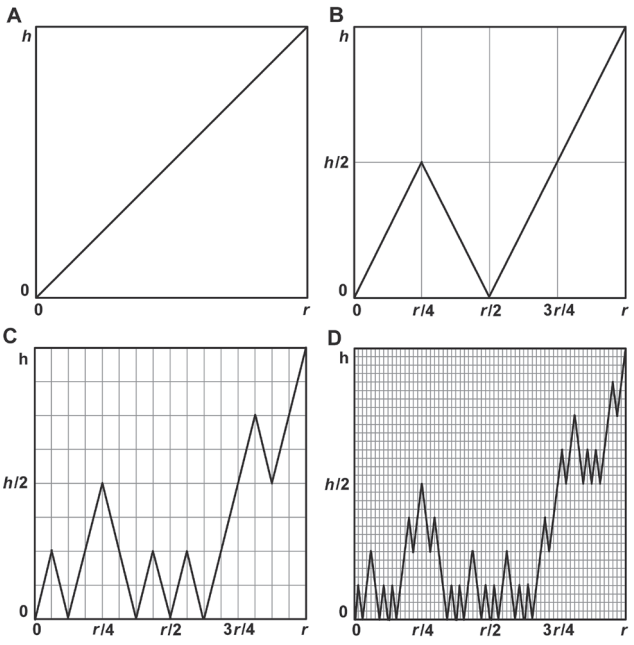

Fig. 3 Example of self-affined fractals according to Turcotte (2007a), modified. Note: A – zero initial condition of the shape of a self-affined fractal: an initiator, i.e. a straight line leading from point X(0, 0) to point Y(r, h), overlaid with one cell of a regular grid; B – the first step in the formation a self-affined fractal: generator, consisting of four lines, overlaid with four cells of regular grids; C – the second step in the formation of a self-affined fractal, overlaid with 16 cells of regular grids; D – the third step in the formation of a self-affined fractal, overlaid with 64 cells of regular grids.

step, each line (initiator) is likewise divided into four lines (generator), which can be overlapped exactly by sixteen (Figure 3C) and sixty four (Figure 3D) cells of a regular grid, respectively.

A regular grid can also be used in determining the size and shape complexity of complex geomorphic networks and their fractal dimension, e.g. Mandelbrot (1982), Rodríguez-Iturbe & Rinaldo (2001), Zelinka & Včelař & Čandík (2006), Turcotte (2007a) or Tichý (2012) (Table 4). A complex geomorphic network, such as a drainage pattern or valley network, is overlapped by a regular grid, the size of the cell side is usually defined in the interval *r* (0, 1) (Rodríguez-Iturbe & Rinaldo 2001). The cell size *r* in each step gradually decreases, thus the regular grid overlapping the drainage pattern or valley network becomes more detailed. The closer *r* is to 0, the more accurate the value of the box-counting dimension. The value of the fractal dimension is not dependent on the base of the logarithm (Table 4).

It was determined that the "fractal dimension of drainage patterns and valley networks according to Mandelbrot (1982)", the "box-counting dimension according to Turcotte (2007a)" and the "capacity dimension according to Tichý (2012)" reach values in the open interval (1, 2) (Table 4, Figure 5) in four steps using a regular grid, i.e. the first step $r_1 = 1$, the second step $r_2 = 0.5$, the third step $r_3 = 0.25$, and the fourth step $r_4 = 0.125$ (Table 4; Figure 4), on schematic valley networks according to

Tab. 4 The method of determining the fractal dimension by application of the regular grid by different authors and their application of schematic valley networks by Howard (1967).

Name	Calculation		Dendritic	Parallel	Trellis	Rectangular	Radial	Annular
"fractal dimension of drainage patterns and valley networks according to Mandelbrot (1985)"	$N_2 / N_1 = k^D$ After modification: $D = ln_{(k)} (N_2 / N_1)$ or $D = log_{(k)} (N_2 / N_1)$	D – fractal dimension; N_1 –number of cells covering drainage pattern and valley network with sizes x_1 and y_1; N_2 – number of cells covering drainage pattern and valley network with sizes $x_2 = kx_1$ and $y_2 = ky_1$; k – scaling factor, i.e. r_1/r_2, where r_1 – length of the cell side of the regular grid which covers drainage pattern and valley network with N_1 cells; r_2 – length of the cell side of the regular grid which covers drainage pattern and valley network with N_2.	$r_1 = 1$ $r_2 = 0.5$ $r_3 = 0.25$ $r_4 = 0.125$ $N_1 = 9$ $N_2 = 33$ $N_3 = 113$ $N_4 = 286$ $D_1 = 1.874$ $D_2 = 1.776$ $D_3 = 1.340$	$r_1 = 1$ $r_2 = 0.5$ $r_3 = 0.25$ $r_4 = 0.125$ $N_1 = 9$ $N_2 = 35$ $N_3 = 120$ $N_4 = 309$ $D_1 = 1.959$ $D_2 = 1.778$ $D_3 = 1.365$	$r_1 = 1$ $r_2 = 0.5$ $r_3 = 0.25$ $r_4 = 0.125$ $N_1 = 9$ $N_2 = 35$ $N_3 = 135$ $N_4 = 438$ $D_1 = 1.959$ $D_2 = 1.948$ $D_3 = 1.698$	$r_1 = 1$ $r_2 = 0.5$ $r_3 = 0.25$ $r_4 = 0.125$ $N_1 = 9$ $N_2 = 31$ $N_3 = 104$ $N_4 = 244$ $D_1 = 1.784$ $D_2 = 1.746$ $D_3 = 1.230$	$r_1 = 1$ $r_2 = 0.5$ $r_3 = 0.25$ $r_4 = 0.125$ $N_1 = 9$ $N_2 = 32$ $N_3 = 92$ $N_4 = 231$ $D_1 = 1.830$ $D_2 = 1.524$ $D_3 = 1.328$	$r_1 = 1$ $r_2 = 0.5$ $r_3 = 0.25$ $r_4 = 0.125$ $N_1 = 9$ $N_2 = 27$ $N_3 = 79$ $N_4 = 212$ $D_1 = 1.585$ $D_2 = 1.549$ $D_3 = 1.424$
"box-counting dimensions according to Rodríguez-Iturbe & Rinaldo (2001) / Kolmogorov dimensions according to Zelinka & Včelař & Čandík (2006)"	$D = ln\ N(r) / ln\ (1/r)$ or $D = log\ N(r) / log\ (1/r)$	D – box-counting dimension / Kolmogorov dimension; r – length of one cell side of the regular grid, which covers drainage pattern and valley network; $N(r)$ – number of cells of the regular grid, which covers drainage pattern and valley network. Calculation of ox-counting dimension is defined only for cell sizes lengths r (0; 1), and the closer the r is to 0, the value of box-counting dimension is more accurate.	$r_1 = 1$ $r_2 = 0.5$ $r_3 = 0.25$ $r_4 = 0.125$ $N_1 = 9$ $N_2 = 33$ $N_3 = 113$ $N_4 = 286$ D_1 – can not $D_2 = 5.044$ $D_3 = 3.410$ $D_4 = 2.720$	$r_1 = 1$ $r_2 = 0.5$ $r_3 = 0.25$ $r_4 = 0.125$ $N_1 = 9$ $N_2 = 35$ $N_3 = 120$ $N_4 = 309$ D_1 – can not $D_2 = 5.129$ $D_3 = 3.453$ $D_4 = 2.757$	$r_1 = 1$ $r_2 = 0.5$ $r_3 = 0.25$ $r_4 = 0.125$ $N_1 = 9$ $N_2 = 35$ $N_3 = 135$ $N_4 = 438$ D_1 – can not $D_2 = 5.129$ $D_3 = 3.538$ $D_4 = 2.925$	$r_1 = 1$ $r_2 = 0.5$ $r_3 = 0.25$ $r_4 = 0.125$ $N_1 = 9$ $N_2 = 31$ $N_3 = 104$ $N_4 = 244$ D_1 – can not $D_2 = 4.954$ $D_3 = 3.350$ $D_4 = 2.644$	$r_1 = 1$ $r_2 = 0.5$ $r_3 = 0.25$ $r_4 = 0.125$ $N_1 = 9$ $N_2 = 32$ $N_3 = 92$ $N_4 = 231$ D_1 – can not $D_2 = 5.000$ $D_3 = 3.262$ $D_4 = 2.617$	$r_1 = 1$ $r_2 = 0.5$ $r_3 = 0.25$ $r_4 = 0.125$ $N_1 = 9$ $N_2 = 27$ $N_3 = 79$ $N_4 = 212$ D_1 – can not $D_2 = 4.755$ $D_3 = 3.152$ $D_4 = 2.576$
"box-counting dimension according to Turcotte (2007a)"	$D = ln\ (N_2/N_1) / ln\ (r_1/r_2)$ or $D = log\ (N_2/N_1) / log\ (r_1/r_2)$	D – box-counting dimension; N_1 – number of cells covering drainage pattern and valley network with sizes r_1; N_2 – number of cells covering drainage pattern and valley network with sizes r_2.	$r_1 = 1$ $r_2 = 0.5$ $r_3 = 0.25$ $r_4 = 0.125$ $N_1 = 9$ $N_2 = 33$ $N_3 = 113$ $N_4 = 286$ $D_1 = 1.874$ $D_2 = 1.776$ $D_3 = 1.340$	$r_1 = 1$ $r_2 = 0.5$ $r_3 = 0.25$ $r_4 = 0.125$ $N_1 = 9$ $N_2 = 35$ $N_3 = 120$ $N_4 = 309$ $D_1 = 1.959$ $D_2 = 1.778$ $D_3 = 1.365$	$r_1 = 1$ $r_2 = 0.5$ $r_3 = 0.25$ $r_4 = 0.125$ $N_1 = 9$ $N_2 = 35$ $N_3 = 135$ $N_4 = 438$ $D_1 = 1.959$ $D_2 = 1.948$ $D_3 = 1.698$	$r_1 = 1$ $r_2 = 0.5$ $r_3 = 0.25$ $r_4 = 0.125$ $N_1 = 9$ $N_2 = 31$ $N_3 = 104$ $N_4 = 244$ $D_1 = 1.784$ $D_2 = 1.746$ $D_3 = 1.230$	$r_1 = 1$ $r_2 = 0.5$ $r_3 = 0.25$ $r_4 = 0.125$ $N_1 = 9$ $N_2 = 32$ $N_3 = 92$ $N_4 = 231$ $D_1 = 1.830$ $D_2 = 1.524$ $D_3 = 1.328$	$r_1 = 1$ $r_2 = 0.5$ $r_3 = 0.25$ $r_4 = 0.125$ $N_1 = 9$ $N_2 = 27$ $N_3 = 79$ $N_4 = 212$ $D_1 = 1.585$ $D_2 = 1.549$ $D_3 = 1.424$
"capacity dimension according to Tichý (2012)"	$D = ln\ (N) / ln\ (n)$ or $D = log\ (N) / log\ (n)$	D – capacity dimension; N – number of cells covering drainage pattern and valley netrosk; n – number of cells forming the site of regular grid.	$N_1 = 9$ $N_2 = 33$ $N_3 = 113$ $N_4 = 286$ $n_1 = 3$ $n_2 = 6$ $n_3 = 12$ $n_4 = 24$ $D_1 = 2.000$ $D_2 = 1.951$ $D_3 = 1.902$ $D_4 = 1.780$	$N_1 = 9$ $N_2 = 35$ $N_3 = 120$ $N_4 = 309$ $n_1 = 3$ $n_2 = 6$ $n_3 = 12$ $n_4 = 24$ $D_1 = 2.000$ $D_2 = 1.984$ $D_3 = 1.927$ $D_4 = 1.804$	$N_1 = 9$ $N_2 = 35$ $N_3 = 135$ $N_4 = 438$ $n_1 = 3$ $n_2 = 6$ $n_3 = 12$ $n_4 = 24$ $D_1 = 2.000$ $D_2 = 1.984$ $D_3 = 1.974$ $D_4 = 1.914$	$N_1 = 9$ $N_2 = 31$ $N_3 = 104$ $N_4 = 244$ $n_1 = 3$ $n_2 = 6$ $n_3 = 12$ $n_4 = 24$ $D_1 = 2.000$ $D_2 = 1.917$ $D_3 = 1.869$ $D_4 = 1.730$	$N_1 = 9$ $N_2 = 32$ $N_3 = 92$ $N_4 = 231$ $n_1 = 3$ $n_2 = 6$ $n_3 = 12$ $n_4 = 24$ $D_1 = 2.000$ $D_2 = 1.934$ $D_3 = 1.820$ $D_4 = 1.713$	$N_1 = 9$ $N_2 = 27$ $N_3 = 79$ $N_4 = 212$ $n_1 = 3$ $n_2 = 6$ $n_3 = 12$ $n_4 = 24$ $D_1 = 2.000$ $D_2 = 1.839$ $D_3 = 1.758$ $D_4 = 1.685$

