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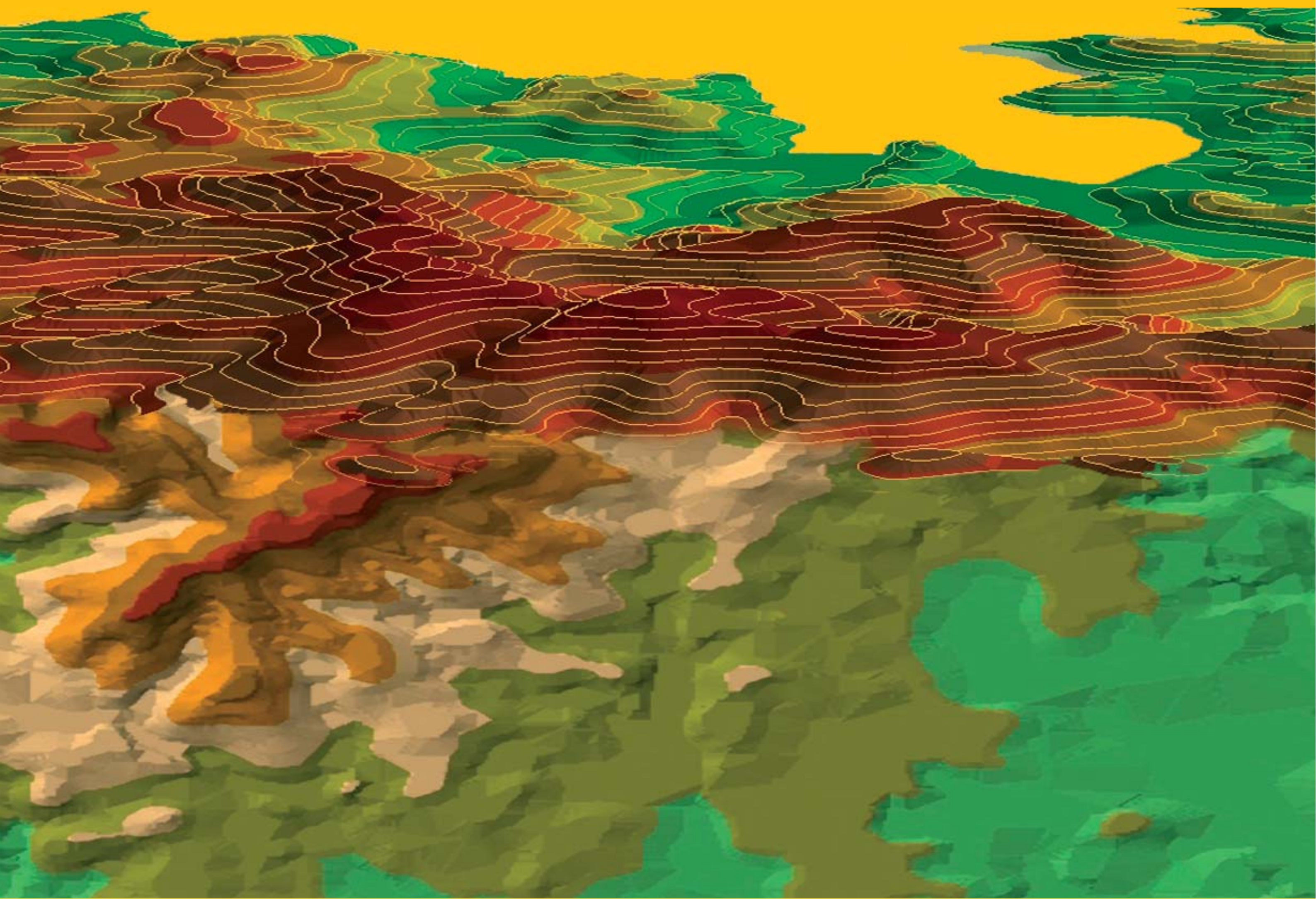

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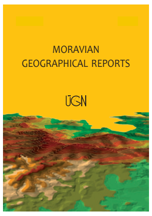

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The delimitation of areas of strategic intervention in Poland: A methodological trial and its results

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Abstract

This main aim of this study is the examination and discussion of a conceptual and theoretical model for Poland's areas of strategic intervention. Following a review of the current strategic documents at national and regional levels, it is possible to propose two basic categories of areas of strategic intervention: 1) growth areas (territories with natural or socioeconomic properties particularly favourable for development); and 2) problem areas (territories with unfavourable features and socioeconomic and/or natural processes). Among the problem areas it is possible to distinguish three main types: the social, the economic and the natural, albeit with the possibility of applying an even more detailed typology that allows for combinations of these types. Scientific findings can be combined with the results of empirical research to encourage the proposal of a new method of delimiting areas of strategic intervention. The identification of growth areas is primarily based on expert knowledge, which is clearly qualitative. In turn, the processes by which problem areas are delimited is quantitative in nature, reflecting analyses of selected diagnostic indicators that take social, economic and natural issues into account. The results which were obtained relate to the concept of endogenous development, as well as the assumptions under pinning policies of territorial cohesion.

Key words: *planning, strategic areas, growth areas, problem areas, Poland*

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1. Introduction

Contemporary processes of socioeconomic development can be categorised by factors tending to increase spatial and regional disparities. These unfavourable phenomena, manifested both in society and in terms of polarised space, need to be counteracted using an effective development policy. Today, there is a prevalent view seeking to condition the outward spread of development from territories most likely to play host to it (e.g. agglomerations and metropolitan areas). In this context, processes of regional polarisation, as well as the diffusion of growth, are taken as encompassed in a development policy based around the polarisation-diffusion model. The concept underpinning this model is considered to be based on theories of unbalanced regional development, given their structure, by many authors originating from F. Perroux (1955), A. O. Hirschman (1958), and J. Friedmann and W. Alonso (1966). The primary assumption here is that growth is, by its very nature, uneven, given that it is concentrated in areas where conditions are most suitable.

A. Pike et al. (2006) note that, from the point of view of territorial development, the "winner" regions are generally the large metropolitan regions and just some industrial or tourist regions. It would thus seem that the concept of poles of growth might still have something to offer in terms of practical success, but only if defined factors underpinning growth are present. Indeed, in this article, we seek to justify the idea that such a probable conditioning of success entails the way in which localised poles of growth are based on certain selected elements of the settlement network. In the case of poorly-developed regions, there is a need to seek out the inherent potential that, when supported appropriately (via intervention) will help determine an area's competitive advantage. What is clear in all of this is the need for a very tailored, individualised approach to be taken to regions, with effective use being made of their inherent resources. In this context, Pike et al. (2006) postulate nothing less than the formulation of "alternative development strategies".

At the same time, spatial structure is currently defined, not only by place and territory, but also by inter-linkages (Castells, 2008). What are involved here are not merely links between poles of growth (creating extensive network configurations, such as Poland's proposed network metropolis:

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Korcelli et al., 2010), but also the integrated development of urban and rural areas, as well as improved connectivity at the individual level.

As is clear, such assumptions are in line with the current cohesion policy of the European Union, whose subjects are defined areas. This reflects the now-effective recognition of territorial disparities within each and every EU Member State. The development of a given territory is also very much conditioned by the quality and quantity of its internal resources, as well as the degree to which these are being used. It is on this basis that the role of coordination and steering at the regional level has increased, along with the need for regional endogenous resources to be utilised.

Today, territory is less likely to be looked at from the point of view of administrative boundaries, with greater attention being paid to internal potential, key resources and barriers to development. This further denotes even greater interest in the development of given administrative units that are homogeneous in character, and defined in terms of similar natural, social or economic features. The assumption is that the activation of a region's potential will have a positive influence on the living conditions of its inhabitants, and will allow the most efficient use to be made of intervention, and of the investment associated with it. Assumptions like these guide the theoretical concepts of territorial capital (Camagni, 2008; Capello et al., 2009), endogenous capacity (Scott and Storper, 2003), the place-based economy (Barca, 2009), non-endogenous development (Ray, 1997), and local conditioning and networking (Fujita et al., 1999). The further assumption here is that territorial cohesion inter alia entails the establishment of the kind of regional policy that is in line with the paradigm of territorially targetted policy, with emphasis put on local development conditions, and with account taken of given places' specifics and comparative advantages (Bohme, 2011; Zaucha et al., 2015). All of these concepts in turn assume that practical activity should involve a wise choice of specific features, and putting in place the best opportunities for defined areas to develop, with action in consequence being focused within their boundaries.

These days it is not therefore the case that the very idea of strategic public assistance is undermined. Rather, efforts are being made to direct such activity as effectively as possible, sometimes also by "going off the beaten track" where public assistance is concerned. In Germany – regarded as nothing less than a 'trial plot' for this kind of policy given the 1990 reunification – regional policy is seen to focus mainly on the eastern *Länder*, under an assumption that there will be a gradual cessation of support for the old industrial districts located in the West (like the Ruhr or the Saarland), with these having been allocated just about all of the funding pre-1990 (Lentz, 2010). A similar change of public-aid strategy (including an end to support for mining districts) took place in the UK (Lagendijk, 2007).

In recent decades, the professed goal of the regional policy adopted centrally in Germany has thus been to even out the levels of development of the two parts of the country (Spatial Development…, 2001; Cohesion Policy…, 2014), with the sectorally-conditioned areas of intervention now playing host to technical infrastructure and human capital (Strubelt, 2010). The efforts to restructure Eastern Germany have not been without their critics, however, and it is interesting that some of the latter are in countries also passing through the post-1990 systemic transformation, with emphasis placed on the underestimation of historical and cultural matters (Horváth, 2012).

In the Central and Eastern European Countries (CEECs), there is a universal need for regional policy to be pursued, in reflection of the status of many areas as lagging behind in both infrastructural and social terms. Work by J. Penzés (2013) that brings together results from various authors, makes it clear that about 50% of Poland, the Czech Republic, Slovakia and Hungary can be regarded as peripheral. The problem status arising out of this kind of peripheralisation is scale-dependent, and relates in particular to spatial accessibility (Novotný et al., 2015). At the same time, these countries pursue regional policies that differ greatly from one another and do not always favour the achievement of territorial cohesion (Cotella, 2006).

The idea of tailoring to meet the needs of individual regions facilitates devising model solutions with respect to transformations anticipated in areas characterised by given socioeconomic and environmental features. What is therefore indicated is the development of a synthetic configuration, classifying regions, that allows the most effective actions to be taken. One of the tools helping the regions' spatial differentiation to be understood and decisions as regards the disbursement of assistance taken, is the typology of territorial units, or else the delimitation of areas needing external support. At the EU level, such classification work is the subject matter for projects pursued and expert reports drawn up, e.g. within the framework of the European Observation Network, Territorial Development and Cohesion (ESPON) Programme, or such projects as European Development Opportunities in Rural Areas (EDORA) (Copus et al., 2011; EDORA, 2011), European Land Use Patterns (LUPA) (Bański and Garcia, 2013) and Small and Medium sized Towns in their Functional Territorial Context (TOWN) (TOWN, 2014).

A particular kind of territorial category is the Problem Area, long analysed and now well-known in the subject literature. Classification in this case is usually conceptualised in relation to subject matter, or is indicated in regional typologies. Problem Areas have been a focus for the European Union Cohesion Policy, just as they had been widely identified previously within the framework of the East European Countries (EEC) regional policy (as agricultural areas lagging behind, areas with declining industries, and peripheral regions failing to attract investment), and EU agricultural policy (mountainous areas, areas with low-quality productive agricultural space, and areas experiencing specific difficulties). The focus was on supporting the least-developed areas, but it did not yield the anticipated results (General Report on the Activities..., 2002; Churski, 2010; Tondl, 2001). Documents relating to the spatial policy on Problem Areas often has these areas down as somehow "specific" or isolated. Detailed treatment is afforded geographical isolation (in the context of islands and mountain valleys; Damsgaard et al., 2011). Many studies also stress the state of the environment as a key factor, given that this helps condition intervention in a given area.