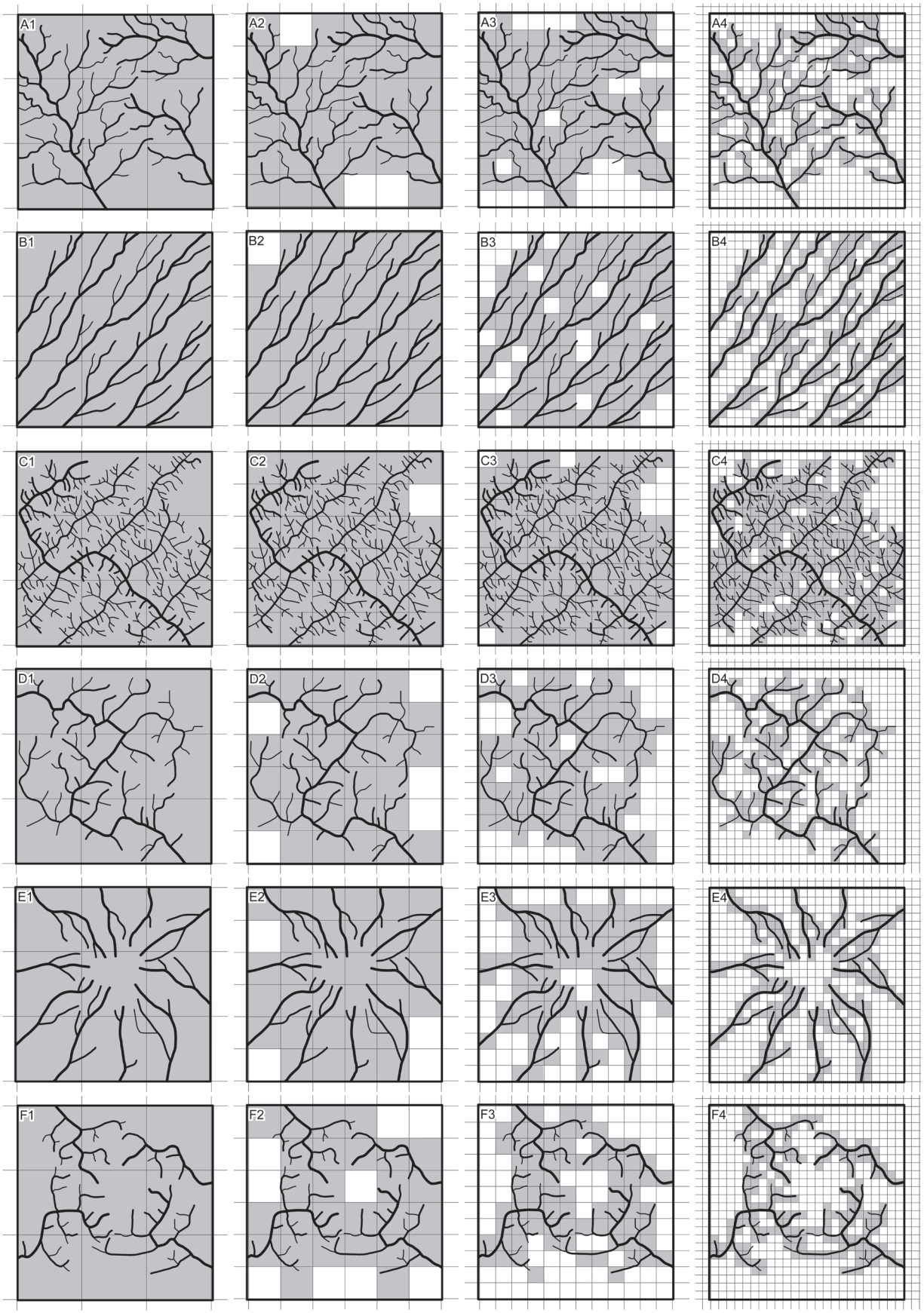

Fig. 4 Using a regular grid for the calculation of the fractal dimension of schematic valley networks according to Howard (1967). Note: A – dendritic valley network; B – parallel valley network; C – trellis valley network; D – rectangular valley network; E – radial valley network; F – annular valley network; 1 – the first step: $r_1 = 1$, N_1 (A, B, C, D, E, F) = 9; 2 – the second step: $r_2 = 0.5$, N_2 (A) = 33, N_2 (B, C) = 35, N_2 (D) = 31, N_2 (E) = 32, N_2 (F) = 27; 3 – the third step: $r_3 = 0.25$, N_3 (A) = 113, N_3 (B) = 120, N_3 (C) = 135, N_3 (D) = 104, N_3 (E) = 92, N_3 (F) = 79; 4 – the fourth step: $r_4 = 0.125$, N_4 (A) = 286, N_4 (B) = 309, N_4 (C) = 438, N_4 (D) = 244, N_4 (E) = 231, N_4 (F) = 212.

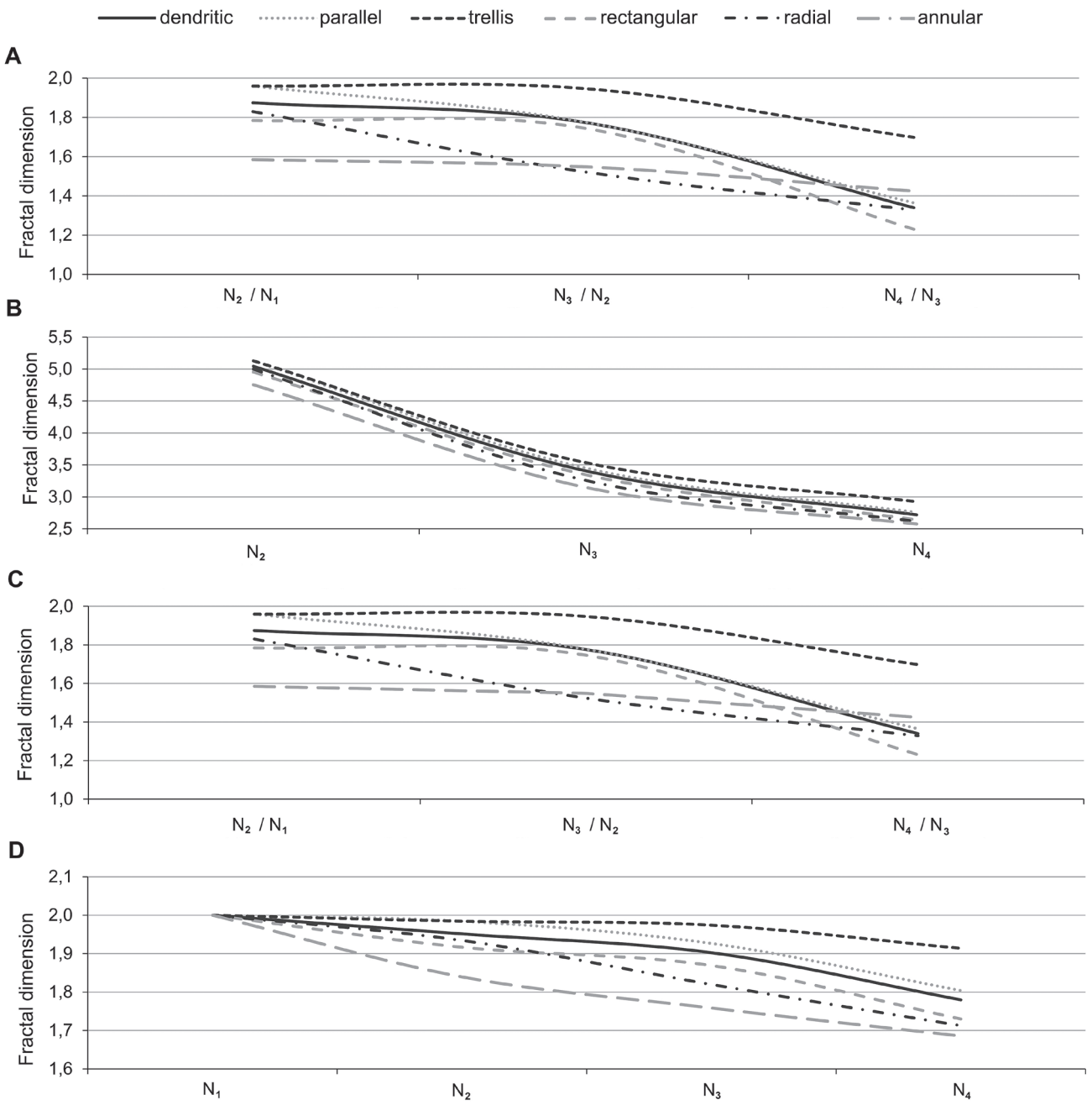

Fig. 5 Value of fractal dimensions applied to schematic valley networks according to Howard (1967). Note: A – "fractal dimension of drainage patterns and valley networks according to Mandelbrot (1982)"; B – "box-counting dimension according to Rodriguez-Iturbe & Rinaldo (2001) / Kolmogorov dimension according to Zelinka & Včelař & Čandík (2006)"; C – "box-counting dimension according to Turcotte (2007a); and D – "capacity dimension according to Tichý (2012)".

Howard (1967). This is in accordance with the definitions of a fractal dimension according to Hausdorff (1919 in Mandelbrot 2003), Baas (2002), and others. When Turcotte (2007a) defines the calculation of his "box-counting dimension", he refers to the definition of a "fractal dimension of drainage patterns and valley networks according to Mandelbrot (1982)", and although this calculation is adjusted in the four steps, the values of both dimensions are identical (Table 4; Figure 5). The values of the "box-counting dimension according to Rodriguez-Iturbe & Rinaldo (2001) / Kolmogorov dimension according to Zelinka & Včelař & Čandík (2006)", are greater than 2 (Table 4; Figure 5). In each further step the value of the dimension decreases. Thus, in order for the dimension value to reach values of an open interval (1, 2) more steps are required than for the other mentioned fractal dimensions.

3.2.3 Cellular automata

Fonstad (2006) studied the relations between landscape ecology and geomorphology and he studied fractal landscape shapes by means of so-called cellular automata. Cellular automata are used for modeling the time and space of fractal systems. The study area is divided into

discrete cells (squares, triangles or hexagons), which form a regular grid (square, triangular or hexagonal), called a cellular network. The cell size is determined based on the parameters of a specific territory, i.e. it varies in different studies. Cells in the network have values according to whether or not they contain the studied fractal shape, i.e. if the value of the cell is 1 (black), the fractal shape is present but if the value of the cell is 0 (white), the fractal shape is not present. In each step, the cell values change depending on the value of the individual cells and their surroundings.

Cellular automata were first used in geomorphology by Barca et al. (1986) during the research of landslides and erosion. Afterwards cellular automata were used in other geomorphological studies, for example on the areal extent of erosion, the spatial distribution of aeolian sediments, or shapes of sand dunes. For the study of drainage patterns, cellular automata can be used only: 1) in semi-arid or arid areas where there are temporary streams (no surface runoff during the year); or 2) in areas where the bedrock is composed of unconsolidated rocks, that allow river braiding, and where the river easily and quickly relocates its riverbed. In such areas, the cell values in cellular automata may change and the changes of drainage patterns can be modeled using cellular automata. However, in most cases of drainage patterns and in all cases of valley networks, the use of cellular automata is not possible, since the cells in the grid should always have the same values. Despite the fact that in most cases of drainage patterns and in all cases of valley networks the use of cellular automata is not possible (because the cells in the grid have the same values), the "fractal cellar model according to Bi et al. (2012)" is considered to be inspirational and therefore will also be briefly analyzed.

3.2.4 "Fractal cellular model according to Bi et al. (2012)"

Bi et al. (2012) use a "fractal cellular model" to evaluate the fractal dimension of the landscape in the area of the Ordos Block (an area of 500,000 km^2 with located between the North China Platform and the Tibetan Plateau). This method can show the spatial variation of the fractal properties of the relief. It is a moving model, where "windows" of varying sizes are created which shift on the digital images of the area. The size of the squares sides W, which form a quadratic grid, is calculated from the relationship:

$$W = 2^n + 1,$$

where n is a positive whole number in the interval <1; 10>. If n = 6 m, then the size of the shifting "window" is 65 × 65 m. The "window" with a size of 65 × 65 m is shifted: 1) from the upper left corner of the study area to the bottom right corner; 2) only about 33 m, so that the segments of the area always partially overlap. Fractal parameters are then examined in the parts of the relief that capture the shifting "window". As with the cellular automata the areas in the "window" are designed as homogeneous units that can reach values of 1 (black) = there is a fractal shape and 0 (white) = there is not a fractal shape.

In general, calculating the size of the squares according to Bi et al. (2012) can also be applied for the study of other fractal landscape shapes. For example, when studying drainage patterns or valley networks, we can substitute n by the most numerous units in the network, i.e. the most frequent length of the rivers or valleys in the study area. In order to study the drainage patterns or valley networks, which consist of the largest number of 3 km long rivers or valleys, an area of 81 km^2 is ideal (sensu Bi et al. 2012). The fractal dimension can then be determined, for example using the "fractal dimension of drainage patterns and valley networks according to Turcotte (1997)", and then it is possible to compare how the value of the fractal dimension varies in different parts of the basin or when resizing the "windows".

4. Conclusion

Fractal landscape shapes are defined in any resolution without indicating the scale, i.e. the shape remains the same at any magnification or diminution (Baas 2002; Farina 2006), and they have a so-called hierarchical scale (Bendix 1994), where the shapes in the given scale are affected by the whole of the superior scale and they alternatively affect the subcomplex of a hierarchically lower scale. Self-similar and self-affined fractals are primarily used to describe and illustrate natural objects. Wherein, e.g. in determining the fractal shape of drainage patterns and valley networks, the results according to Mandelbrot (1982) and Turcott (1997), i.e. self-similar fractals, and according to Voss (1988), i.e. self-affined fractals, are different.

If the drainage patterns or valley networks are self-similar fractals, then the fractal dimension can be best determined using the "fractal dimension of drainage patterns and valley networks according to Turcotte (1997)". Although this is not limited by the open interval (1, 2) many authors use it as a universal method for calculating the fractal parameters and it is frequently used. If there is also an area of interest, i.e. a catchment area or area of the valley network which is divided into sub-areas, e.g. using the method according to Bi et al. (2012), the resulting value of the "fractal dimension of the drainage patterns and valley networks according to Turcotte (1997)" would be more accurate.

If the drainage patterns or valley networks are self-affined fractals, it is better to determine the fractal dimension by methods that use regular grids. When applying the method to determine the fractal dimension using a regular grid on a schematic valley network according to Howard (1967) it was determined that the "fractal dimension of drainage patterns and valley networks by Mandelbrot (1982)", "box-counting dimension according to

Turcotte (2007)" and "capacity dimension according to Tichý (2012)" show a value in the open interval (1, 2). In contrast, the value of "box-counting dimensions according to Rodríguez-Iturbe & Rinaldo (2001) / Kolmogorov dimensions according to Zelinka & Včelař & Čandík (2006)", was greater than 2, so to reach the values in the open interval (1, 2), more steps are needed than for the other fractal dimensions.

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RESUMÉ

Rešeršní článek: metody fraktální geometrie používané při studiích komplexních geomorfologických sítí

Metody fraktální geometrie umožňují kvantitativně popsat soběpodobné či soběpříbuzné tvary reliéfu, umožňují komplexní/holistické studium přírodních objektů v různých měřítkách a srovnání hodnot analýz z různých měřítek (Mandelbrot 1967; Burrough 1981). Vzhledem k hierarchickému měřítku (Bendix 1994) a fraktálové soběpodobnosti (Mandelbrot 1982; Stuwe 2007) fraktálních tvarů reliéfu tvořících složité sítě musejí být k jejich reprezentativnímu a objektivnímu zhodnocení použity vhodné morfometrické charakteristiky a zvoleno vhodné měřítko.

Tento rešeršní článek definuje a porovnává: 1) základní termíny fraktální geometrie, tj. fraktálová dimenze, soběpodobné, soběpříbuzné a náhodné fraktály, hierarchické měřítko, fraktální soběpodobnost a fyzikální hranice systému; a 2) vybrané metody určení fraktální dimenze geomorfologických komplexních sítí. Z fraktálních tvarů reliéfu tvořící komplexní sítě kladen důraz především na říční a údolní sítě.

Pokud říční či údolní sítě tvoří v různých měřítkách soběpodobné fraktály, je vhodné pro určení jejich fraktálních dimenzí užít „fraktální dimenze říčních a údolních sítí dle Turcotta (1997)". Naopak pokud říční či údolní sítě tvoří soběpříbuzné fraktály, je vhodné pro určení jejich fraktálních dimenzí užít metody využívající pravidelné mřížky. Při aplikaci metod určení fraktální dimenze pomocí využití pravidelné mřížky na schématické údolní sítě dle Howarda (1967) bylo zjištěno, že „fraktální dimenze říčních a údolních sítí dle Mandelbrota (1985)", „sčítací dimenze dle Turcotta (2007a)" a „kapacitní dimenze dle Tichého (2012)" dosahují hodnot v otevřeném intervalu (1; 2). Naopak hodnoty „sčítací dimenze dle Rodríguez-Iturbe & Rinalda (2001) / Kolmegorovovy dimenze dle Zelinky, Včelaře & Čandíka (2006)" byly větší než 2, čili pro dosažení hodnot v otevřeného intervalu (1; 2), je třeba více kroků než u ostatních fraktálních dimenzí.