In Polish regional policy, a process whereby development has been "individualised" finds its reflection in concepts devised for the categories known as the functional area (FA), area of strategic intervention (ASI) and problem area (PA). Special development instruments are devised for each, *inter alia* financial incentives, a properly-selected investment policy and special streams of funding. The functional areas are also defined and identified in the currently-binding National Spatial Development Concept 2030 (Koncepcja Przestrzennego Zagospodarowania Kraju 2030, 2011).

They are distinguished in terms of common geographical, territorial and socio-economic conditioning characterising a system of functional links and common objectives for forms of development ensuring an efficient utilisation of land. Functional areas are in fact subdivided into the urban and rural, as well as those featuring a specific phenomenon on the macro-regional scale, those in which development potential is being shaped, and those requiring the pursuit of new functions as suitable regional policy instruments are applied.

This same document identifies problem areas – as one of the types of so-called "functional area". These are places in which spatial conflicts or dysfunction regarding development come into existence, leaving it necessary for the state to intervene at the national level. These are therefore areas in which access to services is most limited, towns or cities that have been deprived of the leading socioeconomic function they had discharged previously, near-border areas, areas developing to the most limited extent, areas least accessible in terms of the time it takes to reach them, and revitalised areas.

While functional areas remain a relatively new category in Polish development policy, problem areas have long been a matter of research interest (Bański, 2001). The first classification of them can be found in a study seeking to diagnose the state of the national economy (Kukliński, 1983), in which the research considers five categories of area, i.e. population areas, agricultural areas, areas featuring asocial behaviour, areas characterised by health problems and areas threatened environmentally (ecologically) (Gawryszewski and Potrykowska, 1988; Eberhardt, 1989; Kassenberg and Rolewicz, 1984; Kokotkiewicz, 1985; Kulikowski, 1992; Zagożdżon, 1988). Thereafter, problem areas were not a popular research topic, such that it was only with changes in regional policy following Poland's EU accession that a asis for the intensification of analogous studies was put in place.

In turn, areas of strategic intervention are those in which full utilisation of development potential will only be possible if there is intervention from outside (Krajowa Strategia Rozwoju Regionalnego..., 2010). Such areas are identified in many strategic documents at the national level, as well as in most regional development strategies. Strategic intervention sensu largo is each non-standard public action targeted territorially. The notion of strategic intervention links up irrevocably with regional policy's fundamental dilemma: to support areas already developed and subject to investment? Or to better the chances enjoyed by less-favoured, poorly-developed regions?

As is clear from the detailed analysis of national- and regional-level strategic documents relating to areas of strategic intervention, these may be either problem areas or functional areas – a fact that ensures conceptual confusion, while providing for freedom of interpretation. The methods used to identify areas of strategic intervention are also varied, to such an extent that they lack cohesion. Overall, the 14 national-level documents subject to research here, identified 32 different categories of area of strategic intervention, while the 16 strategies at voivodeship level relate to as many as 138. What is more, a single local-authority area (*gmina*)[1] can sometimes have in excess of 40 types of special areas located in its territory.

This study's main aim has been the contemplation and discussion of a conceptual and theoretical model for intervention areas in Poland, which have featured rapid development over the last 25 years, albeit in association with a wider socio-economic polarisation (growth of disparities) in the territorial dimension. The scientific output here is combined with the results of empirical research to encourage the proposal of a new method of delimiting areas of strategic intervention. The results obtained relate to the concept of endogenous development, as well as the assumptions underpinning policy on territorial cohesion.

2. Conceptual assumptions

A review of Poland's currently-binding strategic documents on the national or regional level, permits the identification of four categories of strategic intervention, with several sub-categories present in each. Two of the categories are so-called special areas, of which the first are of a territorial/administrative nature, comprising different types of urban centre (e.g. regional capitals, sub-regional centres), or else rural areas. Then there is the group identified in terms of subject-matter or sector, with areas of commercial agriculture, potential tourist and health-resort areas, areas of innovative investment and poles of growth. The two remaining categories of areas of strategic intervention – i.e. functional areas and problem areas – reflect strategic solutions adopted in previous years and introduced into physical development policy. Within the above "problem area" category, it is typical to find those in which development processes are unfavourable and in need of support (on account of migration outflows, economic stagnation and so on), areas in which access for goods and services is hindered (on account of a peripheral or near-border location, or in general with limited transport access), and areas featuring environmental problems (frequent floods, droughts, pollution, etc.). The classification is augmented by functional areas, a category that relates to both rural and urban, but also to places with especially valuable natural features, and so on.

In regional policy, there are two main categories of area identifiable, apart from the units arising out of the administrative division of Poland. These are:

1. areas that are homogeneous from the point of view of socioeconomic features as broadly conceived – which can be identified with functional areas; and
2. areas with development processes of defined dynamics and degrees of advancement that may be equated with areas of strategic intervention (Fig. 1).

The latter would be understood as areas in need of action to reinforce inherent potential for development and to prevent negative natural and/or socio-economic phenomena from occurring. This reflects the fact that the two categories of area, while mutually augmentative in part, should be treated separately in regional policy, and will furthermore take account of the different spatial scales at which they occur.

In line with the assumptions referred to above, it is possible to propose two categories of area of strategic intervention:

1. the growth area (GA); and
2. the problem area.

[1] Local government administration ~ commune

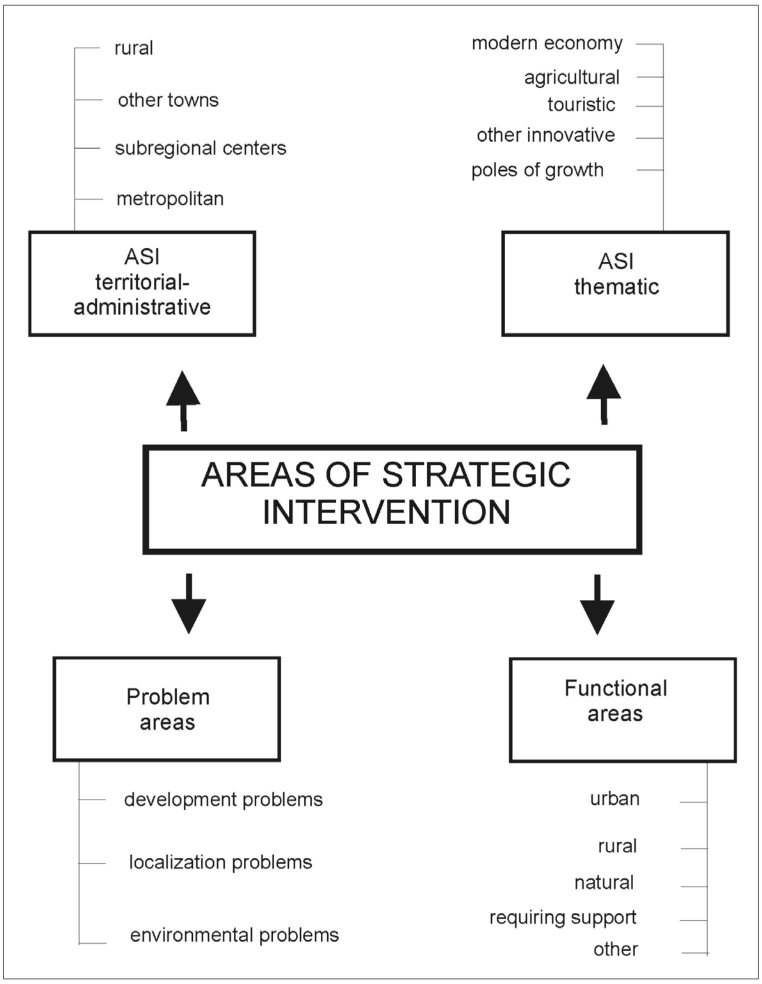

Fig. 1: Classification of areas of strategic intervention on the basis of an analysis of strategic documentation at the national and regional levels. Source: authors' conceptualisation

Beyond that, each of these types may also be subject to delimitation on national, regional and local levels. While the first category can be defined as including territory with natural or socio-economic properties particularly favourable for development, the second would include areas of unfavourable features and socio-economic and/or natural processes.

Growth areas may be treated as "flywheels" of regional development. Underpinning their identification are both an understanding of development mechanisms in operation hitherto and an indication of processes that may arise in the future. The main aim of the activity should be to strengthen their endogenous potential in order to boost competitive advantage. Factors to be taken into account among the criteria for identifying growth areas are an assessment of endogenous resources and investment effectiveness, as well as an appraisal of interventions up to the given time and their outcomes, and of the possibilities for innovations to diffuse.

Problem areas stand in contradistinction to growth areas. Their identification requires the use of an indicator-based method, and it would seem appropriate to distinguish three basic categories thereof, taking social, economic and natural aspects into account. While the first group includes areas in which the socio-demographic features are unfavourable, the second is associated with difficulties with running a business (engaging in economic activity), and the third relates to areas in which human-environment conflicts arise and are present.

3. Methods of delimiting Areas of Strategic Intervention

The identification of growth areas was based on expert knowledge, albeit with a multi-stage delimitation procedure. The first of these stages entailed the indication of "strategic sub-systems" representing the primary environment for the development of society and the economy. Among them, a distinction was drawn between the settlement- and transport-related, industrial and technological, and tourist and recreational sub-systems, as well as some special ones (e.g. those related to military security or to a trans-boundary location). At this point, an indicative list of potential growth areas was generated, reflecting the expert knowledge possessed by the participants. Subsequently, a set of assessment questions was drawn up with a view to appraising the potential results of intervention in the areas already identified. First and foremost, these concerned the long-term development effects, and the possibility for these factors to diffuse (or trickle down) into less-developed areas.

The ten evaluation questions that were used are as follows:

1. Does the GA have a socioeconomic potential suitable for the mobilisation of development processes?
2. Are there unutilised natural and/or socioeconomic resources in the GA?
3. Will intervention ensure that the phenomenon of polycentrism is present in the GA?

4. Does the GA concentrate, within its subsystems, key geographical areas from the point of view of the country as a whole?
5. Will development of the GA result in a diffusion of pro-development stimuli?
6. Is high efficiency of results in relation to outlays anticipated for the GA?
7. Are there features favouring the development of the GA's spatial structure?
8. Will the GA exert a strong impact internationally or domestically?
9. Will intervention in the GA prove safe from the environmental and sustainable development points of view?
10. Does potential intervention in the GA come under the goals set out for development in strategic national documents?

The fourth stage of the research entailed a "point-wise" assessment of potential growth areas made by the experts. The evaluation made in relation to each question received points in the range of 1 = low potential to 10 = high potential.

The delimitation of problem areas was carried out using standard statistical analysis, in which a key aspect was the assessment of the level of socioeconomic development in Poland's units of communes (*gminas*), as defined by appropriately selected diagnostic indicators, which also represent tools for the potential monitoring of change following intervention-related activity. In terms of their scope, the selected indicators took in a broad spectrum of socio-economic and natural features. The indication of problem areas thus related to both a geographical location and a defined scale and the nature of problems requiring intervention.

The delimitation of problem areas was achieved in several stages. At the outset, a selection was made of seven indicators (measures) for each group of problem issues (i.e. for the natural, social and economic: see Tab. 1).

Statistical data originated from Poland's Central Statistical Office (CSO), its State Electoral Commission (SEC) and Central Examination Commission (CKC), as well as from the Institute of Soil Science and Plant Cultivation in Puławy (ISSPC). Use was also made of the resources of the Institute of Geography and Spatial Organization of the Polish Academy of Sciences (IGSO), in regard to potential commercial accessibility (Komornicki et al., 2015), temporal and spatial accessibility (Śleszyński, 2016), and the fragmentation of the landscape.

All measures were standardised using the formula:

$$t_{ij} = \frac{\left(x_{ij} - \overline{x_j}\right)}{l_j}$$

where x_{ij} is the value for feature j in gmina i, x_j the arithmetic mean for feature j, and l_j the standard deviation characterising feature j.