COMPARISON OF THE LONGITUDINAL AND LATERAL PROFILES OF WATERCOURSES USING SONAR-BASED METHODS (ADCP) AND HYDROLOGICAL ANALOGY

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ABSTRACT

In many cases, a flood wave has a pronounced transforming effect on the channel, and the knowledge of the watercourse longitudinal and lateral profiles is of great importance. To obtain data meeting these requirements with adequate accuracy, we alternated the conventional geodesic methods with sonar-based approaches – ADCP – and with results from the CroSolver software, constructed for obtaining bathymetric information.

We compare results achieved from two approaches for preparing geometric data for hydrodynamic models. The respective approaches are considered as possible replacements for the costly conventional geodesic methods. The proposed methods use either data available from the continual monitoring of surface water courses (i.e., discharge measurements), which can capture precisely the lateral channel profile within the entire longitudinal profile, or a robust sonar-based system.

Results obtained from the conducted studies show that our statement about a possibility to synthesize the ALS data with data from hydrological measurements or ADCP sonar in preparing watercourse computational geometry, is valid. A very good agreement was achieved between lateral profiles (determined inundation areas) prepared by using the CroSolver software or the ADCP sonar with lateral profiles established by geodesic surveying.

Keywords: sonar, ADCP, Doppler, discharge, lateral profile, aerial laser scanning

1. Introduction

One of the key factors in getting relevant results from hydrodynamic models is the initial data for schematization of the watercourse channel (Coveney et al. 2010). Proper requirements for the initial data also enable quantification of employed hydrodynamic models to be used for simulations. One-dimensional (1D) hydrodynamic models require initial data with the computational pathway consisting of a set of lateral profiles of the watercourse channel; on the other hand, for two-dimensional (2D) hydrodynamic models, a detailed digital model of the area topography has to be provided, i.e. adjoining inundation areas along with the watercourse itself. Thus, the initial data and the employed model may increase the financial costs of the project (Roub et al. 2012a).

LIDAR (Light Detection and Ranging) aerial laser scanning is one of the most common technologies for obtaining spatial data about a territory (Dolanský 2004). The method of aerial laser scanning (ALS) is based on the principle of laser beam reflection interpreting the image of the investigated object to the laser beam (Novák et al. 2011). The beam is emitted to the Earth surface, and measures the travelled distance to the surface of the investigated area or object.

The most lidar systems consist of a LIDAR scanner, a GPS receiver, an inertial measurement unit (IMU) represented by a desk computer and a device for data storage.

This system is mostly applied to generate accurate digital models of terrains and surfaces (DMT x DMP), which are then used in many fields (building industry, architecture (Hofman and Potůčková 2012), transport, forestry, environment science, defence, etc.), including hydrology and river hydraulics (Roub et al. 2012a). Recently, the activities providing such data sources have been performed in collaboration with the Czech Office for Surveying, Mapping and Cadastre (COSMC), Ministry of Agriculture of the Czech Republic (CR) and Ministry of Defence of the Czech Republic. The following application products will be (and for some localities have already been) generated – the Fourth-generation Digital Model of the CR Territory (DMR 4G), the First-generation Digital Model of the Surface of CR Territory (DMP 1G), the Fifth-generation Digital Model of the CR Territory (DMR 5G) (Brázdil 2009).

The expected date for the completion of DMR 5G, i.e. the date until which the DMR 5G should be completed for the entire CR territory is planned for the end of the year 2015. The present state of DMR 5G processing is shown in Figure 1. In his report, Brázdil (2009) described the basic parameters of individual application products. The potential use of ALS data in the fields of hydrology and river hydraulics was described in other reports, e.g. in Uhlířová and Zbořil (2009), Novák et al. (2011), Roub et al. (2012a), Roub et al. (2012b), Roub et al. (2013).

Aerial laser scanning is characteristic by having its own source of radiation, and therefore by not being limited (as is the case of photogrammetry) by insolation. As already mentioned, the information on the Earth surface (surface objects – buildings, vegetation, etc.) is obtained

http://dx.doi.org/10.14712/23361980.2014.20
Novák, P. – Roub, R. – Hejduk, T. – Vybíral, T. – Hánová, K. – Urban, F. (2014): Comparison of the longitudinal and lateral profiles of watercourses using sonar-based methods (ADCP) and hydrological analogy
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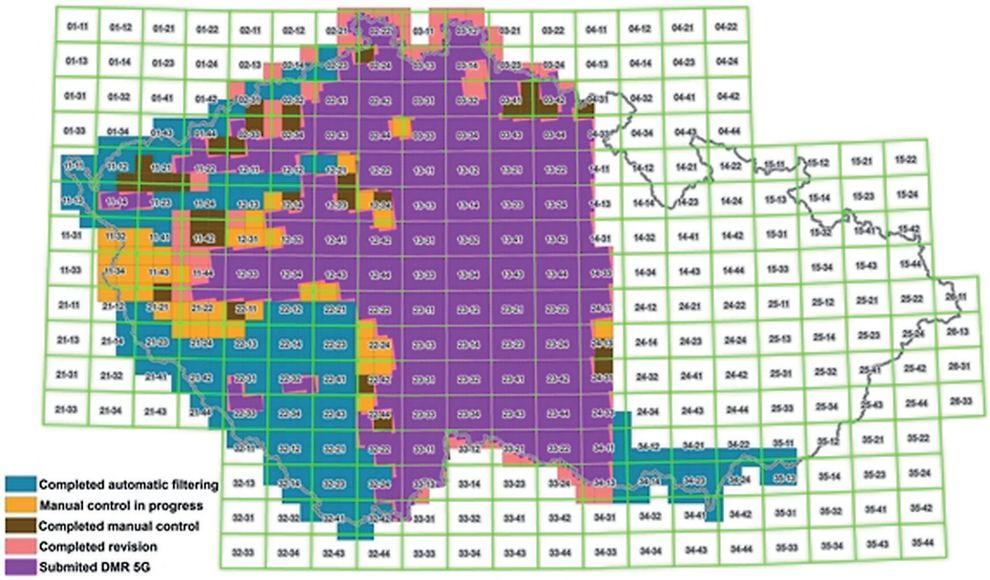

Fig. 1 Present state of DMR 5G processing.

by using the emission of laser beams in the form of pulses from a scanner placed on the airborne carrier (Šíma 2009).

In the case of beam reflection we can talk about 'laser beam reflection' – single or multiple – occurring in localities with significant differences in altitude, such as forests or building edges (Dušánek 2008).

The principle of laser beam behaviour after reaching the surface (vegetation, terrain, buildings) has essentially been defined; however, the situation is different when the laser beam falls close to watercourses and water surfaces. To acquire data from aerial laser scanning, two basic scanners (lidars of different laser detection wavelengths) are used. The first are scanners employing a proximal infrared spectrum laser (see the COSMC project). In the case of water (water surfaces), however, a typical spectral phenomenon consists in the almost complete absorption of infrared radiation resulting in a 'no data' area, i.e. an area missing the altimetry information. Mapping under water level, we have to use the green or blue-green part of the spectrum, which is not absorbed by water and thus (in ideal conditions) reaches the bottom from where it is reflected back.

The current mapping of the levels of watercourses/watercourse channels is based on the principle of dual-use scanners, i.e. infrared (mapping the surface) in combination with blue-green (mapping the bottom). This system is named DIAL – Differential Absorption Lidar. In very clear waters with a quiet surface, the mapping can be done theoretically to depths reaching 50 m. To apply these systems, the flight level must be significantly lower, within a standard range of 200–400 m (Dolanský 2004).

The aim of this work was to verify longitudinal and lateral watercourse profiles obtained from ALS data, which were to a detail specified by sonar-based methods (ADCP) and hydrological analogy (CroSolver) using longitudinal and lateral profiles obtained by conventional geodesic methods.

Table 1 and Figure 2 show the selected segments of watercourses, including the list of their basic characteristics.

2. Selection of the pilot segments of watercourses

Selection of the pilot segments of watercourses was made pursuant to a schedule established by the Czech Office for Surveying, Mapping and Cadastre, as a guarantor of the project 'Preparation of a new altimetry map using the method of aerial laser scanning (ALS)'.

To take into account the specific altitude distribution and variability of the river pattern in the Czech Republic,

Tab. 1 Selected segments of water courses.

Stream ID	The name of the stream	Section of the stream	Length (km)	r.km from – to
120020000100	Otava	Bohuslavec – Písek	7.049	20.343–27.392
133060000100	Úslava	Srby – Novotníky	13.024	49.420–62.444
131080000100	Radbuza	Bělá nad Radbuzou	5.948	8.890–14.838
133060000100	Úslava	Blovice	7.319	34.330–41.649
132140000100	Úhlava	Nýrsko	6.420	79.867–86.287
132140000100	Úhlava	Dolní Lukavice – Přeštice – Lužany	9.253	26.000–35.253

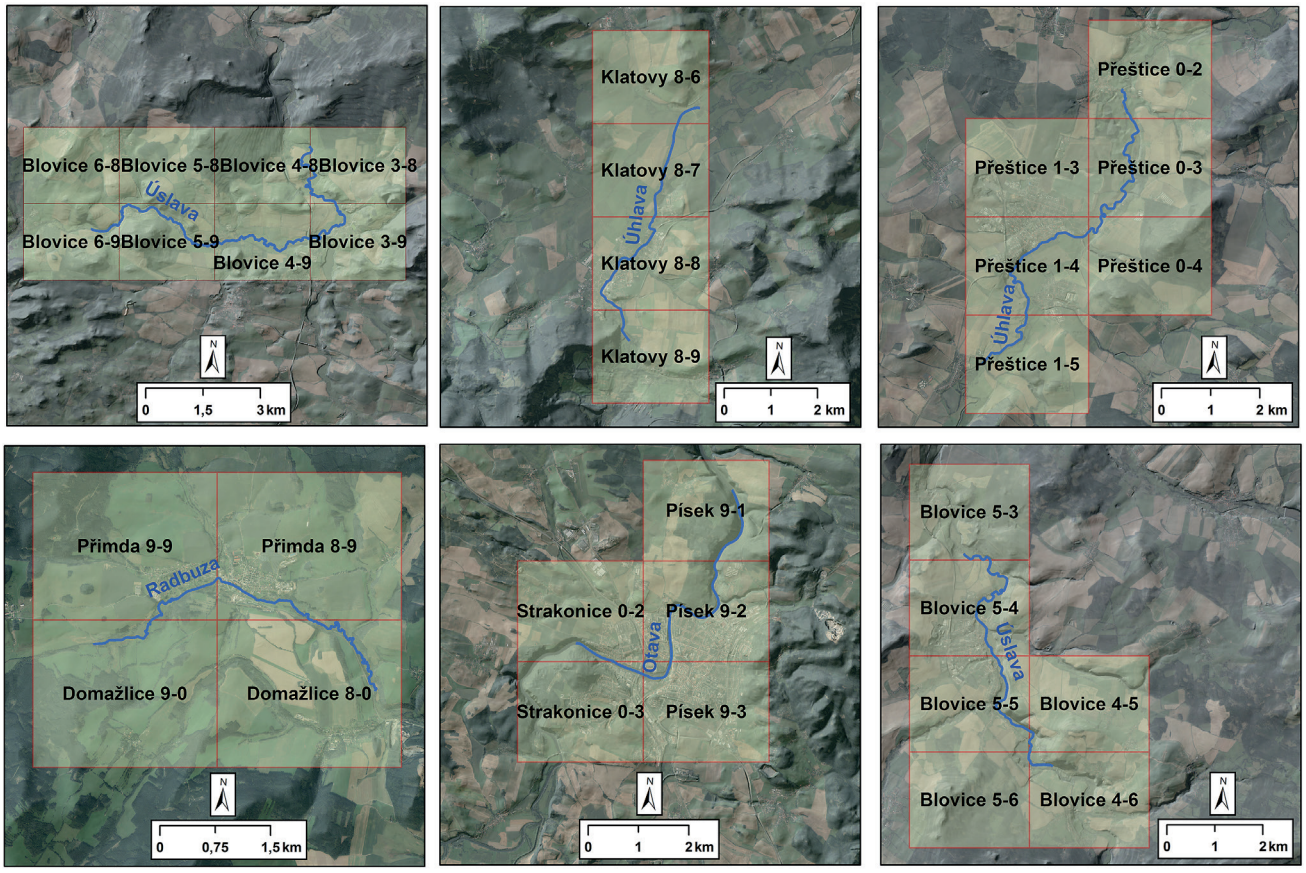

Fig. 2 Selection of pilot segments of water courses.

we selected watercourse segments characterizing best the altitude specificity, which is one of the main criteria of relief articulation. Beside the spatial and temporal distribution of physio-geographic components and elements such as precipitation type, temperature, air humidity, or flora and fauna representation, the altitude also influences characteristics reflecting the nature and course of inundation events.

The variability of the river pattern was assessed in terms of both hydrological parameters, i.e. discharge characteristics and anthropogenic adaptations of watercourses (Langhammer 2003; Maidment 1993), although in most cases, the direct statistical relationship between the watercourse adaptation and the extreme degree of inundation is difficult to prove.

3. Methods

To assess the suitability of employing ALS data for modelling the inundation zones (maps of flood risks/threats), we alternated various approaches to prepare initial altimetry data for setting up a hydrodynamic model. Flood events were modelled in the following variants:

a) As initial data for preparing the watercourse geometry (computational pathway), we used the ALS data, while the model event was reduced by discharge reached at the time of ALS data acquisition (Novák et al. 2011);
b) As initial data for preparing the watercourse geometry (computational pathway), we used the ALS data, while the watercourse channel was recessed by discharge reached at the time of ALS data acquisition using the *CroSolver (Cross section Solver)* software (Roub et al. 2012b);
c) As initial data for preparing the watercourse geometry (computational pathway), we used the ALS data, and the profile of the watercourse channel was adjusted (recessed) based on the data obtained from the ADCP sonar;
d) As initial data for preparing the watercourse geometry (computational pathway), we used the data obtained by the conventional geodesic methods.

a) Reduction of the model discharge by discharge reached at the time of ALS data acquisition

To prepare the initial – geometric – data for hydrodynamic models, the costly conventional geodesic methods were substituted with data available from the continual monitoring of surface water (discharge measurements), which perfectly reflect the lateral channel profile within the entire longitudinal profile. The methodology of this computing variant consists in the establishment of watercourse discharge at the time of ALS data acquisition. Discharge determined in this way is then subtracted from the model event, while the initial computational geometry

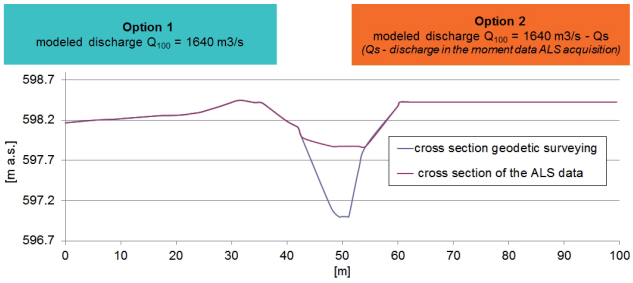

Fig. 3 Computing algorithm for the variant with reduced model discharge.

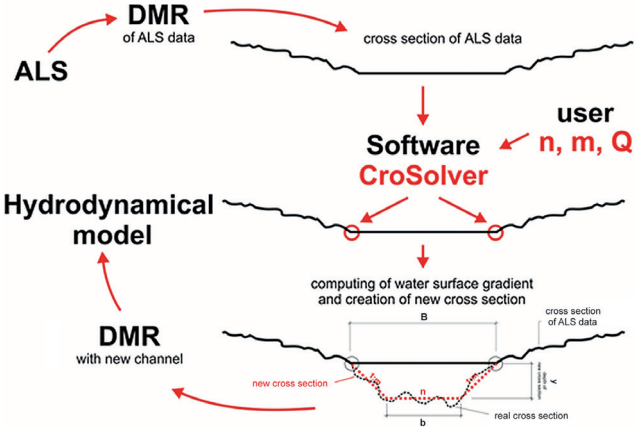

Fig. 4 Computing algorithm for the variant using the CroSolver software.

of the watercourse (and adjoining inundation zones) is prepared on the basis of the ALS data themselves. This approach is documented in Figure 3.

In this case, one of the key factors in getting relevant data is adequate setting of Manning's roughness coefficient (Forzieri et al. 2012) for the transitional zone (no data zone). To achieve the corresponding rate distribution in the lateral channel profile, we had to set up the initial conditions. These conditions had to respect the basic hydraulic principles during water flow in open channels. To create correct conditions in these hydrodynamic models, we had to take into account the effects of absent viscous sub-layer in the transitional zone of the computational geometry derived from the ALS data only. The most appropriate and simplest variant was to adjust the channel roughness adequately using the roughness coefficient. Using a proper setup, we achieved a shift (augmentation) of rates in the channel lateral profile in the location of the transitional zone (Novák et al. 2011).

b) Recess of the watercourse channel by discharge reached at the time of ALS data acquisition

The reflection of hydrological measurements during watercourse schematization into a hydrodynamic model consists in deriving the discharge reached at the time of ALS data acquisition and in using thus determined discharges as a basis for recessing the digital relief model prepared from the ALS data. In this way, we can substitute for the remaining part of the channel profile that has not been reflected by the ALS method in the digital relief model. This enables us to obtain the required watercourse channel geometry, with the capacity equal to the discharge value found in the natural channel (Roub et al. 2012b).

To solve the particular computational variant based on specifying the digital terrain model (DMT) with ALS data, we used discharge established at the time of ALS data acquisition (similarly as in a), but without reducing the simulated discharge by discharge reached at the time of ALS data acquisition). The discharge obtained in this manner was then used for recessing the water channel course in DMT obtained from the ALS data. The computing algorithm is shown in Figure 4.

To recess the watercourse channel, we used the CroSolver programme particularly developed for this purpose by the research team. The CroSolver software represents an external – independent – programme, which is not dependent on an already existing user platform. Thus, users are not limited by the need to have an ESRI license for ArcGIS products, as is the second case in which we are planning to develop software constructed as an individual ArcGIS extension.

c) Establishment of longitudinal and lateral profiles using the ADCP sonar (SonTek)

RiverSurveyor SonTek M9 (Figure 5) is represented by a robust and extremely accurate system of Acoustic Doppler Profiler (ADP) designed particularly for measuring watercourse discharge, depth and rates. This new technology is employed to solve a number of current problems, such as the development of sediments, siltation of retention space in water reservoirs, establishment of discharge in watercourses, etc. (Hess et al. 1995; Liebe et al. 2005; Oyebode et al. 2013). High accuracy and simple use make it possible to measure with security, without any need of incessant adjustments to particular river conditions. To determine the situation and altimetry information x, y, z (h) with ±3 cm accuracy, there is an integrated RTK GPS

Fig. 5 RiverSurveyor SonTek M9.

(real-time kinematic) system allowing a detailed localization of the performed measurements for direct conversion into the S-JTSK system of coordinates. Such accuracy is achieved with the signal available from 8–9 satellites, which in most cases is obtainable. Basic parameters of the employed product SonTek M9 are given in Table 2.

Tab. 2 RiverSurveyor M9 specification [Anonym 2010].

Velocity Measurement	
Profiling Range (Distance)	0.06 to 40 m
Profiling Range (Velocity)	±20 m/s
Accuracy	±0.25% of measured velocity
Resolution	0.001 m/s
Number of Cells	Up to 128
Cell Size	0.02 to 4 m
Transducer Configuration	Nine (9) Transducers
	Dual 4-beam 3.0 MHz/1.0 MHz
	Janus at 25° Slant Angle
	0.5 MHz Vertical Beam
Depth Measurement	
Range	0.20 to 80 m
Accuracy	1%
Resolution	0.001 m
Discharge Measurement	
Range with Bottom-Track	0.3 to 40 m
Range with RTK GPS	0.3 to 80 m
Computations	Internal

To prepare initial data for the hydrodynamic model using the SonTek software, we alternated the approach based on the ADCP-determined lateral profiles with the adjustment (recess) of DMT obtained only with the ALS data, generating the final data form.

By using this approach, the watercourse channel profile is recorded to DMR from the ALS data and individual lateral profiles obtained from the sonar location are mutually interpolated. This methodology is illustrated in Figure 6a and Figure 6b, showing the course of the lateral profile and additionally the distribution of point rates in individual vertices of the colour spectrum.

d) Preparation of initial data by conventional geodetic methods

This method alternates the employment of ALS data with data obtained by the conventional geodetic methods. The method is based on the standard approach currently applied to obtain relevant DMR with regard to river hydraulics.

Additionally located lateral profiles of the watercourse channel are used for the subsequent interpolation of watercourse inter-profile space, similarly as in the variant employing the SonTek product. Watercourse channel bathymetry determined in this way is then combined with the ALS data into final DMR, from which the schematization of the watercourse channel and adjoining inundation is generated.

4. Results and Discussion

To assess the relevance of individual approaches, we compared the scenarios with either the reduction of simulated discharge by the discharge level detected at the time of data acquisition using the ALS method, i.e. based on DMR generated from ALS only, or without reducing the simulated discharge, i.e. based on DMR with the adequately included water-course channel (ALS data + geodetic location), prepared in the variants combined with data from hydrological measurements (CroSolver), data obtained by sonar (RiverSurveyor SonTek M9), or data from the geodetic location of lateral profiles.

In the locations with the geodetically determined lateral profiles, we generated new lateral profiles based on DMR prepared by using the individual approaches (ADCP, hydrological analogy), and we then compared them with the geodetically located lateral profiles.

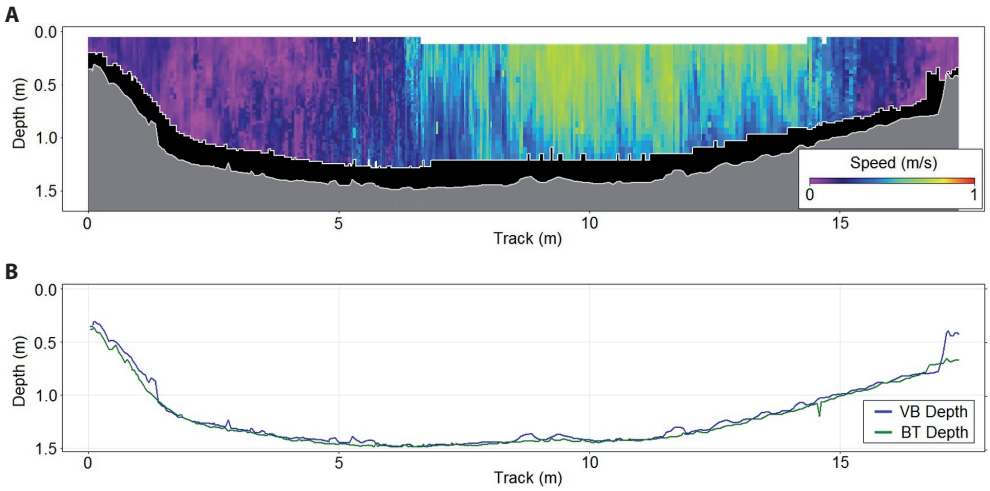

Fig. 6
A – Computing algorithm for the variant using the ADCP sonar (SonTek).
B – Computing algorithm for the variant using the ADCP sonar (SonTek).

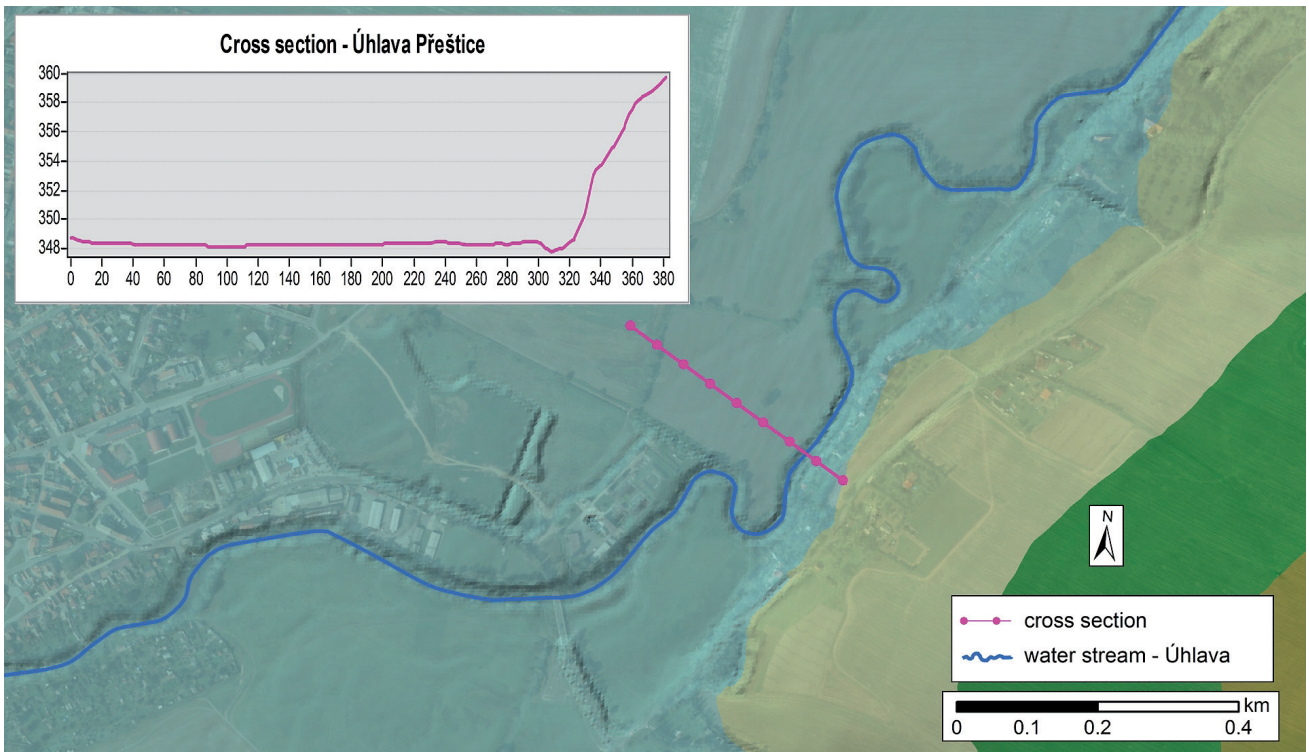

Fig. 7 Typical cross section.

The following results are presented for the lateral profile of the Úhlava watercourse near the town of Přeštice (Figure 7).

Figures 8–11 show lateral profiles for the individual considered variants. The *x* axis shows the length [m] of the lateral profile (its segment in the watercourse channel). The *y* axis shows the altitude [m above sea level].

The comparison of lateral profiles generated from the final DMT, i.e. after recessing the discharge reached at the time of ALS recording, with the geodetically located lateral profiles and profiles prepared with CroSolver shows good correlation, see Figure 12.

The results are also satisfactory for the modelling of the inundation zones themselves, including the scenario

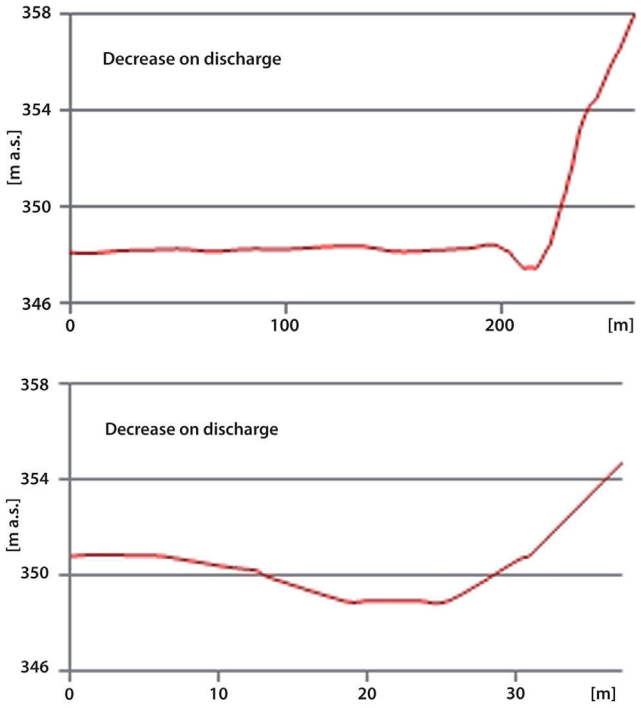

Fig. 8 a,b Option 1 – Decreace on discharge.

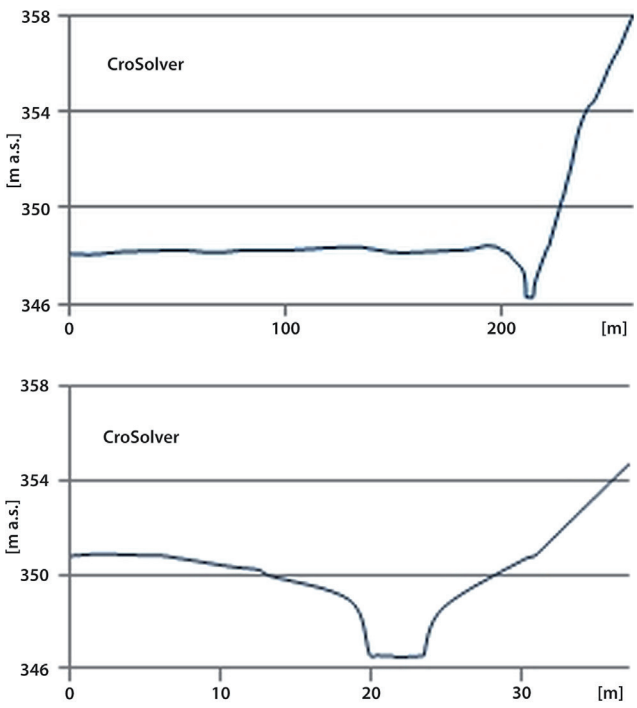

Fig. 9 a,b Option 2 – CroSolver.