General name of indicator	Measure
Natural indicators	
Green space	Green space in m^2 per inhabitant
Threat of flood or inundation	Share of land threatened by flood and inundation
Threat of drought	Climatic Water Balance Index
Conditions unfavourable to agriculture	Areas with Unfavourable Conditions Index
Conflict-generating potential	Product of the number of inhabitants and the extent of naturally-valuable areas
Transformation of the landscape	Landscape Fragmentation Index
Wastewater treatment	Share of populace served by wastewater treatment plants
Social indicators	
Demographic ageing	Share of population accounted for by people of post-productive age (60/65+)
Migration balance	Balance between people registering/deregistering permanent stays (per 100 inhabitants)
Education of the populace	Share of populace aged 13 and over with higher education
Level of school education	Mean primary-school test result
Income poverty	Share of populace on welfare, in line with income
Level of activation of society	Peak turnout at general elections
Access to services	Synthetic index of temporal access to centres offering lower- or higher-order services
Economic indicators	
Overall level of economic development	GDP per inhabitant (as related to national average)
Advanced entrepreneurship	No. of businesses in higher-order services per 1,000 inhabitants
Wealth of local authorities	Own incomes in the commune budget expressed per inhabitant
Wealth of inhabitants and their developments	Utilisable area of dwellings given over for use expressed per inhabitant
Unemployment rate	Number unemployed per 100 people of productive age
Spatial accessibility	Index of potential commercial accessibility
Urbanisation	Share of land that is built-up and urbanised

Tab. 1: Natural, social and economic indicators defined for delimiting problem areas
Source: authors' elaboration

Each standardised value for a measure was then ranked using numbers between 1 and 10, in line with a division into 10 groups of analysed territorial units of equal size. The first 10% of the areal components (gminas) with the lowest values for an indicator obtained the rank 1, the next 10% rank 2 and so on, up to the 10% with the highest values given a ranking of 10.

As this was done, it was borne in mind that certain indicators reflect factors that stimulate development, while others reveal its potential suppression. A last stage then entailed the determination of threshold values below which a unit of territorial administration was assigned to a problem area. The threshold value was determined by reference to the arithmetic mean value, as increased by the size of the standard deviation (Tab. 2).

In line with the delimitation method adopted, the problem areas were identified as natural, social or economic, albeit with statistical analysis making it clear that some territorial units complied with the definitions for problem areas of more than one group.

The effect of this process was ultimately the resulting seven types of problem area to be proposed, i.e. those concentrating (Fig. 2):

1. social problems;
2. economic problems;
3. natural problems;
4. social + economic problems;
5. social + natural problems;
6. economic + natural problems; and
7. social, economic and natural problems.

4. Results and discussion

Using the expert method described previously, it was possible to identify a total of 25 growth areas, with 9 of these related to metropolitan areas and 16 to subject-related areas. Included among the metropolitan areas are:

1. the Warsaw Metropolitan Area;
2. the Bydgoszcz-Toruń Metropolitan Area;
3. the Gdańsk-Sopot-Gdynia Metropolitan Area;
4. the Silesian Conurbation;
5. the Kraków Metroplitan Area;
6. the Łódź Metropolitan Area;
7. the Poznań Metropolitan Area;
8. the Szczecin Metropolitan Area; and
9. the Wrocław Metropolitan Area.

All of these areas are poles of growth at either national or regional levels. Potential interventions here should therefore seek to eliminate any barriers that might disrupt further development, while also enhancing the diffusion thereof. Activity should focus first and foremost on public transport and road infrastructure, waste management and pollution abatement, as well as cooperation at the local government level. Each area also has its specific features needing to gain reflection in the selection of certain intervention measures that are specially targeted or tailored. For example, in the Silesian Conurbation such features are a reduction of the role of extractive and heavy industry, along with support for the developing motorisation cluster, inter alia by helping to back measures that achieve better integration with the R&D sector. In turn, the Kraków Metropolitan Area must work to eliminate the barriers to development provided by the state of

Characteristic	**Problem areas**		
	Natural	Social	Economic
Minimum	18	7	7
Maximum	60	66	69
Median	39	39	39
Mean	38.8	38.5	38.4
Standard deviation	6.1	11.1	13.2
Threshold (mean + SD) after rounding-off	45	50	52
No. of gminas reaching threshold values (% of set given in parenthesis)	424 (17.1)	407 (16.4)	428 (17.3)

Tab. 2: Statistical characteristics and threshold values qualifying gminas for "problem area" status
Source: authors' elaboration

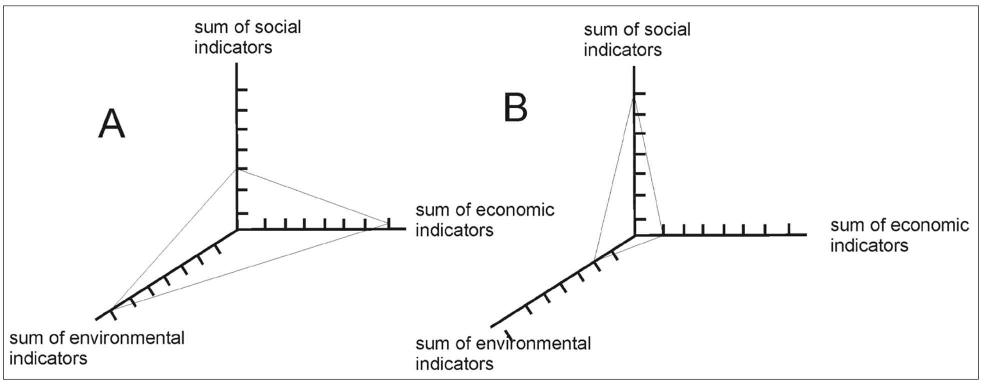

Fig. 2: Model examples of the typology of problem areas: A – an area with a concentration of economic and natural problems; and B – an area with social problems. Source: authors' conceptualisation

the environment (above all manifested by air pollution), while also working on urban planning structure, the protection of monuments, and the very intensive tourist traffic.

The remaining growth areas are characterised by mostly very marked socio-economic specifics that can be seen as arising from the localised nature of natural resources, or else the development of defined sectors of the economy (see Fig. 3). Each area is thus of strategic significance to the national economy when it comes to, for example, the presence of natural resources, food security, new sources of energy, the leading industrial sectors, the development of tourism or cross-border cooperation. It is likewise for these reasons that very well-defined interventions in support of growth need to be made in these areas.

The proposed growth areas are in line with current knowledge, and with the assumptions of the planning documents in place. Certain possible changes in Poland's development policy might offer a basis for the list of areas to be modified, or supplemented with new key categories of area. Certain of the areas also make reference to configurations that are bipolar (e.g. Warsaw–Łódź), tripolar (Gdańsk–Gdynia–Sopot) or transboundary (the Kraków Conurbation plus the Ostrava region in the Czech Republic). In such cases, support must favour the internal complementarity of these configurations, in particular combating the domination of one or other of the poles.

The concept of the growth area should relate first and foremost to the enjoyment of good prospects, or else to the idea of support being extended to ensure development. Growth areas are seen to be assignable to three main categories, i.e. poles of growth, areas characterised by one kind of subject matter or another, and clusters featuring advanced technologies. Where the first category is concerned, identification should concentrate on the socio-economic potential broadly conceived, as this connects with given areas' capacities to function as poles of development. In turn, identification in relation to the two remaining categories should arise out of a diagnosis of the state of modern technology and R&D backup, as well as specialised services, food security and environmental resources.

Where areas featuring problems of a natural origin are concerned, some 424 gminas could be implicated, representing 17% of the national total, occupying over 16% of the area of Poland and resided in by 31% of the population nationally (Fig. 4). These areas are concentrated spatially, with 40% of all the gminas involved located in Mazowieckie, Wielkopolskie or Lubelskie voivodeships. The largest natural problem areas are along the lower or middle stretches of the River Vistula, as well as in the upper Oder Valley. In each case, the problem in question is the threat of flooding. Other key environmental problems involve erosion of the coast, water shortages, soil erosion and the fragmentation of formerly

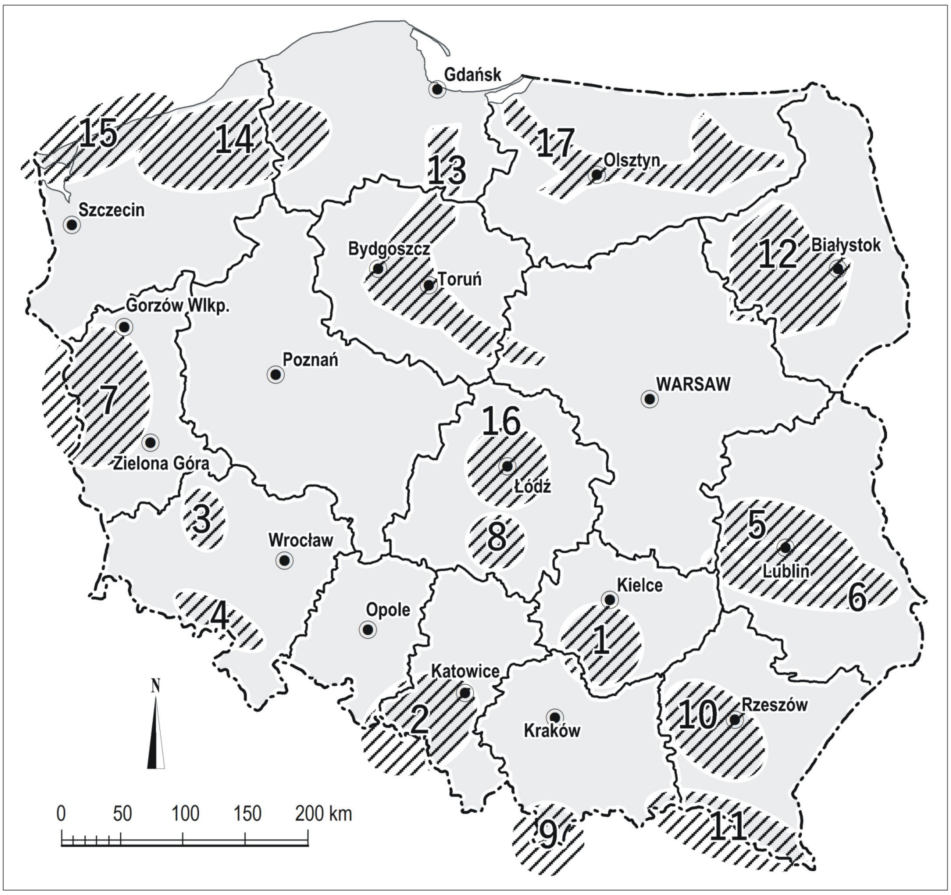

Fig. 3: Areas of strategic intervention – growth areas
Legend: 1) the Świętokrzyski Ceramics and Construction Industry Cluster; 2) the Katowice-Rybnik-Bielsko-Biała Conurbation); 3) the Legnica-Głogów Industrial District; 4) the Sudety Industrial District; 5) the Lublin Industry and Power-Supply Cluster; 6) the Lublin Agricultural Region; 7) the Lubuskie-Brandenburg Transboundary Area; 8) the Bełchatów Industrial District; 9) the Tatra Mountain Trasboundary Area; 10) Aviation Valley; 11) the Eastern Carpathian Tourist Region; 12) the Podlasie Dairying Cluster; 13) the Lower Vistula Valley; 14) the Pomeranian Renewable Energy Zone; 15) the Western Coast; 16) the Łódź Node; 17) the Warmia-Mazury Tiger.
Source: authors' research