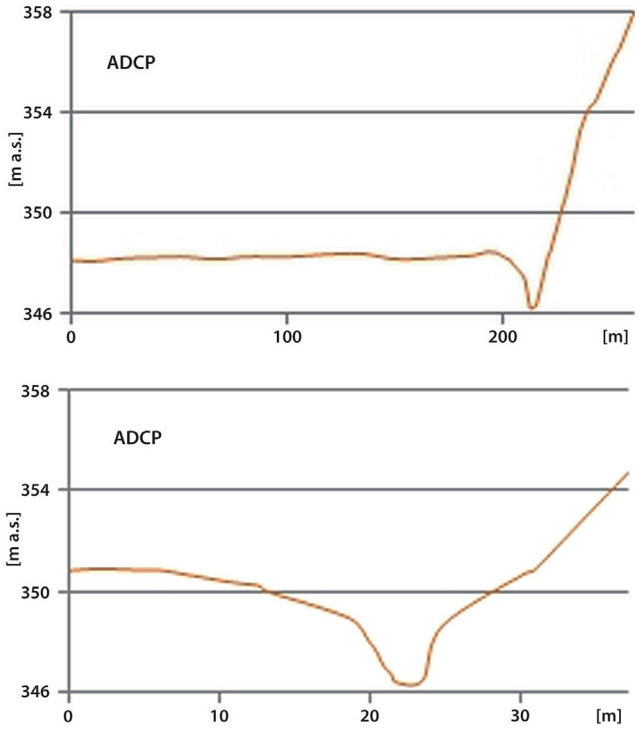

Fig. 10 a,b Option 3 – ADCP.

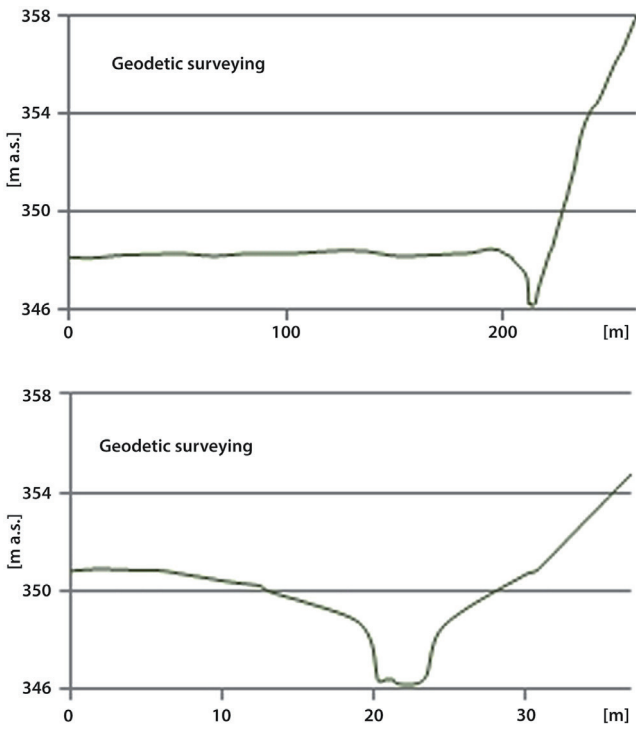

Fig. 11 a,b Option 4 – Geodetic surveying.

prepared with DMT without recessing the water channel course, which is simulated with reduced discharge.

Although the depicted lateral profiles do not reach absolute similarity, i.e. are not totally identical, the deviations are rather small and do not have subsequent effects on the results obtained with the hydrodynamic model.

Moreover, the application of the CroSolver software led to significant correlation of results even in the area between the individual lateral profiles within the 'inter-profile' area. These results were obtained by depicting new lateral profiles using DMR prepared by the CroSolver software in the area between the individual geodetically located lateral profiles (at a spacing of ca 90–120 m). These profiles were then compared with the additionally located profiles by conventional geodesy as well as with the lateral profiles from DMR prepared by expert interpolation of the original geodetically located profiles.

The comparison of lateral profiles from the interpolated inter-profile area with the additionally geodetically located lateral profiles shows that the lateral profiles obtained from DMR with the interpolated – manually edited – inter-profile area display high fluctuation as compared with the geodetically located profiles.

Furthermore, the accuracy of the lateral profiles from the manually edited inter-profile areas decreases with the increasing distance from the reference (geodetically located) lateral profile, resulting in channel profile over-sizing or under-sizing (Roub et al. 2012b).

An advantage in using ADCP methods in the preparation of watercourse geometry is also the acquisition of relevant data about the discharge profile of the watercourse within its entire longitudinal profile. However, time consumption and financial costs for obtaining the data are considerably higher as compared with methods based on the quantitative monitoring. With using the sonar, the lateral profile is recorded in detail and with high accuracy since it consists of a great amount of points. This situation, however, leads to inaccurate up to chaotic generation of watercourse channel in the inter-profile areas (at interpolation of lateral profiles). This particularly applies to segments with the pronounced watercourse meandering. A partial solution of this problem is the reduction of points in the respective lateral profiles. A more detailed specification of the inter-profile parts of watercourses is a subject of further development. In more or less straight segments, the generated course of watercourse channel is

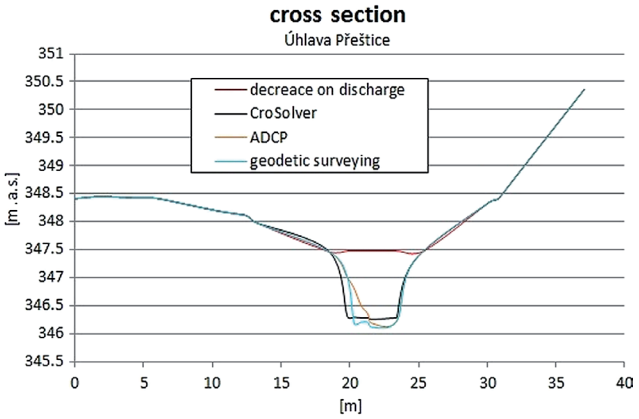

Fig. 12 Option 1–4.

of high quality and suitable for use in generating hydrodynamic models.

5. Conclusion

Data sources (DMR 4G, DMR 5G, DMP) obtained by mapping the altimetry of the Czech Republic represent a powerful tool, also serving other fields beside hydrology or river hydraulics.

The results of our analyses confirm the hypothesis that ALS data can be combined with data from hydrological measurements or with using the ADCP sonar to generate the computational geometry of the watercourse. Using the CroSolver software or the ADCP sonar, very good correlation of lateral profiles (established inundation zones) has been reached with the lateral profiles obtained by the geodetic location. The ADCP sonar-based approach was used in these analyses as a tool to verify the watercourse geometry and, at the same time, to compare discharge values from the monitoring network of quantitative hydrological monitoring performed by companies '*Povodí*' or CHMI. The limited data sources of detailed geodetic documentation available for in-depth reflection of the actual inter-profile area or time requirements for data acquisition by the ADCP sonar point out a possibility for a more extensive use of combined ALS data with hydrological analogy in practice. Wider application of such a combination based on the use of conventional geodetic methods for getting the altimetry data would also have positive consequences in reduced costs needed for setting up the hydrodynamic model itself. In the case of 'small' watercourses where the constant flow is irrelevant, we should automatically select the approach without recession by using the data from hydrological measurements, and the geodetically located profiles should serve for control only.

However, the indisputably best variant for the generation of relevant DMT seems to be the application of the above-mentioned dual-use lidar for mapping both the watercourse surface and the watercourse bottom. Greater use of this approach would have a positive impact not only on the generation of the hydrodynamic model alone, but also on the quantification of the retention volumes of water reservoirs as well as on a more accurate establishment of the retention space capacities.

Acknowledgements

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RÉSUMÉ

Srovnání podélného a příčného profilu vodního toku za použití přístupů založených na sonaru (ADCP) a hydrologických měření

Jeden z rozhodujících faktorů pro získání relevantních výsledků z hydrodynamických modelů, představují vstupní data pro schematizaci koryta vodního toku (Coveney et al. 2010). Dle požadavku na vstupní data je možné kvantifikovat i použité hydrodynamické modely, které budou pro prováděné simulace použity. Jednorozměrné (1D) hydrodynamické modely se vyznačují nižšími požadavky na vstupní data, kdy výpočetní trať je tvořena souborem příčných profilů koryta vodního toku, naproti tomu u dvourozměrných (2D) hydrodynamických modelů je nutné sestavit pro celé řešené území detailní digitální model reliéfu, tj. přilehlé inundace, ale i samotného vodního toku. S ohledem na vstupní data a použitý model roste i finanční náročnost celého projektu (Roub a kol. 2012a). V řadě případů dochází k významnému transformačnímu efektu povodňové vlny v samotném korytě, a proto je znalost podélného a příčného profilu řešeného vodního toku velice významná. Pro potřeby získání takovýchto dat, které budou v požadované přesnosti tyto podmínky naplňovat, byly alternovány konvenční geodetické metody s přístupy založenými na sonaru – ADCP (SonTek) – a výsledky ze softwaru Profile Solver, který byl cíleně sestaven pro potřeby získání výškopisné informace pod hladinou vodního toku.

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FLOW AND SEDIMENT SIZE VARIABILITY NAER GRAVEL BARS IN THE BESKIDY MOUNTAINS IN THE POLISH CARPATHIANS

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ABSTRACT

The purpose of the paper is to identify differences in hydraulic conditions in the areas closest to already-developed gravel bars situated in a small, mountain stream in the area of the Polish part of the Carpathian Mountains. Basic hydraulic parameters of flowing water, including velocity, shear stress, Froude number, Reynolds number and flow resistance coefficient were examined within the region of two different gravel bars in a mountain stream. At the same time, sediment samples were drawn from the riverbed in the area in which the hydraulic measurements were taken. After analysing the data, several conclusions were presented concerning sedimentation of gravel and hydraulic parameters within the cross section of a mountainous stream. The study was undertaken on Skawica-Jałowiecki Stream in the Polish part of the Carpathian Mountains called the Beskidy Mountains.

Keywords: gravel bar, shear stress, shear velocity, bedload, hydraulics parameters, mountain stream

"The River lifts itself from its long bed. Poised wholly on its dream" by Hart Crane, from *The River*.

1. Introduction

River bars are typical of all rivers and are mimicked in other linear shear flows (Church, Jones 1982). So far, no formal criterion has been developed for the presence of bars in terms of flow and sediment characteristics. Bars, defined as accumulations of sediment grains, or sand and/or gravel deposits (Whittow 1984), cannot develop if the flow depth is approximately equal to the minimum grain size (Church and Jones 1982). In alluvial channels, three types of bars are commonly recognized: alternating bars, point bars and braid bars (Selby 1985). Alternating bars form in straight channel segments within curves of meandering thawleg. Point bars develop in areas of relatively low stream power at the inside of channel meander. Braid bars, mostly diamond-shaped, are often associated with coarse material. They are aligned to the flow and are called longitudinal bars (Selby 1985).

Although bar forms have been commonly described in sandy or gravelly meandering rivers, little attention has been given to the role of obstructions in controlling geomorphic forms in coarse-grained environments (Carling and Reader 1981; De Jong and Ergenzinger 1995; Galia and Hradecky 2012). As far as the geometry of mountain streams is concerned, bars start to develop in the middle and lower reaches where the channels reach high width-to-depth ratios (Chang 1980; Radecki-Pawlik 2011). Deposition of a river bar is directly related to bend curvature, reflecting particularly the role of sharp bands in arresting sediment under lower energy conditions. Other reasons for bar depositions are obstructions or hindrances caused by large boulders or bedrocks (a common spot for the formation of re-attachment bars), or wooden logs behind which sediment is trapped.

There are only a few studies on the role played by bars in a gravel stream environment, particularly in shaping a river channel and stopping bank erosion as well as improving river fauna conditions (Wyżga et al. 2009, 2013). It is sometimes suggested that bars height should be treated as roughness elements to calculate channel bed roughness associated usually with the dimensions of grains that form the river bed (Radecki-Pawlik 2002b). This finding is of great interest, particularly in relation to high floods, since when one is talking about roughness elements under flooding conditions the dimension of particular gravel found on the river bed might be not sufficient to describe the real roughness conditions in the river.

The purpose of the current paper is to identifydifferences in hydraulic conditions in the areas closest to already-developed gravel bars situated in a small, mountain stream in the area of the Polish part of the Carpathian Mountains. The paper also describes a difference in bedload particle size that was found in the area in which the hydraulics parameters were examined.

2. Study area

The upper part of Skawica-Jałowiecki Stream in the Polish part of the Carpathian Mountains (Figure 1) is flashy and experiences frequent bedload movement. It is situated in the Carpathian flysch, and its streambed consists mostly of sandstone and claystone bedload

http://dx.doi.org/10.14712/23361980.2014.21
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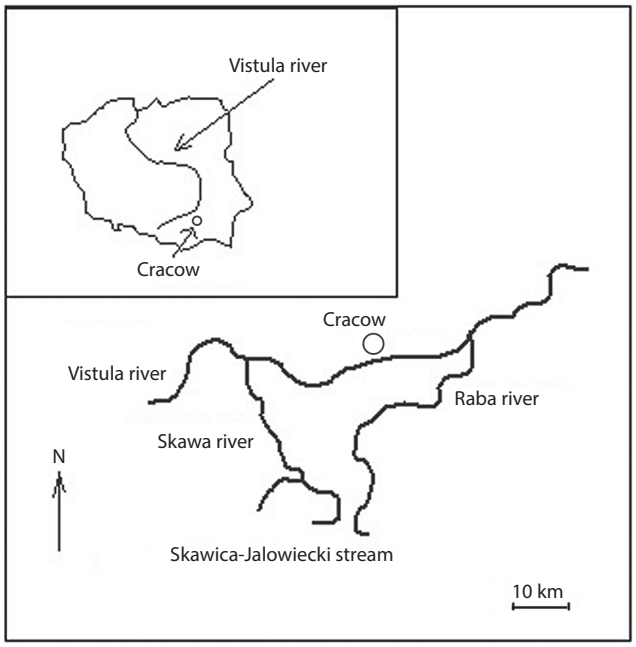

Fig. 1 Catchment study region.

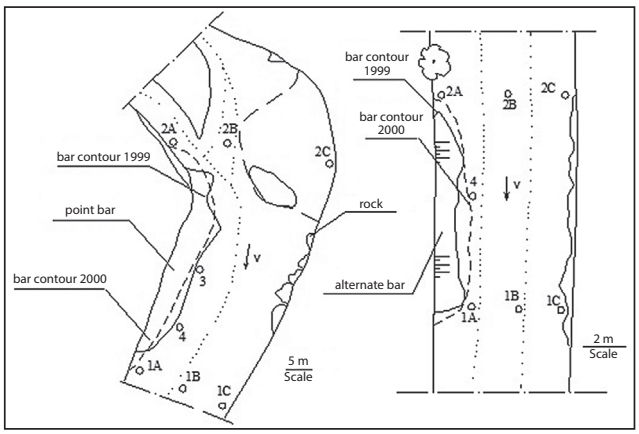

Fig. 2 Investigated gravel bars and measuring points.

pebbles and cobbles that form a framework, the interstices of which are filled by a matrix of finer sediment.

Tab. 1 Physical characteristics of Skawica-Jałowiecki Stream catchment.

Variables	Skawica-Jałowiecki Stream
Precipitation [mm]	1189
Catchment study area [km^2]	19.300
Maximum stream altitude [m a.s.l.]	1130
Minimum research point altitude [m a.s.l.]	594
Channel gradient (average within study area) [–]	0.085
Minimum annual discharge [m^3 s^{-1}]	0.020
Mean annual discharge [m^3 s^{-1}]	0.460
Bankfull [m^3 s^{-1}]	18.400
Two years flood $Q_{50\%}$ [m^3 s^{-1}]	11.300
Four years flood $Q_{25\%}$ [m^3 s^{-1}]	21.200
Five years flood $Q_{20\%}$ [m^3 s^{-1}]	23.950
Ten years flood $Q_{10\%}$ [m^3 s^{-1}]	38.400
One hundred years flood $Q_{1\%}$ [m^3 s^{-1}]	80.400

Suspended sediment loads are small and contribute insignificantly to channel morphology. Within the 1109.5 m long study reach, Skawica-Jałowiecki cuts through an alluvial bed, mostly Quaternary Holocene river gravel, sand and mudstone (Książkiewicz 1963). The upstream portion of the study reach just borders upon a Tertiary Palaeogene reach where mica-sandstone, sandstone, mudstone and phyllite predominate.