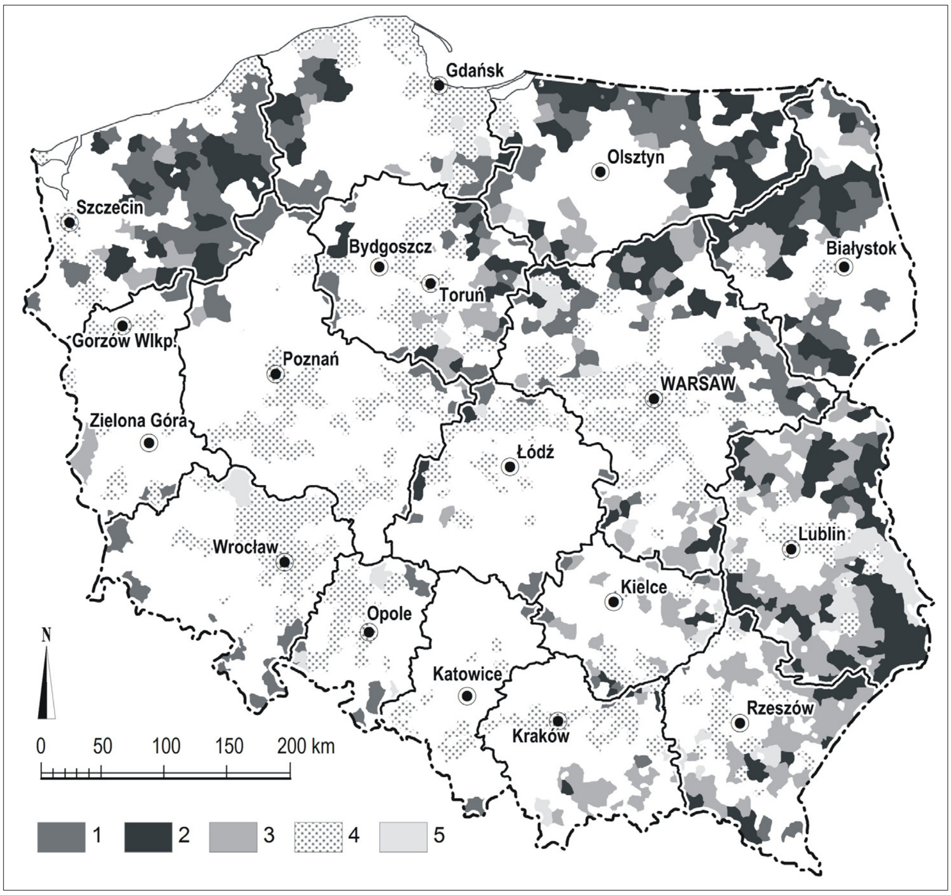

Fig. 4: Distribution of problem areas
Legend: 1) PA with a concentration of social problems; 2) PA with a concentration of social + economic problems; 3) PA with a concentration of economic problems, 4) PA with a concentration of natural problems; 5) other PA
Source: authors' research

continuous forest complexes. The natural problem areas rather rarely "interact" with areas categorised from the social or economic points of view. This shows that only a few gminas are concentrated in areas with both environmental or economic problems and those of a social nature.

Problem areas in the "social" category were identified in more than 16% of all gminas, accounting for 21% of the total area of Poland, but resided in by only 6% of the national population. Social problems first and foremost are concentrated in rural or weakly-urbanised areas. Almost 2/3 of the problem gminas are located in just five of Poland's province-regions (Lubelskie, Mazowieckie, Podlaskie, Warmińsko-Mazurskie and Zachodniopomorskie voivodeships). The clearest set of contiguous areas afflicted by social problems is present in Central Pomerania, while others are in north-eastern and eastern Poland. Problems there arise from out-migrant outflows, ageing of the remaining inhabitants and a skewing of the structure of the population by gender (with "shortages" of women of marriageable age).

Problem areas in the "economic" category were in turn found to comprise some 428 gminas, whose total area equals about 20% of Poland, with a population just below 7% of the national total. They are found mostly in such areas as Lubelskie and Mazowieckie voivodeships, as well as Podkarpackie and Podlaskie. The spatial distribution of the data make it clear that key factors denoting economic problems are an over-dependence of the local economy on agriculture (to the point of near mono-functionality in some areas), as well as the related phenomena of limited economic activity on the part of inhabitants and a level of unemployment that can be regarded as high in comparison with other regions of Poland.

This work to delimit problem areas confirmed what is known in the literature, in that phenomena of a problematic nature are above all found in eastern Poland and in Central Pomerania (Węcławowicz et al., 2006; Bański and Mazur, 2009; Churski, 2010; Komornicki and Śleszyński, 2009).

5. Conclusions

The need for a "sorting-out" process was perceived in the conceptual and methodological confusion arising from the fact that Polish regional policy deals with different types of designated "areas" (e.g. special areas, areas of strategic intervention, functional areas, problem areas, towns or cities considered to be losing key functions, and so on), and in that which is connoted – and even the area embraced – by the designation may be characterised by a high degree of overlap. The process by which concepts in national- and regional-level planning documents became so heterogeneous appears to have started with Poland's EU accession, and in part reflects initiatives seeking to harmonise domestic regional policy with EU standards, and in part also the practical need to disburse EU funding. The instability of the political and institutional environment in Poland has also played a role.

The identification of the areas of strategic intervention arises out of a comprehensive diagnosis of the socio-economic situation and the state of the natural environment, an analysis of current thrusts in development policy at home and abroad, and in the application of expert knowledge. The latter proved particularly crucial in the identification of growth areas, given the markedly qualitative nature of the phenomena involved. In turn, the process by which problem areas are delimited is quantitative in nature, reflecting analyses of selected diagnostic indicators that take social, economic and natural issues into account. Reference to subject literature in which authors make use of various statistical measures helps confirm the distribution of the problem areas whose existence is signalled in the present study. This reflects the fact that the precise choice of indicator (assuming at least that there are an appropriate number thereof) does not have a very marked influence on the existence of problem areas, and their distribution as mapped.

Areas of strategic intervention do not constitute a homogeneous category, in that they are taken to include:

1. growth areas, i.e. places with favourable prospects for development in which intervention can help to further competitive advantage, regionally or nationally; and
2. problem areas, in which socio-economic phenomena and/or those relating to the natural situation, generate development challenges that require defined forms of intervention from beyond their boundaries.

Among the problem areas it is possible to distinguish three main types, i.e. the social, the economic and the natural; albeit with the possibility of applying a more detailed typology that allows for combinations of these types (as social + natural, socio-economic, economic + natural, and mixed). Analyses made it clear that the largest group comprises areas in which problems of a natural origin are concentrated (361 gminas), followed by areas with concentrations of economic problems (194 gminas), areas with both social and economic problems (188 gminas), and areas with concentrations of social problems (182 gminas). This left only two categories characterised by a small number of local-authority areas, i.e. those with economic + natural problems (26 gminas) and those with social + natural problems (17 gminas).

This research confirmed how diverse the areas of strategic intervention are, as well as the fact that this is true both of the growth area and problem area sub-categories. In Polish conditions, this represents the verification of the thesis that development policies need to be targetted and tailored, regionally. In the context of discussions on regional policy models, including the polarisation and diffusion paradigms, the research showed that effective intervention in given areas requires parallel support for a polycentric network of growth poles (or areas), and for areas afflicted by economic, social or environmental problems.

The research materials also show how factors determining the need for intervention differ greatly from one area to another: inter alia, noteworthy are the areas in a relatively favourable economic situation, but nevertheless facing serious social problems; or else those in which environmental factors present a serious barrier to development (Zaucha et al., 2015). This all reveals that, while strategic documents in the countries of Central Europe often mention territorial cohesion, this is in practice understood only narrowly among decision makers (often as a specific kind of tool by which territorial cohesion objectives can be achieved). The process of delimiting problem areas used here reveals that this is just one way of looking at the issue, at the same time pointing to the major role played by other components of territorial cohesion (Medeiros, 2011), such as environmental sustainability and polycentrism or the cooperation between units.

In a methodological sense, the delimitation process pursued here is just one possible proposal. Its suitability would nevertheless seem attested to by the straightforwardness of the assumptions employed, which allow for the ready identification of factors speaking for intervention. This also makes it possible for the effects of solutions (development policies) to be tracked.

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References:

BAŃSKI, J. (2001): Problem areas in Polish agriculture, Geographia Polonica, 74(1): 47–63.

BAŃSKI, J., GARCIA-BLANCO, G. [eds.] (2013): European Land Use Patterns, Rural Studies, 32 Warsaw, IGSO PAS.

BAŃSKI, J., MAZUR, M. (2009): Identyfikacja obszarów o silnej koncentracji problemów społecznych. In: Bański, J. [ed.]: Analiza zróżnicowania i perspektyw rozwoju obszarów wiejskich w Polsce do 2015 roku. Studia Obszarów Wiejskich, 16 (pp. 79–95). Warszawa, GiPZ PAN, PTG.

BARCA, F. (2009): An agenda for a reformed Cohesion Policy. A place-based approach to meeting European Union challenges and expectations, Independent Report prepared at the request of Danuta Hübner, Commissioner for Regional Policy [online] [cit. 01.02.2014]. Available at: http://ec.europa.eu/regional_policy/archive/policy/future/barca_en.htm

BÖHME, K. (2011): Internal Summary of the Workshop on Territorial Cohesion Indicators organised by the ESPON INTERCO project 14.01.2011. ESPON INTERCO. Unpublished manuscript.

CAMAGNI, R. (2008): Regional competitiveness: towards a theory of territorial capital. In: Capello, R., Camagni, R., Chizzolini, P., Frasati, R. [eds.]: Modelling regional scenarios for the enlarged Europe: European competitiveness and global strategies. Berlin, Springer-Verlag.

CAPELLO, R., CARAGLIU, A., NIJKAMP, P. (2009): Territorial Capital and Regional Growth: Increasing Returns in Cognitive Knowledge Use [online]. Available at: http://papers.tinbergen.nl/09059.pdf

CASTELLLS, M. (2008): The rise of the network society: The information age: Economy, society, and culture. Oxford, Wiley Blackwell.

CHURSKI, P. (2010): Problem areas in Polish regional policy. Moravian Geographical Reports, 18(2): 23–35.

Cohesion Policy and Germany (2014): European Commission [online] [cit. 26.02.2016]. Available at: http://ec.europa.eu/regional_policy/sources/information/cohesion-policy-achievement-and-future-investment

COPUS, A. K., DAX, T., SHUCKSMITH, M., MEREDITH, D. (2011): Cohesion Policy for rural areas after 2013: A rationale derived from the EDORA project (European Development Opportunities in Rural Areas) – ESPON 2013 Project 2013/1/2. Studies in Agricultural Economics, 113(2): 121–132.

COTELLA, G. (2006): Economic growth and territorial cohesion in CEECs: what changes for local development? Geografický časopis, 58(4): 259–277.

DAMSGAARD, O., DOUCET, P., DRAHOS, Z., GERE, L., ILLÉS, L., JETMAR, M., KOMORNICKI, T., LOPEZ, L., PÉTI, M., PROKAI, R., RADVÁNSZKI, A., RICZ, J., SALAMIN, G., SCHMIDT-SEIWERT, V., SCHÖN, P., SOMFAI, A., SÜTŐ, A., TOMAY, K., VANAUTGAERDEN, L., ZAUCHA, J (2011): The Territorial State and Perspectives of the European Union. 2011 update. Background document for the Territorial Agenda of the European Union 2020, Budapest, Vati.

EBERHARDT, P. (1989): Regiony wyludniające się w Polsce. Prace Geograficzne 148, Warsaw: IGSO PAS.

EDORA (2011): European Development Oportunities in Rural Areas. Final Report. ESPON, Luxemburg.

FRIEDMAN, J., ALONSO, W. (1966): Regional development and planning. Cambridge, MIT Press.

FUJITA, M., KRUGMAN, P., VENABLES, A. J. (1999): The Spatial Economy: Cities, Regions, and International Trade. Cambridge, MA: MIT Press.

GAWRYSZEWSKI, A., POTRYKOWSKA, A. (1988). Rural depopulation areas in Poland. Geographia Polonica, 54: 81–100.

General Report on the Activities of the European Union 2001 (2002): European Commission, Brussels – Luxembourg.

HIRSCHMAN, A. (1958): The Strategy of Economic Development. New Haven: Yale University.

HORVÁTH, G. (2012): The German Mezzogiorno? Discussion Papers, 86, Budapest, Institute of Regional Studies Research Centre for Economic and Regional Studies Hungarian Academy of Sciences.