Many gravel river bed-forms, such as point and middle bars, can be seen within the investigated Skawica-Jalowiecki reach. Most gravel bed-forms have developed behind and in front of obstacles, and those situated at riverbanks (meander-bars) are quite stable. The detailed geology and geomorphology of the region has been described in Radecki-Pawlik (2002a). Some basic physical characteristics of the catchment study area are presented in Table 1.

3. Methods

For the purpose of the study, the 1109.5 meter-long research reach was selected within Zawoja municipality. Identification and field measurements of bed-forms were carried out during autumn 1999 and early spring 2000. The study was based on a hydraulic survey of water velocity close to the stream bed to calculate shear stress, drag coefficient and other hydraulic characteristics. Two well-developed stream bed features were recognized in the form of Point Bar A, situated downstream of a stream band at the upper part of the reach, and Alternation Bar B, an upstream-of-obstruction bar attached to the right bank of the creek (the obstruction in this case being a megacluster). Research cross-sections were established within the regions of the two bars, and measuring points were fixed within them. Wading velocity measurements were performed at all of these points (Figure 2).

Photo 1 Investigated gravel point bar in Skawica-Jałowiecki stream.

Photo 2 Investigated alternate point bar in Skawica-Jałowiecki stream.

Water velocity measurements were based on Jarrett's (1990) findings regarding the taking of velocity profiles in mountain stream cross-sections. It means that flow velocity was measured at 0.6 of depth measured from the surface (depth-averaged velocity) and 1 cm above bed surface (near-bed velocity) using Ott Nautilus C 2000 electro-magnetic current-meter. Gordon et al. (1992) and Bergeron, Abraham's (1992) methods were then applied to the field data, and shear velocity V_* values were calculated from the velocity profiles obtained near-to-river-bed. Finally, shear stress τ values were calculated from:

$$\tau = V_*^2 \rho \ [\mathrm{N\ m^{-2}}],$$

where ρ is water density [kg m^{-3}] and V_* is shear velocity [m s^{-1}].

Shear stress value (V_*) was obtained just directly from the equation $v = f(D)$ (Gordon et al. 1992):

$$V_* = a / 5.75,$$

where a is slope coefficient v = $f(D)$, according to the general line equation:

$$v = aD + b,$$

where D is water depth above the stream bed [m], b is free coefficient.

To calculate the flow resistance coefficient (f), the conclusions drawn by VenTe Chow (1967), Wijbenga (1990) and Przedwojski et al. (1995) were applied. Flow resistance coefficient was obtained from:

$$f = 8gJR/V_{mean}^2 = 8(V_*/V_{mean})^2,$$

where R is hydraulic radius [m], J is slope [–], V_{mean} is mean velocity [m/s].

The detailed methods used to obtain values for all of the above-mentioned parameters using classic hydraulics equations are shown in Radecki-Pawlik (2002a).

Samples of bed-load sediment deposits were also collected in the area in which the hydraulics data were

Tab. 2 Results of hydraulic measurements and calculations – point bar "a".

Point number	Water discharge (Q) [$m^3\ s^{-1}$]	Froude number (Fr)	Shear velocity (V_*) [cm s^{-1}]	Reynolds number (Re)	Shear stress (τ) [N m^{-2}]	Flow resistance coefficient (f)
1a	0.34	0.20	1.95	7,571	0.38	0.1225
1b	0.34	0.30	8.59	488,851	7.39	0.4367
1c	0.34	0.20	4.11	16,886	1.69	0.3021
2a	0.34	0.30	8.39	106,663	7.06	0.9053
2b	0.34	1.50	11.98	106,555	14.36	0.0543
2c	0.34	0.08	1.50	15,196	0.25	0.1466
3	0.34	0.44	4.48	38,862	2.01	0.0787
4	0.34	0.10	5.23	16,282	2.74	0.8835
1a	1.04	0.60	79.61	94,623	22.30	0.2823
1b	1.04	0.70	15.50	182,856	24.00	0.1414
1c	1.04	0.40	8.87	43,015	7.80	0.2885
2a	1.04	1.06	17.60	221,360	31.10	0.1015
2b	1.04	0.50	11.09	57,007	12.30	0.3239
2c	1.04	0.01	0.19	1,637	0.01	0.3136
3	1.04	0.80	31.77	211,493	100.93	0.0444
4	1.04	0.80	11.41	75,261	13.04	0.1555

Tab. 3 Results of hydraulic measurements and calculations: up-stream-of-obstruction bar "b".

Point number	Water discharge (Q) [$m^3 s^{-1}$]	Froude number (Fr)	Shear velocity (V_*) [$cm s^{-1}$]	Reynolds number (Re)	Shear stress (τ) [$N m^{-2}$]	Flow resistance coefficient (f)
1a	0.34	0.43	2.50	48,358	0.62	0.0205
1b	0.34	0.50	8.37	42,930	7.02	0.2255
1c	0.34	0.40	3.29	30,429	1.09	0.0505
2a	0.34	0.05	1.44	9,402	0.21	0.3765
2b	0.34	0.30	7.39	67,310	5.47	0.6687
2c	0.34	0.20	5.21	18,539	2.72	0.4038
4	0.34	0.04	0.56	2,341	0.04	0.2439
1a	1.04	0.53	6.49	53,784	4.21	0.0989
1b	1.04	0.60	17.27	214,292	29.80	0.1898
1c	1.04	0.60	19.29	136,091	37.20	0.3584
2a	1.04	0.08	2.69	9,056	0.87	0.9142
2b	1.04	0.90	13.38	195,812	17.90	0.0789
2c	1.04	0.54	5.63	159,169	3.10	0.0291
4	1.04	0.50	10.93	62,525	11.90	0.2891

Tab. 4 Characteristic grain size dimensions within the region of investigated point bars.

	d_5	d_{10}	d_{16}	d_{25}	d_{50}	d_{60}	d_{75}	d_{84}	d_{90}	d_{95}
alternate bar "b"										
1A	77.6	95.4	115.7	146.2	230.8	264.6	315.4	345.9	366.2	383.1
1B	14.8	25.0	39.6	55.3	72.3	74.5	77.8	79.8	109.5	138.7
1C	6.1	10.8	15.3	20.6	36.2	42.9	52.1	56.4	59.2	76.1
2A	15.0	28.5	34.9	42.9	73.2	96.6	131.6	152.6	166.7	178.3
2B	21.1	32.6	43.8	54.4	72.8	78.6	133.3	171.7	197.3	218.7
2C	7.8	13.5	19.8	29.2	45.4	52.0	76.2	111.8	135.5	155.2
4	22.1	33.0	46.9	70.8	75.4	77.3	80.6	120.0	146.2	168.1
point bar "a"										
1A	18.500	34.100	54.40	70.40	77.50	82.20	111.40	128.90	140.6	150.30
1B	41.200	70.200	71.10	72.50	76.40	77.90	90.10	151.20	192.00	226.00
1C	20.300	32.000	43.20	56.50	74.40	77.60	107.80	141.00	163.10	181.60
2A	15.800	25.500	36.40	52.60	74.70	77.50	105.70	143.30	168.30	189.10
2B	14.300	17.900	21.70	27.40	45.20	51.30	56.80	61.00	98.10	129.10
2C	0.002	0.003	0.01	0.02	0.13	0.21	0.34	0.41	0.47	0.51
3	11.100	18.900	28.90	49.30	94.30	117.40	152.10	173.00	186.60	198.40
4	24.600	37.900	50.40	60.90	76.30	80.00	136.20	170.00	192.50	211.20

Tab. 5 Percentage of different grain shapes of bed load.

Grain shape	Percentage
Spherical	4.43
Bladed	41.00
Disc-shaped and rod-like	54.57
	100 %

gathered. The technique of sampling described by Wolman (1954) was applied. Later, grain size curves were plotted and characteristic grain dimensions were read. Additionally, for grain shape analysis, 339 single grains were chosen randomly from the riverbed and carefully measured along axis b. Grain shapes were described according to Zingg (Gradziński et al. 1986; Gordon et al. 1992).

4. Results

For reasons of clarity, all results obtained are presented in tables. Tables 2 and 3 show all hydraulics parameters measured and calculated above the research points within the regions of the investigated bars (Figure 3). Wading measurements were taken under two discharges. The first was Q = 0.34 $m^3 s^{-1}$, which is close to the mean annual flow (Q = 0.46 $m^3 s^{-1}$) (Table 1). The second discharge was a spring flood, when Q reached 1.04 $m^3 s^{-1}$. In the case of the second discharge, bedload movement under these conditions was observed. Sediment samples were taken from all the places in which the velocity measurements were done, right after the water dropped. The sediment data are presented in the form of characteristic

grain dimensions (Tables 4), and as shape dominant grains (Table 5).

5. Discussion and Conclusions

The sediment deposited within the region of the investigated bars varied in diameter along the structure as well as across the cross-sections of the stream. In general, d_{50} was between 36.2–230.8 mm (a representative grain size), d_{16} between 15.3–125.7 mm, and d_{84} between 56.4–345.0 mm. The biggest differences in sediment diameters were observed along Alternate Bar B. Along Point Bar A, coarser sediment was deposited very close to the bar structure (Point 3) where the highest value of shear stress (τ = 100.93 N m^{-2}) was noted, as well as the highest value for shear velocity (all calculated for Q = 1.04 m^3 s^{-1} flood discharge). Above Point 2B, the biggest shear stress value (τ = 14.36 N m^{-2}) was found under mean annual flow conditions (Q = 0.34 m^3 s^{-1}). In this case, Fr was > 1, whereas at 2B under Q = 1.04 m^3 s^{-1} Fr was < 1 and shear stress and shear velocity were significantly smaller than under mean annual flow conditions. In the latter case, the water appeared to behave as it does above a typical riffle in a riffle-and-pool sequence when reversal velocity phenomena are observed. Point 2C is extraordinary in that it lies in the shadow of rock piled up on the streambed. A huge amount of fine sediment is deposited here, and Fr remains < 1, even under flood conditions.

Along Alternate Bar B, coarser sediment was deposited at Points 1A and 4, again close to the bar structure. The highest values of shear stress under flooding conditions were above Points 1B and 1C. The biggest shear stress value under annual discharge was again observed at Point 2B. The finest sediment was deposited along the left bank of the stream – opposite to the developed alternate bar structure. Point 2A was in the shadow of the bar, and shear stress and shear velocity were smallest here. The thawleg line, in the contest of hydraulics parameters, appeared to work like a vertical riffle within the reach. Along that line, Fr, shear stress and shear velocity were the highest under both run discharges.

When analyzing the sediment we observed that his sediment size variation is characterised by a complex pattern rather than a simple decreasingtrend and by a relatively low overall rate of fining, similar like in Surian 2002. But since the distance along which we did investigations was relatively short we could not find any connectivity's (again in Surian 2002; Liebaultand Piegay 2001). We observed that the trends in grain sizes observed along the barsmight differ with scale – and also significantpredictor of grain size is site location because localchannel width appears to strongly influence the parametersof grain size (compare Rengers and Wohl 2007). We also associated the changes of sediment sizes with discharges (Emmett and Wolman 2001) through values of shear stresses we calculated. And finally we observed that since the coarser sediment in a cross-section is deposited along the outer line of developed bars, we might presume that it is due to flow through the gravel (here groundwater) along the bars (compare Bunke and Gonser 1997; Carling et al. 2007). Thus, the following conclusions were drawn from the analysis of hydraulic and sediment results within the regions of the investigated bars:

1. Coarser sediment in a cross-section is deposited along the outer line of developed bars. Thus, bars are in a constant process of build-up. The distal part of the bars appears to be particularly stable.
2. Fine sediment is deposited at the opposite bank to where the bars are formed. Shear stress, FR and shear velocity values are the smallest here.
3. Fine sediment is deposited at spots within the stream reaches called "shadows", even under flood conditions. Such shadows may be found behind rocks and/or proximal part of bars.
4. In the case of Alternate Bar B, the highest values of shear stress, shear velocity and Froude number are found along the thawleg linelying approximately in the middle of the stream cross-sections within a bar region.
5. For Point Bar A, the highest Froude number is observed in the proximal part of the bar, at the entrance between the bar and the opposite bank, along the thawleg. Under annual flow conditions, it is possible to find places within a region of point bar that function similarly to riffle-and-pool sequences, where reversal velocity phenomena are observed.
6. With respect to the shapes of grains deposited in mountain, alluvial streams, the highest percentage are disc-shaped and rod-like. The next highest percentage are bladed. Spherical grains are a very small percentage less than 5%.

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RÉSUMÉ

Flow and sediment size variability in different gravel bars region – the Beskidy Mountains in Polish Carpathians

The purpose of the paper is to identify differences in hydraulic conditions in the areas closest to already-developed gravel bars situated in a small, mountain stream in the area of the Polish part of the Carpathian Mountains. Basic hydraulic parameters of flowing water, including velocity, shear stress, Froude number, Reynolds number and flow resistance coefficient were examined within the region of two different gravel bars in a mountain stream. At the same time, sediment samples were drawn from the riverbed in the area in which the hydraulics measurements were taken. After analyzing the data, several conclusions were presented concerning sedimentation of gravel and hydraulics parameters within the cross section of a mountainous stream. The study was undertaken on Skawica-Jałowiecki Stream in the Polish part of the Carpathian Mountains called Beskidy Mountains. The following main conclusions were drawn from the analysis of hydraulic and sediment results within the regions of the investigated bars: coarser sediment in a cross-section is deposited along the outer line of developed bars; fine sediment is deposited at the opposite bank to where the bars are formed thus shear stresses, FR and shear velocity values are the smallest here; fine sediment is deposited at spots within the stream reaches called "shadows", even under flood conditions – such shadows may be found behind rocks and/or proximal part of bars; with respect to the shapes of grains deposited in mountain, alluvial streams, the highest percentage are disc-shaped and rod-like – the next highest percentage are bladed, whereas spherical grains are a very small percentage less than 5%.

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COMPARISON OF TWO FLOOD RISK ASSESSMENT METHODS IN THE CASE OF THE TURIEC RIVER, SLOVAKIA

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ABSTRACT

Floods are the most common natural process causing damage to property and loss of life in our geographical area. Efforts to reduce the risk of flooding require methods for assessing the flood risk. Application and comparison of these methods in the same area allows us to describe the differences which could not be discovered only by studying the procedure of these methods. Two methods of flood risk assessment and their outputs were compared in one part of the Turiec River in Slovakia. Results of these methods are different flood risk maps while the key difference is the definition of risk. Risk is defined on the entire surface of the modelled scenarios in the case of the risk map based on Method I. In Method II, flood risk represents an area with unacceptable risk which means the risk where the threshold value has been exceeded. The two methods obtained similar results regarding areas subject to the greatest risk of flood damage. However, Method II appears to be more effective. It uses flood depth and flood velocity information and includes creation of a Flood danger map – a suitable tool for urban planning. The method focuses only on the localities where it is urgent to reduce the flood risk.