KASSENBERG, A., ROLEWICZ, C. (1984). Obszary ekologicznego zagrożenia (wstępna diagnoza przestrzenna – 1980 r.). In: Gospodarka zasobami przyrody, 85: 150–155.

KLAASSEN, L. (1965): Area economic and social redevelopment: guidelines for programmes. Paris, OECD.

KOKOTKIEWICZ, I. (1985): Obszary problemowe w Polsce, interpretacja z punktu widzenia zagrożeń. In: Kukliński, A. [ed.]: Gospodarka przestrzenna Polski wczoraj, dziś i jutro, 2: 84–96. Warsaw, PAX.

KOMORNICKI, T., ŚLESZYŃSKI, P. (2009). Typologia obszarów wiejskich pod względem powiązań funkcjonalnych i relacji miasto-wieś. In: Bański., J. [ed.]: Analiza zróżnicowania i perspektyw rozwoju obszarów wiejskich w Polsce do 2015 roku.Studia Obszarów Wiejskich, 16: 9–38. Warsaw, IGSO PAS, PTG.

KOMORNICKI, T., ROSIK, P., STĘPNIAK, M., GOLISZEK, S., KOWALCZYK, K. (2015): Estimation of expected intervention results using transport accessibility measures adjusted to the needs of strategic and operational documents concerning the financial perspective 2014–2020, Report prepared by the Institute of Geography and Spatial Organization of the Polish Academy of Sciences on the order of Ministry of Infrastructure and Development.

Koncepcja Przestrzennego Zagospodarowania Kraju 2030 (2011): Warsaw, Ministry of Regional Development of the Republic of Poland.

KORCELLI, P., DEGÓRSKI, M., DRZAZGA, D., KOMORNICKI, T., MARKOWSKI, T., SZLACHTA, J., ZAUCHA, J. (2010): Ekspercki projekt koncepcji przestrzennego zagospodarowania kraju do roku 2033. Studia KPZK PAN, 78.

Krajowa Strategia Rozwoju Regionalnego 2010–2020 (2010): Regiony, Miasta, Obszary wiejskie, Ministerstwo Rozwoju Regionalnego, Warszawa.

KUKLIŃSKI, A. (1983): Diagnoza stanu gospodarki przestrzennej Polski. Wstępne wyniki badań. Biuletyn KPZK PAN, 123.

KULIKOWSKI, R. (1992): Obszary problemowe rolnictwa w Polsce. Wybrane zagadnienia obszarów wiejskich. Biuletyn KPZK PAN, 158: 23–40.

LAGENDIJK, A. (2007). Regional anchoring and modernization strategies in non-core regions: Evidence from the UK and Germany. European Planning Studies, 7(6): 775–792.

LENTZ, S. [ed.]: (2010): Restructuring Eastern Germany. German Annual of Spatial Research and Policy, Berlin, Heidelberg, Springer Verlag.

MEDEIROS, E. (2016): Territorial Cohesion: An EU Concept, European Journal of Spatial Development, 60 [online] [cit. 18.02.2018]. Available at: http://www.nordregio.se/Global/EJSD/Refereed%20articles/refereed60.pdf

NOVOTNÝ, L., MAZUR, M., EGEDY, T. (2015): Definition and delimitation of peripheries of Visegrad countries, Studia Obszarów Wiejskich, 39: 35–48.

PERROUX, F. (1955). Note sur la notion de "pôle de croissance". Economie Appliquée, 8(1–2): 307–320.

PENZÉS, J. (2013): The dimensions of peripheral areas and their restructuring in Central Europe. Hungarian Geographical Bulletin, 62(4): 373–386.

PIKE, A., RODRIGUES-POSE, A., TOMANEY, J. (2006): Local and regional development. New York, London, Routledge.

RAY, C. (1997): Towards a theory of the dialectic of rural development. Sociologia Ruralis, 27(3): 345–362.

SCOTT, A., STORPER, M. (2003): Regions, Globalization, Development. Regional Studies, 37(6–7): 579–593.

Spatial Development and Spatial Planning in Germany (2001): Bonn, Federal Office for Building and Regional Planning.

STRUBELT, W. (2010): Policy lessons from the reconstruction of East Germany – The former German Democratic Republic. In: Gorzelak, G., Bachtler, J., Smętkowski, M. [eds.]: Regional Development in Central and Eastern Europe – Development Processes and Policy Challenges (pp. 71–90). London–New York, Routledge.

ŚLESZYŃSKI, P. (2016): A synthetic index of the spatio-temporal accessibility of communes in Poland. Geographia Polonica, 89(4): 567–574.

ŚLESZYŃSKI, P., BAŃSKI, J., DEGÓRSKI, M., KOMORNICKI, T. (2017): Delimitation of problem areas in Poland. Geographia Polonica, 90(2): 131–138.

TONDL, G. (2001): Regional policy. In: Artis, M., Nixson, F. [eds.]: The Economics of European Union. Policy and Analysis (pp. 171–197): Oxford, Oxford University Press.

TOWN (2014): Small and medium sized towns in their functional territorial context. Draft Final Report. Leuven, ESPON-KU.

WĘCŁAWOWICZ, G., BAŃSKI, J., DEGÓRSKI, M., KOMORNICKI, T., KORCELLI, P., ŚLESZYŃSKI, P. (2006): Przestrzenne zagospodarowanie Polski na początku XXI wieku. Monografie, 6. Warsaw, IGSO PAS.

ZAGOŻDŻON, A. (1988): Kilka uwag o obszarach problemowych. In: Gospodarka przestrzenna, region, lokalność. Biuletyn KPZK, 138.

ZAUCHA, J., BRODZICKI, T., CIOŁEK, D., KOMORNICKI, T., MOGIŁA, Z., SZLACHTA, J., ZALESKI,, J. (2015): Terytorialny wymiar wzrostu i rozwoju. Warsaw-Sopot: Diffin, Institute of Development.

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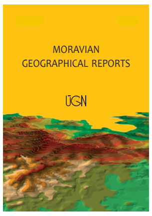

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DE GRUYTER OPEN

Technological relatedness, knowledge space and smart specialisation: The case of Germany

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Abstract

The level of technological specialisation in the regions of Germany is assessed in this paper, as well as how such specialisation has evolved over time. Further, in three selected regions (Munich, Düsseldorf and Oberes Elbtal/Osterzgebirge), the knowledge space is explored in detail and compared to existing smart specialisation strategies. Average relatedness and knowledge space based upon EPO patent applications are used to measure the specialisation and technology trajectories of the German regions. Between three periods 1988–1992, 1998–2002 and 2008–2012, the specialisation of Germany based on EPO patent applications increased by 10%, despite a decline in many regions. Machinery and transportation industries have increased their significance. The assessment of regional smart specialisation strategies in the three German states shows that the methodology in terms of the identification of prospective industries is largely variegated and insufficiently developed. More attention should also be given to the choice of an appropriate geographical level of aggregation for analysis. Knowledge relatedness and knowledge complexity could be used as methodological tools for selecting prospective industries in smart specialisation strategies.

Keywords: *patents, technological relatedness, regional specialisation, smart specialisation, Germany*

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1. Introduction

Innovations are considered to be the main driver of economic growth (Aghion and Howitt, 1990). At the same time, innovation activity is spread unevenly and it is one of the most geographically-concentrated economic activities. Europe lags behind the United States in terms of productivity and this is, among other factors, related to a lack of industrial and technological specialisation (Ortega-Argilés, 2012): hence, the discussion about which sources of growth, countries should focus upon. For such purposes, the European Union (EU) implemented the concept of smart specialisation, which puts an emphasis on the most efficient use of public financial resources dedicated to Research and Development (R&D).

Whereas significant attention has been given to the processes of knowledge creation in a spatial context (Audretsch and Feldman, 1996; Asheim and Gertler, 2005), considerably less attention is given to the types of knowledge created in specific locations, how they develop over time and how they affect future development. The recently emerging evolutionary economic geography attempts to explain the change in spatial and regional structures through endogenous technological innovation. The concept of knowledge relatedness focuses on the types of knowledge in specific locations and how existing capabilities affect future technology trajectories (see for example: Rigby, 2015; Kogler et al., 2017). The recently introduced smart specialisation policy has been implemented in the EU regions, although it has been criticised for its inadequately developed theory as well as its methodology (Morgan, 2015; Santoalha, 2016). This paper aims to add to existing research by providing an empirical validation of the knowledge relatedness concept in Germany, and by relating the observed technological trajectories to existing regional smart specialisation strategies.

The aim of this paper is firstly to examine the evolution of knowledge production in German regions, with particular regard to how technologically specialised they are and how this specialisation has evolved over time. This is based on the analysis of European Patents Office (EPO) patents, specifically on the average relatedness index following Kogler et al. (2017), as well as the visualisation of knowledge relatedness in the so-called knowledge space. Following that, in three selected regions the knowledge space is explored in detail and compared to existing smart specialisation strategies.

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The first section summarises existing research on knowledge relatedness and smart specialisation. In the second section, the data are described and there is an explanation of the methodology. Subsequently, results are shown: the situation is evaluated at the country-level; then regional specialisation is considered; and this is followed by an analysis of the situation in three selected spatial planning regions. This analysis is put into the context of prospective industries and existing Research and Innovation Strategies for Smart Specialisation (RIS3). Concluding remarks are found in the final section.

2. Theoretical background: innovation, specialisation and relatedness

The role of innovation in economic growth is now widely accepted in economic theory (Aghion and Howitt, 1990; Audretsch and Feldman, 1996). The separation of production and design as parts of globalisation processes has further reinforced the importance of knowledge production. At the same time, the spatial distribution of innovation activity is very uneven, largely due to the limited diffusion of tacit knowledge over larger distances (Gertler, 2003). Innovation is one of the most spatially concentrated activities and geographical proximity in the creation of knowledge continues to be important (Sonn and Storper, 2008). Spatial proximity is an important but not sufficient condition, though, as other forms of proximity have been identified (Boschma, 2005).

The innovation process is a complex social activity involving various types of knowledges and actors, and regions differ considerably in their innovation characteristics (Iammariono and McCann, 2006). Regional capabilities have been found to be more important for knowledge creation and regional specialisation than national ones (Maskell and Malberg, 2007), which has been confirmed by several studies on specific regions (e.g. Saxenian, 1996). How related new industries are to existing knowledge in a region has already been studied by Teece et al. (1994), Breschi et al. (2003) or Leten et al. (2007) – for an overview see Joo and Kim (2010). Knowledge relatedness has been used to find the connection between technological diversification and firms' technological performance (e.g. Tanriverdi and Venkatraman, 2005). At the company level, absorptive capacity is crucial (Cohen and Levinthal, 1990). Questions remain on whether specialisation (so-called Marshall-Arrow-Romer (MAR) externalities) or diversity (Jacobs externalities) foster more economic growth in cities and regions, though existing research provides evidence for both Jacobian and MAR externalities (see Beaudry and Schiffauerova, 2009).

Evolutionary Economic Geography explores the role of knowledge relatedness in regional development. Evolutionary geography is based on the fact that the production of knowledge stems from specific patterns in a region, patterns which have developed over time (Frenken and Boschma, 2007). Knowledge creation and innovation activity are, in general, path- dependent processes (Martin and Sunley, 2006). Tangible and intangible assets are present in the firm, and over time leak into the region. Therefore, the identification of relatedness between technologies/products/industries and existing capabilities in the region can help to predict future possible technological trajectories. Following the Hidalgo product space concept, researchers focus now more on relatedness between economic activities and how these affect regional development and the emergence of new industries. Based on country exports, Hidalgo et al. (2007) showed how an existing industrial structure can affect future diversification. In recent studies, Neffke et al. (2011) explored the importance of related variety in Sweden, as did Boschma and Iammarino (2009) in Italy and Boschma et al. (2013) in Spain. Knowledge relatedness has been mapped in US cities (Rigby, 2015; Kogler et al., 2013; Balland and Rigby, 2017), the EU15 (Kogler et al., 2017; Vlčková and Kaspříková, 2015) and Ireland (Kogler and Whittle, 2017). These studies have demonstrated that technologies which are closer to the existing knowledge base in the region are more likely to develop there, than those which are unrelated. This paper adds to existing research on knowledge (technological) relatedness by providing an empirical validation of technological relatedness in German regions.