Keywords: Flood risk assessment, Flood hazard map, Flood risk map, HEC-RAS, Turiec

1. Introduction

The recent floods in Europe, especially on the Odra and Morava (1997), Elbe (2002), Rhone (2003), Danube (2006) and in the UK (2000) brought the need for a common strategy for flood risk management at European level (Pender et al. 2011). The answer was the European Directive on the assessment and management of flood risks (Directive 2007/60/EC) with the unofficial name – Flood Directive, which was reflected in the laws and regulations at national level and is currently being implemented in EU member states, not excluding the Czech and Slovak Republic. The first phase of the Flood Directive ended in 2011 and was aimed at creating Preliminary Flood Risk Assessment. The second phase was done in the end of the year 2013 and brought requirement for the creation of flood hazard and flood risk maps and finally the third phase is aimed at producing Flood Management Plans with the end of 2015 deadline (Directive 2007/60/EC). Consequently, there was a need for new methodologies for creating flood hazard and risk maps and Method II used in our evaluation is the result of this process in the Czech Republic (ENV 2009). It was confronted with an older method by Gilard and Givone (1997) which was applied to the study area by Ruman (2011).

There are a considerable number of similar and different methods for flood risk assessment, created by the demands of different groups of interest (insurance companies, governments ...), an overview is provided by Říha (2005) in his work. There is also notable amount of literature focused on the comparison of different approaches to this problem, such as the Barets's work (Barets et al. 2013), the parametric approach and an approach based on the output from the hydraulic models in one area were compared; and the Moel's work (Moel et al. 2007) where the author evaluated the degree of development in flood risk assessment of the EU member states. Comparison of methods creates an image of different approaches to the flooding issue and eases the selection of an adequate methodology for solving a given problem in a specific region.

2. Methodology of evaluation

For comparison purposes, two methods of flood risk assessment have been chosen and are described below. Steps of evaluation have been as follows:

- Creation of flood extents, flood depths and flood velocity maps
- Explanation and comparison of procedures and techniques of both methods leading to creation of Flood Risk maps
- Access of input data
- Confrontation of created Flood Risk Maps
- Comparison of area of risk within the highest risk categories

Creation of flood extent, flood depth and flood velocities maps were done by one dimensional hydraulic modelling (HEC-RAS) of all simulated scenarios.

Because it was intended to evaluate both methods, several input data were set up equal. Firstly, there were

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Ruman, S. (2014): Comparison of two flood risk assessment methods in the case of the Turiec river, Slovakia
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simulated scenarios of return period. The original return periods in Method I were as follows: T_1, T_2, T_5, T_{10}, T_{50} and T_{100} (where T is the return period), while in Method II they were: T_5, T_{20}, T_{50}, T_{100} and T_{500}. The flows of all return periods are displayed in Table 1. One of the goals of this work has been to create risk map based on Flood Directive. However, at the time of creation there was no Slovak methodology implementing Flood Directive in the context of the Slovak Republic and we have only adopted return periods defined in the Slovak legacy (SR, 2010) – T_5, T_{20}, T_{50}, T_{100} and T_{1000}. Secondly, there were categories of land use which were applied from Method II.

The land use category Water was delineated too. However, there was no assessment of risk connected with water areas, because both methods evaluate risk on water equal to zero. Computation of the whole equation was ongoing in ArcGIS interface and an inundation created by T_{1000} was marked as residual due to low probability of occurrence of such a big event.

3. Study area

The river Turiec is 77.4 km long, situated in northern Slovakia. Flow regime is rain-snow (Šimo and Zaťko in Atlas Krajiny SR, 2002) and mean annual flow at gauging station Martin – Turiec (river stationing 6.55 km) is 10.9 m^3/s. Part of the river – 13.15 km long segment – was chosen for comparison purposes. The segment begins at Turiec mouth on the river Vah and ends just after the village called Košťany nad Turcom. In the study area, the river flows through the towns Martin and Vrutky and through the village Košťany nad Turcom (Figure 1). The river channel characteristics are clearly urban at this point. From the outlet up to the river station 1.0 km the sides of the channel are covered by concrete and the river bottom is covered by stones. Afterwards, the river straightens out and the banks are covered by grass, the bottom by stones, the channel is trapezoidal in shape. Levees were built at several places sometimes 3 m high above the ground. There are 14 big bridges and two small dams designed for T_{50} flows and other small structures. In the landscape, mainly in meanders, the sides are beaded by stones, covered by grass or roots of trees.

4. Creation of flood risk map based on Method I

Method I is based on the work of Gillard and Givone (1997), later developed by Trizna (1998), Pfefferova (2010) and applied to Turiec river study area (Ruman 2011). The method is quantitative and flood risk is shown using a scale. Detailed methodology is explained in the mentioned works and the sequence of main steps is as follows:

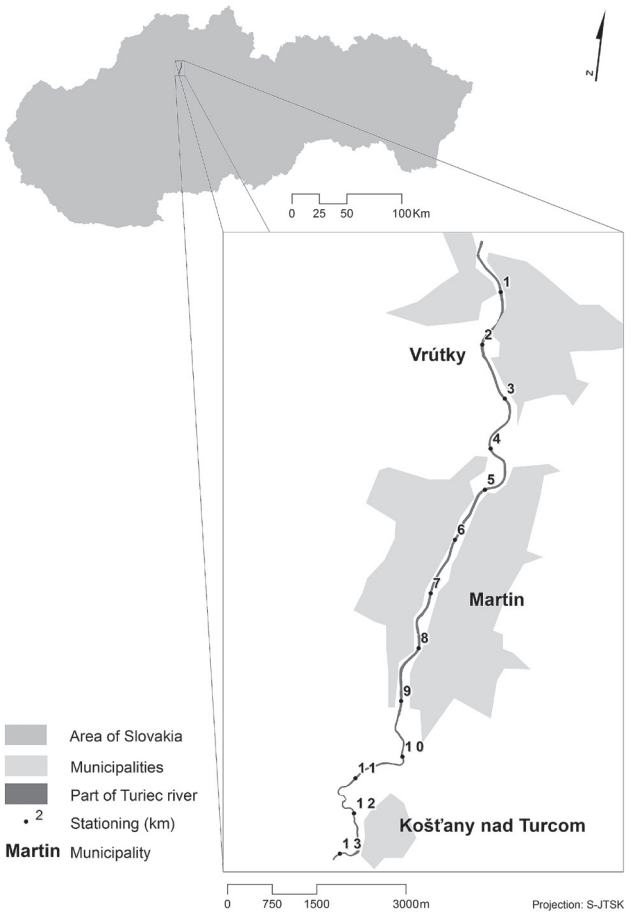

Fig. 1 Map of study area.

- Creation of land use map
- Creation of price map
- Vulnerability assessment
- Flood risk identification

Ten original land use categories have been delineated in this method, namely, Housing, Public Facilities, Manufacture and Fabrication, Transport, Sport and Recreation, Meadows, Broadleaf Forest and Arable Land. However, these have not been used in the comparison. Land use categories were adopted from Method II and are displayed in Table 1.

Price map has been based on prices of land in urban areas from the year 2011 (Špirk, 2011) and due to absence of up-to-date data the land prices in countryside have been taken from the year 1998 (HP, 2011).

It is necessary to define the vulnerability, i.e. the predisposition of the area to damages caused by low resistance against the flood. The vulnerability assessment has been based on the relation: $V = W \times P$, where V is vulnerability, W is weight and P is price of land. The weights have been assigned to all land use categories (Table 1) in order to highlight the vulnerability. The higher the weight, the higher the importance of the category. To eliminate the subjectivity during this process we have used the Saaty

Tab. 1 Land Use categories used in both methods, Weight Assigned (Method I) and Acceptable Risk (Method II).

Method I and Method II		Method I	Method II
Type of land use	**% of area**	**Weight assigned**	**Acceptable Risk**
Housing (HO)	27.72	0.22	Low
Manufacture and Fabrication (MF)	15.90	0.11	Low
Public Facilities (PF)	5.96	0.11	Low
Transport (including stations) (TS)	2.52	0.06	Low
Sport and Recreation (SR)	1.09	0.03	Medium
Green	36.10	0.01	High
Water	9.98	x	x

(1977) method. The result of this step has been the map of vulnerability.

Risk in the study area was obtained by the combination of vulnerability (V), threat (T) and area (A), thus: R = V × T × A. The threat is defined as an average annual frequency in percentage (Table 2) of particular scenario and the Threat map is the map of the scenario extent. The area A is expressed in m^2 and represents the area obtained by the intersection of the Threat map and the Vulnerability map in ArcGIS interface.

Afterwards, 7 categories of risk were created marked from II to VIII, while the criterion for intervals was to achieve similar number of risk values in all intervals. The original method contains 7 risk categories, but we have added another one labelled I. Category I covers the inundation caused by T_{1000} and is referred to as the residual risk. The risk is gradually increasing through the category II up to the category VIII (meaning the highest risk).

5. Creation of flood risk map based on Method II

Method II has its origins in the Swiss methodology (FOWM, 1997), adjusted for the context of the Czech Republic (ENV, 2009). It is a semi quantitative method which does not need to conduct a quantitative evaluation of damages caused by an inundation and where the flood risk is expressed by scaling. However, this method is based on a risk matrix in combination with principles based on expressing the maximum acceptable risk.

The steps of this method are as follows:

- Quantification of flood hazard – calculation of flood intensity
- Assessment of flood danger by risk matrix
- Vulnerability determination based on land use
- Designation of areas with an acceptable risk

Flood hazard can be defined as a threat of flood which causes loss on life and damage to property or landscape. The quantification of flood hazard has been achieved by calculation of flood intensity (FI). FI is the parameter which expresses the flood hazard and it is the function of flood depth d [m] and flood velocity *v* [m/s] (FOWM 1997; Dráb, Říha 2010).

Flood danger is the combination of the probability of the flood occurrence and the flood hazard. The main difference between the danger and the risk is, the danger is not related to the land use. Partial flood danger Di was calculated for i-modeled scenario equal likelihood discharge with return period Ti and with likelihood of probability pi. Procedure has to be repeated for all modelled scenarios and finally the overall danger is computed. Values of danger are divided into four categories and the Flood danger map is created.

Vulnerability, similarly as in Method I, is defined as the predisposition of the area to the damages caused by low resistance against the flood. In Method II 8 vulnerability categories are defined, namely, Housing, Mixed Areas, Public Facilities, Technical Infrastructure, Manufacture and Fabrication, Transport, Sport and Recreation and Green. Categories found in the study area are displayed in Table 1. Furthermore, the so called Sensitive objects are defined in Method II. These are the objects with particular importance, such as hospitals, police stations, schools, etc. (altogether 7 categories). However these objects were not used during our assessment, therefore they are not displayed in the final map.

The risk is the synthesis of the effect of flood danger, vulnerability and exposure. Exposure is a state when the objects in the inundation area are exposed to the flood hazard. Furthermore, Method II uses a term "acceptable risk", with an aim to delineate areas where flood measurements should by done first, e.g. to delineate areas where

Tab. 2 Selected characteristics of modelled scenarios.

Modelled scenario	T_5	T_{10}	T_{50}	T_{100}	T_{1000}
Flow (m^3/s)	150.00	190.00	285.00	335.00	500.000
Area of inundation (m^2)	121,510.00	872,355.40	1,283,755.00	1,458,155.00	4,651,155.000
Whittled areas of scenarios (m^2)	121,510.00	750,845.40	411,400.00	174,400.00	3,193,000.000
% of all area	2.61	16.14	8.85	3.75	68.650
Probability	0.50	0.10	0.02	0.01	0.001
Average annual Frequency in %	50.00	10.00	2.00	1.00	0.100

the risk is unacceptable. In our case this term refers to land use categories which are accepted to be flooded (Table 1). Unacceptable risk has two categories, middle and high. For more detailed information about procedures in Arc GIS see work of Dráb (2006).

6. Results

6.1 Evaluation of both methods

Method I utilizes the probability and is quantitative while Method II uses an average annual frequency in percentage and is semi-quantitative. Originally they are using different land use categories and different return periods, however, for comparison purposes the land use categories were used from Method II and the return periods from the Slovak legacy.

In Method I, the flood hazard is defined as the flood scenario with annual average frequency in percentage, in the latter it is the function of flood intensity.

Both methods are able to assess flood risk in the study area and there is a possibility to propose flood defences. Nevertheless, there is still a demand for further research to investigate cost-benefits of these defence structures. However, proposals are easily made when using Method II, because only the localities with unacceptable risk are displayed.

Method I is a little bit more data demanding due to the requirement to obtain land price information. However, procedures in the Method I are more difficult and both methods require GIS software for processing.

There are also disadvantages in both methods; mainly broad definition of land use category (category Green) which includes forests, grassland as well as agricultural land. The reason can be found in preference of risk in built up areas in Method II.

There is a connection between the set up of categories with unacceptable risk and the use of price map and weights which clearly shows dominant economical and social aspects in overall assessment. Although in case of Method II there can be displayed the sensitive objects which bring further aspects into the assessment.

Advantages and disadvantages of both methods

A. Method I:

Advantages

- Value of area (m^2) at risk is included in the assessment. There is clearly a correlation between the area and the resulting value of flood risk.
- The price of land parcels forms part of the assessment.
- Original method utilizes more land use categories covering wider range (arable land, meadows etc.).

Disadvantages

- Depth and velocity of flow are important factors influencing the scale of damages. However, the method, assumes that the same risk applies to the locality with depth of 5 cm as to the one with depth of 2 m.
- The weight given to each land use category should be rather based on an expert estimation and agreement of scientists from various disciplines.
- The list of defined land use categories is not complete. In different areas can be found other categories (coniferous or mixed forest, mixed areas, etc.).
- The definition of intervals is based just on the data from the study area. Clearly we need a definition which takes into account all possible values also in other areas.
- The price of land in countryside is taken from the year 1998 which is clearly not up-to-date.
- In this condition the method is suitable only for local risk assessment when the comparison with other areas is not necessary.

B. Method II:

Advantages

- Information about flood depths and velocities is included.
- Expert estimation is made out of acceptable risk in land use categories.
- "Flood danger map" is a useful tool for urban planning.
- Unacceptable risk highlights areas where the flood control measures should be made first.
- Sensitive objects can be included into the map, bringing the information about the important objects in the study area.
- Risk assessment on national level.

Disadvantages

- Broad definition of land use category Green.

6.2 Evaluation of flood risk maps

Flood risk maps differ significantly, see Figure 2. The main difference is that either whole area affected by flood scenario lies within the explicit risk category (Method I)

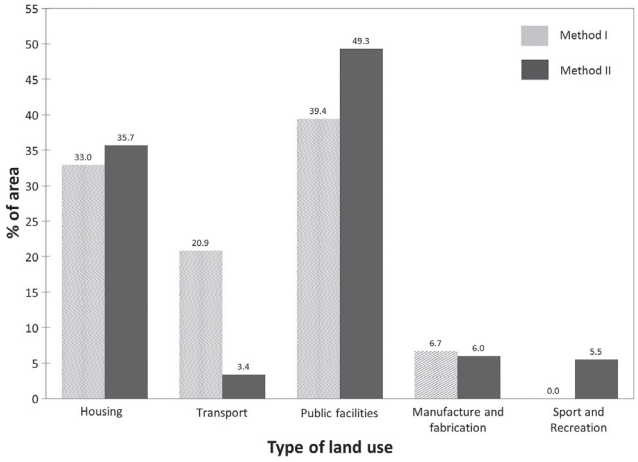

Fig. 2 Comparison of land use categories from both methods in categories "VIII" and "High" (Types of Land use are according to Table 1).

or the risk is designated at places, where the unacceptable risk was found.