The findings of the relatedness research are very useful for the smart specialisation policy. In Europe, the lack of industrial specialisation has been considered one of the obstacles to productivity growth (Ortega-Argilés, 2012), despite increasing specialisation in Europe over time (e.g. Brülhartart and Traeger, 2005). Furthermore, Forey et al. (2009) argue that in many European regions there is a weak correlation between R&D capabilities, training specialisation and industrial structure (see also Coronado et al., 2017). Large differences in innovation output across Europe have been demonstrated, although less attention has been paid to knowledge specialisation, especially in the context of economic integration. This has changed with the introduction of the smart specialisation concept. This concept emerged in academia (Foray et al., 2009) and it has been adopted by policymakers in the EU. The aim of smart specialisation is "to boost regional innovation in order to achieve economic growth and prosperity, by enabling regions to focus on their strengths" (European Commission, 2016). The smart specialisation concept does not aim to make the economic structure of regions more specialised; rather, it is based on the identification of core competencies and potential complementarities in order to make the innovation process more efficient. It emphasises the role of knowledge diffusion processes between sectors, activities and occupations, and avoids "one-size-fits-all" solutions and the automatic prioritisation of high-technology sectors, which are not suitable for all regions. It should among other things overcome the fragmentation and duplication of public investments for Research and Development (R&D) in Europe, the lack of synergies between knowledge economy actors within regions, and the insufficient abilities to build external knowledge networks (Nauwelaers et al., 2014).

What differentiates smart specialisation from traditional industrial and innovation policies is above all a process defined as "entrepreneurial discovery" – an interactive process whereby market forces and the private sector discover and produce information on new innovation activities, and the government evaluates their outputs and supports those that have the greatest potential (OECD, 2013). All EU regions must now develop smart specialisation strategies in order to qualify for structural funding.

The smart specialisation policy requires new measures to identify the main competencies of regions, usually through a combination of qualitative and quantitative data. This is because technological trajectories in most regions have been found to be rather stable (Rigby and Essletzbichler, 1997). Region-specific capabilities are crucial for the identification of prospective industries. This seems to be the main problem of smart specialisation, because there is not yet either sufficient theoretical or empirical bases for the implementation of a smart specialisation policy (Morgan, 2015; Santoalha, 2016). Kogler and Whittle (2017) point out that the relatedness research can help tackle some of these issues as it can be used to identify strengths and knowledge capabilities, identify sectors which should be abandoned, possibly predict future trajectories and how to bridge the gap between two technologies by recombination of existing ones and the emergence of new technological trajectories. The "value" of knowledge also differs. Knowledge (technology) complexity is closely related to economic benefits, since more complex knowledge is based on a larger set of capabilities and such regions grow more (Balland and Rigby, 2007; Hidalgo et al., 2007). Diversifying into complex technologies is difficult for many regions, though. Whereas knowledge relatedness focuses on the costs of moving from one technology to another, knowledge complexity focuses on the potential benefits (Balland et al., 2017). Diversification depends on current capabilities and the proximity of new technological possibilities, but knowledge production in other locations is also important (Rigby, 2015), as is stressed in the local buzz and global pipelines conceptual framework (Bathelt et al., 2004).

Since tacit knowledge and path dependence play a crucial role in the innovation process (Gertler, 2003), Germany's historical industrial orientation significantly affects its current R&D and innovation activities. Germany has the highest number of patents in Europe, above average R&D expenditures (2.9% of GDP) and close links between schools and companies (vocational training). Due to their very distinct histories, we can expect large variations between the former socialist German Democratic Republic (East) and the Western market-based system of Germany. In 2006, Germany implemented the High-Tech Strategy and its update in 2011 introduced the term Industrie 4.0, describing a focus on automatisation and digitalisation in manufacturing. There are several studies exploring R&D and innovation in Germany (e.g. Peters, 2008; Beise and Stahl, 1999), as well as innovation policies (e.g. Kiese, 2008; Kiese and Wrobel, 2011; Kroll et al., 2016). To the best of our knowledge, the regional (knowledge) specialisation within Germany has been studied only by Suedekum (2006), who found that between 1993 and 2001 there was neither a process of regional specialisation nor one of the geographical concentration of industries in Germany. Regional specialisation has also been explored as a part of the RIS3 documents.

3. Data and methodology: patents and knowledge relatedness

Measuring knowledge relatedness and its visualisation in knowledge space will enable us to assess the specialisation of German regions and the identification of prospective industries in line with the concept of smart specialisation. In general, it is difficult to measure knowledge and technology (Pavitt, 1982). This is because it is more a social rather than a technical process. Several input and output indicators of innovation activity have been used (e.g. R&D investment, patents, R&D workers), although all of them suffer from several limitations. Patents reflect the knowledge base of the region, are unique in the extent of detail involved and in the breadth of their geographical and historical coverage. Nonetheless, not all patented inventions are innovations, not all inventions are patentable, and many inventions are never patented (Acs and Audretsch, 1989). There are also differences in the propensity to patent between industries, and the allocation of patents to the relevant industry is not easy (Grupp, 1998; Griliches, 1998). Countries specialising in manufacturing and ICT have a higher propensity to patent than countries with a large service sector, which engage more in trademark protection (OECD, 2011). Further, there are country differences in patenting activity (Cohen et al., 2002), and patents do not measure economic value (Hall et al., 2001; Schankerman and Pakes, 1986). Despite these limitations, patents have been widely used in economic research (e.g. Scherer, 1982; Griliches, 1998) and are a reliable measure of innovative activity at the industrial and regional level (Acs and Audretsch, 1989). Further, due to the strong manufacturing orientation of Germany, using patents is more suitable here than in many other countries.

We use patent applications from the OECD REGPAT database (OECD, 2016), which covers patent applications filed with the European Patent Office (EPO) relating to more than 5,500 regions. Although patent applications do not measure economic value and the value of most patents is negligible (Hall et al., 2001), using simple counts is sufficient since we are interested in innovation activity and technological relatedness. We use the date of patent applications (priority date) rather than that of patent grants, because the priority date is the closest to the invention activity. The country of the inventor is sed rather than the country of the patent owner, since we are interested in the innovation capabilities of regions. We only include inventors from Germany. If inventors are assigned to more countries (or regions), we divide the patent between inventors. We use three five-year periods to account for yearly variations: 1988–1992, 1998–2002, and 2008–2012. Knowledge relatedness is measured at NUTS1 (Bundesländer) and NUTS2 regions. Several NUTS1 are at the same time NUTS2 regions. We also provide a more detailed analysis in three of the 96 German spatial planning units: Munich, Düsseldorf and Oberes Elbtal/Osterzgebirge, where Dresden is located.

Indices used to measure technological specialisation and diversity, such as the Herfindahl index, expect the distance between sectors to be the same (Rigby, 2015), which is unsuitable for our purposes. Therefore, we use technological (knowledge) relatedness, which can be measured by patent citations or the probability of relations between technological fields (patent co-classification data). In this paper, knowledge relatedness is measured based on the patent categories each patent belongs to, based on Kogler et al. (2017). The classification of patents to industries has been problematic because patent categories do not correspond to industrial sectors. In this paper, we use the International Patent Classification (IPC) of 121 sub-categories and split them into 7 industrial categories, according to Kogler et al. (2017). These are different from the IPC categories, which do not reflect the industries accordingly. Each patent is then placed into one or more of the patent categories, which reflect the technological characteristics of the underlying knowledge. If a patent is split into 3 regions (one of them in Berlin) and two patent classes (e.g. A47 and B01), then the share of Berlin in class A47 will be $(1/3) \times (1/2)$.

The data from the REGPAT have a few limitations. For example, for the first period 1988–1992, the assignment of patents to the regions is often missing. Furthermore, there is a slight decline in the number of patents between 1998–2002 and 2008–2012, although there has been a slight increase in patent applications under EPO from Germany. This is related to the fact that information on patents is generally available 18 months after the priority date and thus some patent applications may be missing from the dataset. Since the major focus of this paper is on knowledge relatedness and smart specialisation, we assume this will not affect the overall results.

The knowledge space is used to demonstrate the specialisation of the region and the evolution of its technological specialisation (entry and exit into specific technological sectors), based on the visualisation of the relationship between individual patent categories. We follow the product space concept introduced by Hidalgo et al. (2007), which is based on the assumption that the specialisation of a country is related to the knowledge and capabilities present in a given country. This concept has also been used in other contexts such as mapping carbon dioxide emissions in trade (Vlčková et al., 2015). The relatedness between individual patent categories measures the co-occurrence of these categories in particular patents. We assume that the more often a patent belongs to two different patent categories the higher is the probability that these patent categories share a similar knowledge base.

The knowledge space maps how individual categories are related. The first symmetric matrix which includes the number of patents belonging to particular categories is prepared. This matrix of co-occurrences can then be used to derive a measure of relatedness between technological fields, and to provide a visualisation of relations between patent classes in the networks. Overall there are 121 patent classes, belonging to 7 different fields. We apply the same method as Kogler et al. (2017): we measure the knowledge relatedness based on the probability that an individual patent belongs to more categories. Let P be the number of granted patents, p be a particular patent and i and j patent categories. If a patent belongs to category i, then $F_{ip} = 1$. If a patent does not belong to category i then $F_{ip} = 0$. The number of patents for category i is $N_i = \sum_p F_{ip}$. $N_{ij} = \sum_p F_{ip} F_{jp}$ indicates the number of patents belonging to both category i and category j. This is done for all 121 categories resulting in a 121 × 121 matrix, which indicates the number of patents belonging to both categories. Knowledge relatedness is also affected by the total number of patents belonging to a category. Thus a standardised matrix of co-occurrence (S), which indicates technological relatedness between two different categories in a year, is created with the elements

$$S_{ij} = N_{ij} / \sqrt{N_i * N_j}$$

where the elements on the main diagonal of the matrix S are set to 1.

This was computed and used for the construction of knowledge networks (the knowledge space). With the help of Cytoscape software, the relations between the 121 patent categories are mapped. We use the Edge-weighted Force-directed layout to position the nodes and edges in the network. Such a layout uses some kind of physical simulation that models the nodes as physical objects and the edges as springs connecting those objects together (Cytoscape, 2017). Nodes represent patent categories and the size of the nodes indicates the number of patents in the category. Patent categories with the same sections are marked with the same colour (see Fig. 1). Only the strongest relations are mapped.

To map the situation in the three selected regions in Section 4.3, we used revealed technological advantage (Archibugi and Pianta, 1992). Revealed technological advantage (RTA) measures whether a region has greater share of patents in the technology class compared to the whole sample (in our case Germany). RTA is based on a simple formula

$$RTA = \left(\frac{P_{ir}}{P_{Ir}}\right) / \left(\frac{P_{iR}}{P_{IR}}\right)$$

where P indicates the number of patents, P_{ir} is the number of patents in category i and region r, P_{Ir} is the total number of patents in region r. P_{iR} is the number of all patents in category i in all regions R and P_{IR} is the number of all patents in all regions. RTA > 1 indicates specialisation in the technological field.

Whilst knowledge relatedness measures the relation between two patent categories, we also need to identify the average knowledge relatedness score (AR) for each region to assess the knowledge specialisation. Average relatedness is thus a summary measure of specialisation and enables the comparison of knowledge relatedness between regions, in patent sections and over time.

Higher average knowledge relatedness score indicates that patents are being generated in technological areas that are closer to one another in the knowledge space (patent classes tend to co-occur at a higher frequency). Lower AR scores indicate that patents that are distributed further apart in the knowledge space.