A comparison of the risk areas with the highest risk (category VIII and High) of both methods shows that the area which fall into the category VIII and High, is very similar (Table 3). It is located exclusively in urban areas of debated municipalities. The area, which is identically identified by both methods covers 3.54% (164,560.97 m^2) out of the total considered area (Figure 3). This can be caused by two reasons. Firstly by ranges of risk intervals in Method I. Secondly by weighted factor assigned to categories of land use for the Method I and the definition of acceptable risk for land use categories in Method II, as shown in Diagram 1. Diagram 1 shows that the areas of land use categories in the two highest categories of risk methods are very similar. There remains the question of how important the setup of ranges in risk intervals was in case of Method I. The answer would require expanding of comparison to other territories.

Tab. 3 Comparison of highest risk categories areas from both methods.

Name of method and type of category	Area (m^2)	% of all assessed area
I. (VIII)	236,471.05	5.08
II. (High)	204,834.70	4.40

Land prices considered in Method I appear to have no significant effect on the results. To some extent, this can be explained by the fact that the highest price of land can be expected in the category "Housing", while the lowest in the category "Green" (what does not always correspond to the reality). Clearly, application of the not up-to-date price in the countryside highlighted these areas too.

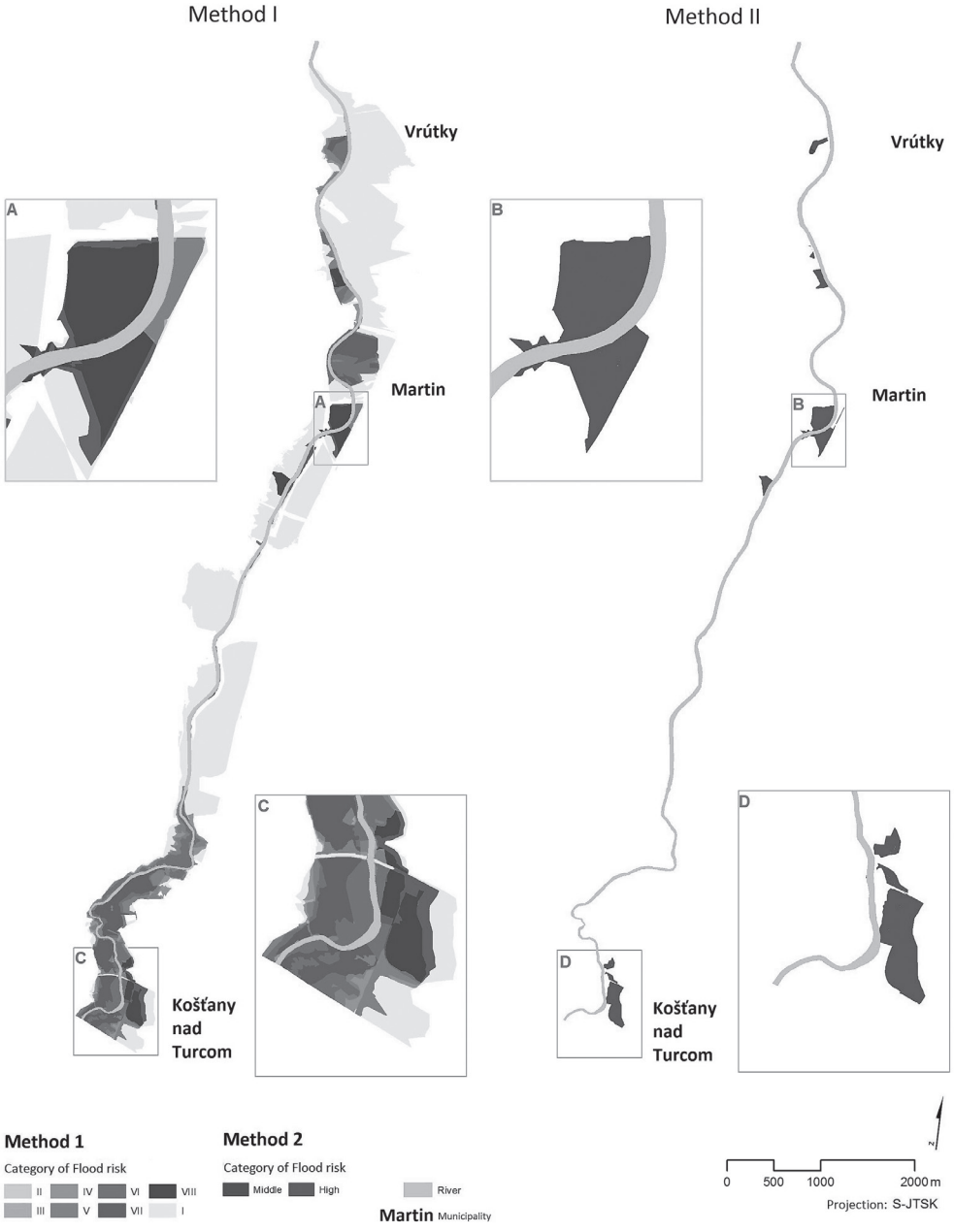

Fig. 3 Comparison of flood risk map assign by Method 1 and Method 2.

7. Discussion and conclusion

Different flood risk maps have been developed as a result of application of two methods of flood risk assessment in the 13.15 km long part of the river Turiec. The fundamental difference is the aim of the methods. While the first one pretends to assess the risk in whole flood scenarios, Method II shows only areas where the attention should be paid.

This means, the decision where to locate flood defenses or to adopt flood control measures is easily made in Method II, while in Method I it is not so clear.

Even though both methods use different procedures in the assessment process, similar results were obtained when comparing the areas in the highest risk categories, Method II is more effective than the first one. It takes into account flood depth and flood velocity maps and one of the results is Flood danger map as a base for urban planning.

Method I is a little bit more data demanding due to the requirements to obtain land price information. However, procedures in Method II require better knowledge of Arc GIS.

The resulting flood risk maps may be affected by several factors which may be divided according to the data entering the process into two groups: the factors affecting hydraulic calculations and the factors affecting risk assessment. The factors affecting hydraulic calculations are mainly associated with possible changes in the shape

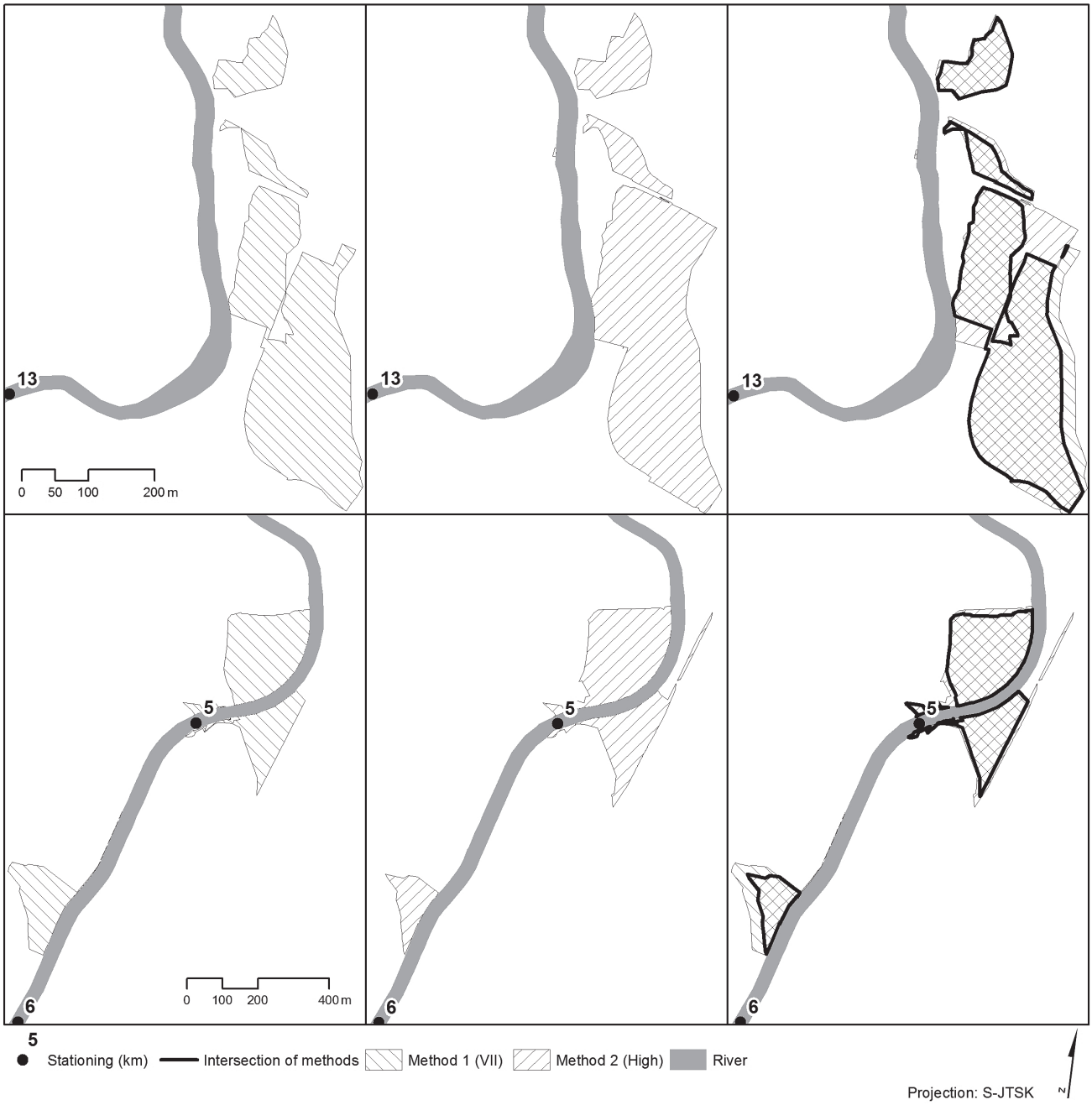

Fig. 4 Differences in areas of flood risk cathegories (VII and High) identified by both methods.

of the river channel, roughness conditions (land use), the construction of new flood defenses, the uncertainty of input data and the choice of hydraulic model (Horits and Bates 2002). In particular, uncertainty in DEM significantly distorts the extent of floodplains as well as depth and velocity (Cook and Merwade 2009; Sanders 2007). In our case, the obtained DEM had vertical accuracy of 0.8 m. Also the usage of a hydraulic model in the process of flood risk management enables us to assess the current state of the system. Nevertheless, it is clear, processes occurring in the floodplain and in the river channel itself are dynamic in nature and therefore non-stationary (Pender et al. 2011).

The latter group is formed by factors affecting data entering into the process of risk assessment itself. These are particularly the topicality of urban plans, the land use in open country and land prices. Here it is necessary to note, that when creating the risk map there were used only actual land use categories based on the current state of urban plans in municipalities. However, in case of both methods it is possible to consider possibilities for development. Risk maps are subjects of change and Method II requires repeated generation of these maps every six years (ENV, 2009).

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RESUMÉ

Porovnání dvou metodik hodnocení povodňového rizika na příkladu řeky Turiec, Slovenská republika

Směrnice Evropského parlamentu a Rady ze dne 23. října 2000 2007/60/ES o vyhodnocování a zvládání povodňových rizik (Directive 2007/60/EC) je v současnosti implementovanou strategií v oblasti povodňové problematiky v zemích Evropské unie. Strategie je rozdělena na tři hlavní fáze s přesně definovaným termínem ukončení. Fáze jedna – Předběžné vyhodnocení povodňových rizik (2011), Fáze dvě – Mapy povodňového nebezpečí a povodňových rizik (2013) a Fáze tři – Plány pro zvládání povodňových rizik (2015). Pro splnění druhé fáze bylo nutno vytvořit postup tvorby těchto map. Metodika, která je výsledkem zmiňovaného procesu v České Republice (v příspěvku s názvem: Metoda II), je v předkládaném článku konfrontována s metodikou dle Gilarda a Givone z roku 1997 (v práci s názvem: Metoda I).

Pro porovnání byl zvolen 13,15 km dlouhý úsek řeky Turiec situovaný na severním Slovensku protékající městy Martin, Vrútky a obcí Košťany nad Turcom.

Prvním krokem hodnocení bylo vytvoření map hloubek a rychlostí na zkoumaném úseku s povodňovými scénáři představujícími N-leté vody (N_5, N_{20}, N_{50}, N_{100} a N_{1000}) pomocí jednodimensionálního hydraulického modelu HEC-RAS. Následně byly porovnány postupné kroky obou metodik, výsledné mapy rizika a zhodnocena náročnost metodik na vstupní data. Posledním krokem analýzy bylo porovnání rozlohy území zařazených do kategorie s nejvyšším stupněm povodňového rizika.

Obě metodiky uvažují s pravděpodobností a jsou schopné určit povodňové riziko a na jeho základě navrhnout případné protipovodňové opatření, resp. zaměřit se na nejvíc rizikové plochy. V případě Metody II je však identifikace těchto ploch výrazně snadnější. Nicméně pro určení efektivnosti opatření by bylo potřebné vypracovat kvantitativní analýzu škod způsobených povodní.

Z hlediska sběru dat je o něco náročnější Metoda I, která vyžaduje i cenové mapy oblasti. Avšak náročností zpracování dominuje Metoda II vyžadující údaje o rychlosti proudění a hloubky vody v toku a inundaci. V obou případech bylo použito nástrojů GIS. Jako nevýhodné se jeví značně široké definování kategorie využití země „zeleň". Ta zahrnuje lesy, louky, ale i ornou půdu. Jak Metoda I používající cenové mapy, tak Metoda II aplikovaná v ČR definující přijatelné riziko pro jednotlivé kategorie využití země, poukazují na převládající ekonomické a sociální hledisko vyjádření rizika.

Výsledné mapy povodňového rizika se výrazně odlišují. Metoda I vychází z předpokladu, že celá oblast zasažená povodňovým scénářem má definován určitý stupeň (kategorii) rizika. Metoda II však určuje stupeň rizika na základě překryvu mapy využití země (s definovaným přijatelným rizikem) a mapy ohrožení.

Rozloha ploch s nejvyšším povodňovým rizikem je v obou metodikách přibližně shodná. Tyto plochy jsou situovány výhradně v intravilánech zkoumaných obcí. Podobnost těchto výstupů může být dána jednak definováním intervalů rizika v Metodě I a jednak určením stupně významností pro jednotlivé kategorie využití země v případě Metody I a přijatelného rizika, které je definováno pro každou kategorii využití země, v případě Metody II. Ceny pozemku uvažované v Metodě I pravděpodobně nemají značný vliv na výstupy (Mapy povodňového rizika). Do určité míry je možno tento jev vysvětlit skutečností, že nejvyšší cenu pozemku lze očekávat v kategorii „Bydlení", nejnižší v kategorii „Zeleň" (to však ne vždy musí odpovídat realitě).

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