The average knowledge relatedness for a year t and country c is calculated as

$$\mathrm{AR}^{tc} = \frac{\sum_j \sum_i S_{ii}^t * D_{ii}^{t,r} + \sum_i S_{ij}^t * 2D_{ij}^{t,r}}{N^{t,r} * (N^{t,r} - 1)} \quad for\ i \neq j$$

where S_{ij}^t is the knowledge relatedness between patents in classes i and j, $D_{ij}^{t,r}$ indicates the number of pairs of patents belonging to category i and j in a year t and region r, $N^{t,r}$ is the total number of patents in a year t and region r.

4. Results: Technological specialisation in Germany and German regions

4.1 Technological specialisation in Germany

Germany has the highest number of patent applications in Europe and globally it accounted for 15% of EPO patent applications in 2015, following the USA with 18% (OECD, 2017). Despite the growing number of patent applications from German inventors, its global share has been declining due to the rise of emerging markets such as China. The biggest patent applicants in Germany include firms like Siemens, Bosch and BASF. Germany has high labour productivity, the share of expenditures on R&D reached 2.9% of GDP, and business R&D accounted for 68% of these expenditures in 2015 (OECD, 2017). Within the EU, Germany has the highest number of innovative enterprises, but a relatively lower share of venture capital. The dual education system combining general transferable skills and structured learning on the job, is supportive for providing technical skills and a strong supply of graduates. There is also widespread cooperation between the public and business sectors, and private and public research complement each other (Beise and Stahl, 1999), such as the Max Planck Society or the Fraunhofer Society.

Germany dominates in medium-high-tech industries, particularly engineering industries, automobiles and chemicals, and also in environmental and energy technologies. The high number of patents is among other things explained by the above-average share of industries with a higher propensity to patent, such as ICT, the automobile industry, medical equipment and energy technology. In terms of patenting in the selected categories, there has been a notable increase in Machinery and transport over time. This category accounts for one third of all EPO applications. Electronics and Industrial processes both accounted for about 14% of EPO applications in the latest period. Surprisingly, the categories which are associated with newer technologies such as Drugs and medicine, Electronics and Instruments, have risen only slightly or have stagnated over the past twenty years (see Tab. 1). This contrasts with the situation in the EU15 (see Kogler et al., 2017) and confirms the large and continuing specialisation of Germany in Machinery and transport. In spite of that, Germany continues to be also one of the main producers of Drugs and medicine.

In terms of specialisation (measured by average relatedness – AR) in Germany, there has been a slight rise over the whole period (by approximately 10%), but a slight decline between the last two periods. Kogler et al. (2017) found increase in specialisation by over 30% in the EU15 regions although they examined the situation only until 2005 and several German regions have already witnessed decline in specialisation. This requires further research of the situation in EU states. In terms of AR within the categories the highest is in Drugs, medicine since there are only a few patent classes in this category. Average relatedness is also at a high level in Consumer goods, the smallest category. On the other hand, the smallest AR is in Machinery and transport and it is decreasing over time. This can be affected by the rising number of patent applications (relatively and absolutely) in this category. Overall an increase of AR has been found in most categories (Electronics, Instruments, Drugs, medicine and Consumer goods).

The growth in the Machinery, transport category is also confirmed by increasing R&D expenditure. The highest and increasing business R&D investment (BERD) intensity between 1995 and 2013 in Germany was in Motor vehicles, trailers and other transport equipment, and it accounted for a third of total German BERD. On the other hand, Electrical equipment and Chemicals and chemical products have decreasing BERD intensities (European Commission, 2016). The low levels of spending are in high-tech areas; pharmaceuticals, ICT, radio, TV and communication equipment, and medical precision and optical instruments. The service sector also has a relatively low research intensity (European Commission, 2016).

As the knowledge space indicates, there is an obvious clustering of patent classes within the same category over time (see Fig. 1). Some categories such as Industrial processes (blue) and Chemicals, materials (black) are getting closer to each another. This indicates that within these categories a more similar type of knowledge is being used. Also Machinery, transport (purple) is getting more dispersed over the knowledge space (also demonstrated through a decrease in AR), particularly closer to Instruments (green) and Electronics (red). This is probably related to the fact that Machinery, transport is increasingly using Instruments, such as optics and measuring technologies and ICT technologies from the Electronics category, and this trend is likely to accelerate with the ever-growing pace of digitisation. Drugs, medicine are clustering apart from the others, which is confirmed by the increasing AR within the group (see Tab. 1).

4.2 Regional differences and patterns of specialisation

We explore innovation activity in Germany using NUTS1 and NUTS2 regions. Over the period, the patent applications to EPO from German inventors have increased by 70%. At the level of Bundesländer (NUTS1), there are very large differences between the former East and West German states. Whilst between 1988 and 1992, East German states (excluding Berlin) only accounted for 1 percent of all patent applications to EPO, in 2008–2012 it had increased to about 6%.

Patent applications are concentrated primarily in southern Germany: in Bavaria (25% of EPO applications), followed by Baden-Württemberg (24%) and North Rhine-Westphalia (22%). All these three regions have strong manufacturing traditions; in Baden-Württemberg, many TNCs are headquartered, such as Daimler AG, Robert Bosch GmbH and SAP SE, although mid-sized companies are the backbone of the economy. The Bavarian economy is associated mostly with the automotive industry (BMW, Audi, MAN), although

Category	Patent classes in category	1988–1992			1998–2002			2008–2012		
		Patents	Share on total	AR within the group	Patents	Share on total	AR within the group	Patents	Share on total	AR within the group
Electronics	8	7,704	13%	0.247	15,878	16%	0.277	13,598	14%	0.278
Instruments	12	6,459	11%	0.246	14,201	15%	0.229	12,631	13%	0.272
Chemicals, materials	22	10,449	18%	0.128	13,227	14%	0.120	11,442	12%	0.113
Drugs, medicine	3	3,584	6%	0.653	7,697	8%	0.624	7,916	8%	0.674
Industrial processes	36	10,431	18%	0.078	13,749	14%	0.076	13,385	14%	0.074
Machinery, transport	32	16,731	29%	0.097	30,114	31%	0.104	32,296	34%	0.088
Consumer goods	8	1,802	3%	0.367	2,696	3%	0.404	3,062	3%	0.425
Total	**121**	**57,159**	**100%**	**0.030**	**97,562**	**100%**	**0.034**	**94,330**	**100%**	**0.033**

Tab. 1: Patent applications and average relatedness in the main categories
Source: authors' calculations based on data from OECD (2016)

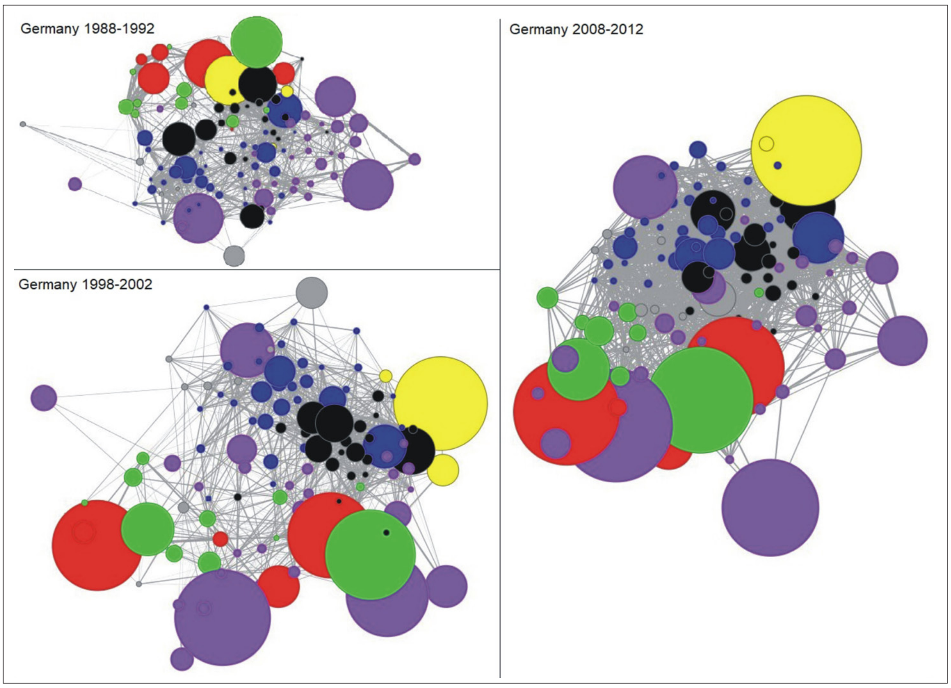

Fig. 1: Germany´s knowledge space (Notes: Red = Electronics, Green = Instruments, Black = Chemicals, Materials, Yellow = Drugs, medicine, Blue = Industrial Processes, Purple = Machinery, transport, Grey = Consumer Goods. Size of the nodes indicate the number of patents. The biggest yellow node represents category A61-Medical or veterinary science; hygiene with 6 301 patents)
Source: authors' calculations using data from OECD (2016)

the electronics industry is also significant. The Ruhr area, as one of the most important industrial regions despite significant economic restructuring in recent decades, is a part of North Rhine-Westphalia. On the other hand, the lowest shares of patents are in very small regions like Mecklenburg-Western Pomerania. Due to large variations in size, the relative numbers of patents per population are more testifying. Both Baden-Württemberg and Bavaria have the highest relative patenting activity, followed by Hessen. The lowest patenting rates can be found in the East-German states of Saxony-Anhalt, Mecklenburg-Western Pomerania and Saxony. The most specialised (highest AR) Bundesländer are the three city-states of Berlin, Bremen and Hamburg. This is line with the findings of existing studies that average relatedness is negatively related to urban/region sise (Kogler et al., 2013; Rigby, 2015).

The least specialised regions are North Rhine-Westphalia, Saxony-Anhalt and Saxony. Low levels of specialisation also occur in Bavaria. North Rhine-Westphalia and Bavaria are large states with highly diversified industrial structures, whereas in Saxony and Saxony-Anhalt low specialisation could be related to their communist history and continuing economic restructuring. Specialisation has increased in most states between 1988–1992 and 1998–2002. Between 1998–2002 and 2008–2012, however, specialisation slightly declined or remained stable in all states except Saarland and Bremen. There are large variations between the German states in terms of their population size, area, economic structure and patenting, as well as other indicators (such as R&D expenditures, researchers and R&D personnel). Therefore, we focus more on NUTS2 regions and specifically follow the situation in three German planning regions.

At the level of NUTS2, the highest number of patents is in Upper Bavaria (electronics and instruments, ICT), Stuttgart (electrical engineering, media industries), Düsseldorf (telecommunications centre), Karlsruhe (a mix of innovative companies and well-established universities), and Darmstadt (chemical and pharmaceutical industry). These five regions are in the top ten of patent output in the EU and account for 37% of all patent applications in Germany. The highest increase over the period has been in the former East German regions and also in Bremen and Upper Palatinate. In terms of patents per population, the highest numbers are in Stuttgart, Tübingen, Middle Franconia and Upper Bavaria (all located in Baden-Württemberg and Bavaria). The lowest numbers are in Mecklenburg-Western-Pomerania and Saxony-Anhalt (both in East Germany). Other indicators show similar results. Expenditures on R&D exceed 6% of GDP in Stuttgart and Braunschweig and over 4% in Tübingen, Upper Bavaria and Karlsruhe, where leading universities and/or innovative companies are located. High expenditures are also recorded for Dresden (see Section 4.3 below). Very high numbers of researchers (relatively) are also located in Stuttgart, Upper Bavaria, Karlsruhe, and Braunschweig.

In terms of specialisation, the most specialised regions are not only Upper Palatinate and Lower Franconia but also the cities of Berlin, Bremen and Hamburg (see above). The least specialised are Münster and Chemnitz. Figure 2 demonstrates the specialisation of the regions. There are large variations across Germany and the most specialised remain in the central parts. There is no obvious trend. Some of the most innovative regions are highly specialised, such as Stuttgart and Darmstadt; others like Düsseldorf and Upper Bavaria are more technically diversified (see Section 4.3). As was the case with the NUTS1 level, most NUTS2 regions have also witnessed increasing specialisation between 1988–1992 and 1998–2002, with the exception of a few East-German regions with extremely low numbers of patent applications in the first period. Between 1998–2002 and 2008–2012 specialisation stagnated or declined. Only

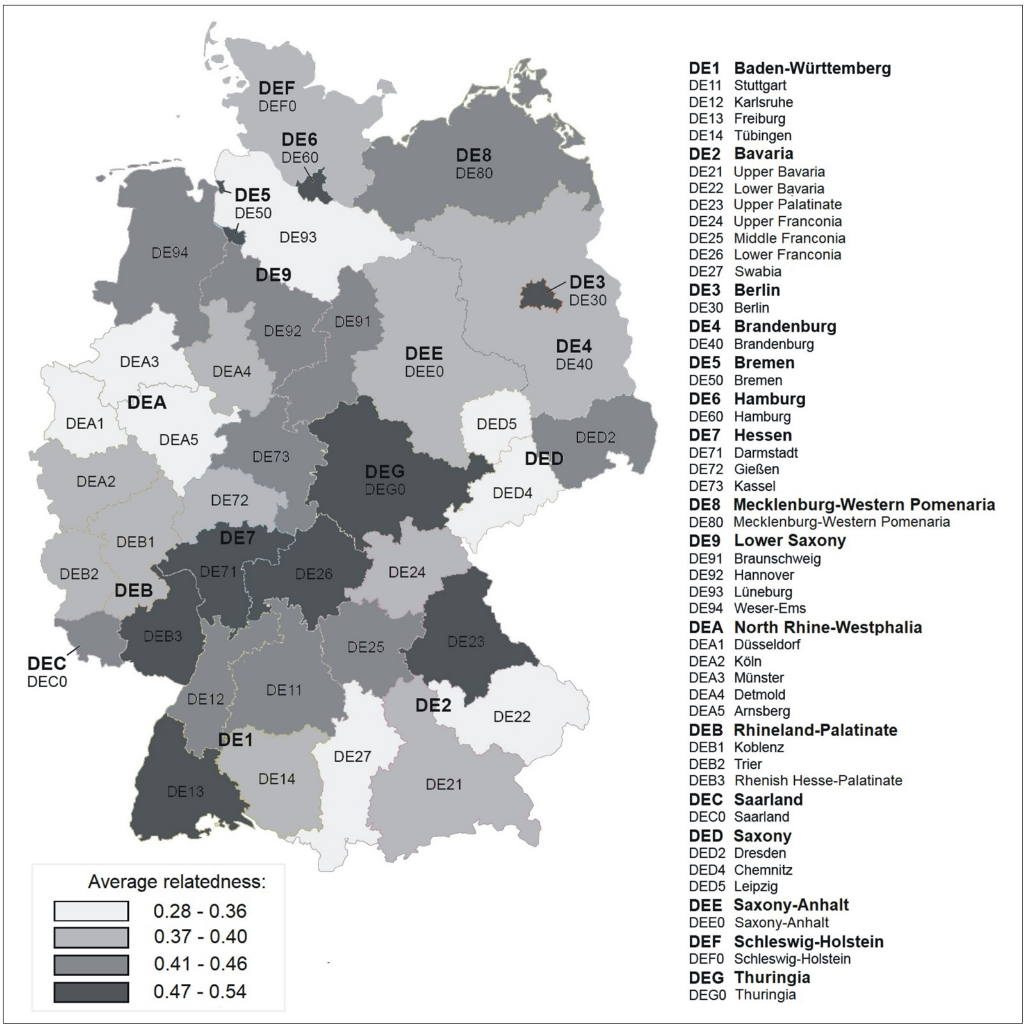

Fig. 2: Average technological relatedness in German NUTS2 regions
Source: authors' elaboration using data from OECD (2016)

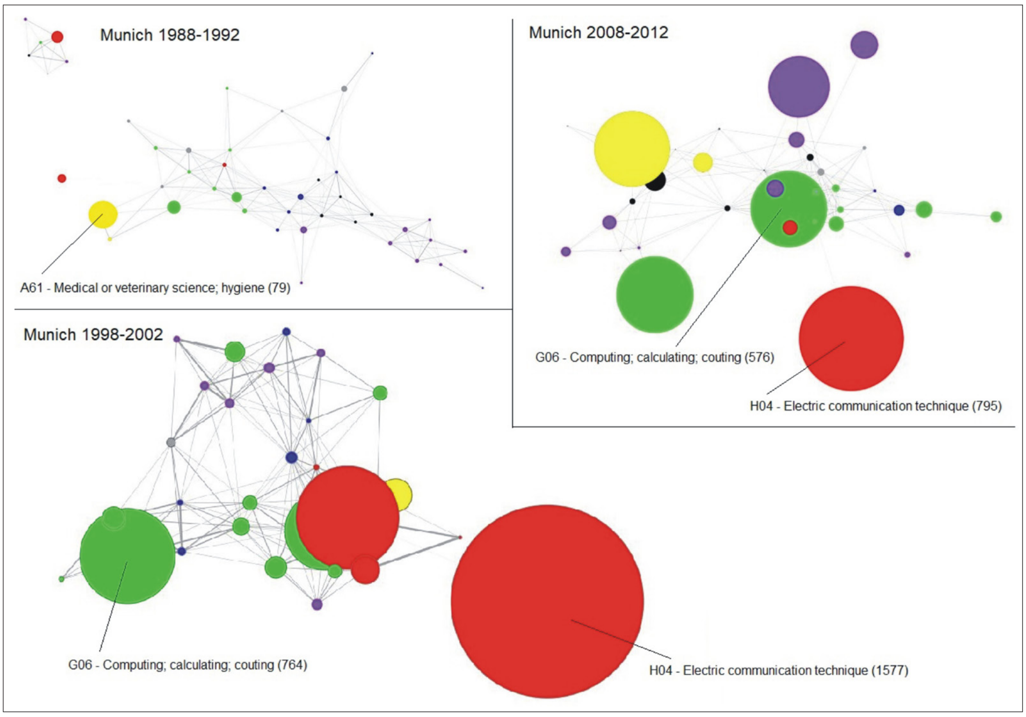

Fig. 3: Munich knowledge space (Note: The nodes are scaled to allow comparison between the periods. The numbers in brackets indicate the number of patents)
Source: authors' elaboration using data from OECD (2016)

a few NUTS2 regions witnessed growth in specialisation and these are Franken, Lower Franconia, Bremen, Darmstadt, Kassel, Detmold, Trier and Chemnitz.

4.3 Knowledge space and smart specialisation strategies in Munich, Düsseldorf and Oberes Elbtal / Osterzgebirge

Since NUTS1 and even NUTS2 regions are variegated in terms of their size, area and economic and innovation output, we will illustrate the technological trajectories in three regional planning units: Munich, Düsseldorf and Oberes Elbtal/Osterzgebirge (Dresden). Munich is a high-tech region with the highest number of patents and diversified industrial structure. Düsseldorf is considered as highly innovative with the third highest number of patents in Germany, although part of it is located in the old industrial area of the Ruhr, which has undergone economic restructuring. Dresden is an emerging region located in Saxony, one of the Eastern German states. These three regions do not provide a representative sample and are used only as illustrations. We map the evolution of the knowledge space and average relatedness in the three periods. Only patent classes that exhibit relative specialisation based on the RTA measure (revealed technological advantage: see Section3, above) have been chosen. We then compare these technological trajectories to existing smart specialisation strategies. In Germany, smart specialisation policies are set at the level of individual states (NUTS1 regions). Therefore, we also examine patenting and RTA in patents at that state level.

4.3.1 Munich

The Greater Munich planning region is located in Bavaria, and includes the city of Munich as well as surrounding districts (e.g. Erding, Dachau) among the most densely populated areas. Munich is considered to be one of the largest high-tech clusters in Europe with a major focus on ICT, automotive and aviation, as well as medical engineering and financial services. Large domestic and foreign enterprises coexist with Small and Medium Enterprises (SMEs), with the largest companies (and patent applicants) in the region including BMW, General Electric, Google and Siemens. Further, two major research organisations, the Max Planck Society and the Fraunhofer Society, have their headquarters in Munich, for which patents are filed (Baier et al., 2013). As the knowledge space (see Fig. 3) indicates, there has been a significant rise in the patent applications since the first period, as well as a change in industrial orientation. Whereas at the turn of the 1990s there were almost 50 patent classes with RTA, in 2008–2012 there were fewer than 40. The region has lost RTA in Chemicals (black) and Industrial processes (blue). The Electronics industry (red) has become much more important despite a decline in the latest period, while Instruments (green) are rising steadily. What is specific in all periods is the fact that the patent class “H04-Electric communication technique”, the biggest one in the last two periods, is separated from all other nodes, indicating the absence of co-occurrence with other patent classes. This might be related to research activities of multinational enterprises and should be further explored. On the other hand, Instruments and Mechanical engineering, machines, transport are getting closer, which may reflect the upcoming trend of industry 4.0 (robotisation, automatisation). The average relatedness increased between 1988–1992 and 1998–2002 from 0.044 to 0.061, but declined again to 0.045 in the period 2008–2012.

4.3.2 Düsseldorf

Part of the Düsseldorf planning unit is located in one of the oldest industrial regions and a major urban area in Europe - the Ruhr: Wesel county and the cities of Duisburg, Essen, Mülheim an der Ruhr and Oberhausen are all part of the Ruhr conurbation. Since the 1970s, the Ruhr area has undergone extensive restructuring from a coal and steel-based economy to a more diversified service economy. The city triangle of Remscheid-Solingen-Wuppertal is still largely manufacturing-oriented, whereas the cities of Mönchengladbach and Krefeld have experienced the decline of a once-dominant textile industry. Düsseldorf has traditionally been more service oriented and is one of the major telecommunication centres in Germany, as well as a centre of life sciences (Hospers, 2004; Rehfeld and Nordhause-Janz, 2017). From Figure 4, one can see that the knowledge space reflects the changing industrial structure. While Industrial processes (blue), Chemicals and materials (black) and Mechanical engineering, machines, transport (purple) dominated at the turn of the 1990s, the role of Pharmaceuticals and biotechnology (yellow) has increased significantly. Several major pharmaceutical and biotechnological companies are located in Düsseldorf (Qiagen, Monsato, Abbott). In both of the periods 1998–2002 and 2008–2012, the patent category “A61-Medical and veterinary science” had the highest number of patents. The category “C12-Biochemistry” class was also significant, as well as “C08-Organic macromolecular compounds”. Over the whole period, the average relatedness has risen slightly from the late 1980s and has been relatively stable since the second period (0.033). Düsseldorf continues to be the most diversified of the three planning units under exploration here, which is understandable given the high variability of the planning unit.

4.3.3 Oberes Elbtal/Osterzgebirge

Oberes Elbtal/Osterzgebirge includes the city of Dresden and its neighbouring districts. As part of the former German Democratic Republic, the major focus was on heavy industry and there were almost no EPO patent applications prior to 1990. Saxony was successful in attracting a number of major manufacturing companies, as well as institutes of national research organisations, to the region, as it carried out the most successful transformation among Eastern German regions (Kroll et al., 2016). The automobile, machinery and metal production industries continue to be important, along with the significant growth of the electronics sector. Semiconductor cluster Silicon Saxony, which was set up in 2000, is internationally renowned and has won public support from both federal and European levels. From the knowledge space, it is obvious that there is a continuous rise of patent applications: see Figure 5. In 1988–1992, a few patent classes with RTA were in Mechanical engineering, machines, transport (purple) and Industrial processes (blue). In later periods, Electronics, electrical engineering (red), followed by Instruments (green) and Chemicals and materials (black), started to dominate. Since general mechanical engineering is considered to be the least complex and digital communication the most complex technology (Balland and Rigby, 2017), this signifies a move towards more complex technologies in Dresden. More specifically, the most patent applications in the period 2008–2012 were in the category “H01-Basic electric elements”, with a decline from the earlier period. On the other hand, applications in the patent class “G01-Measuring, testing” have been rising steadily. This region has also witnessed

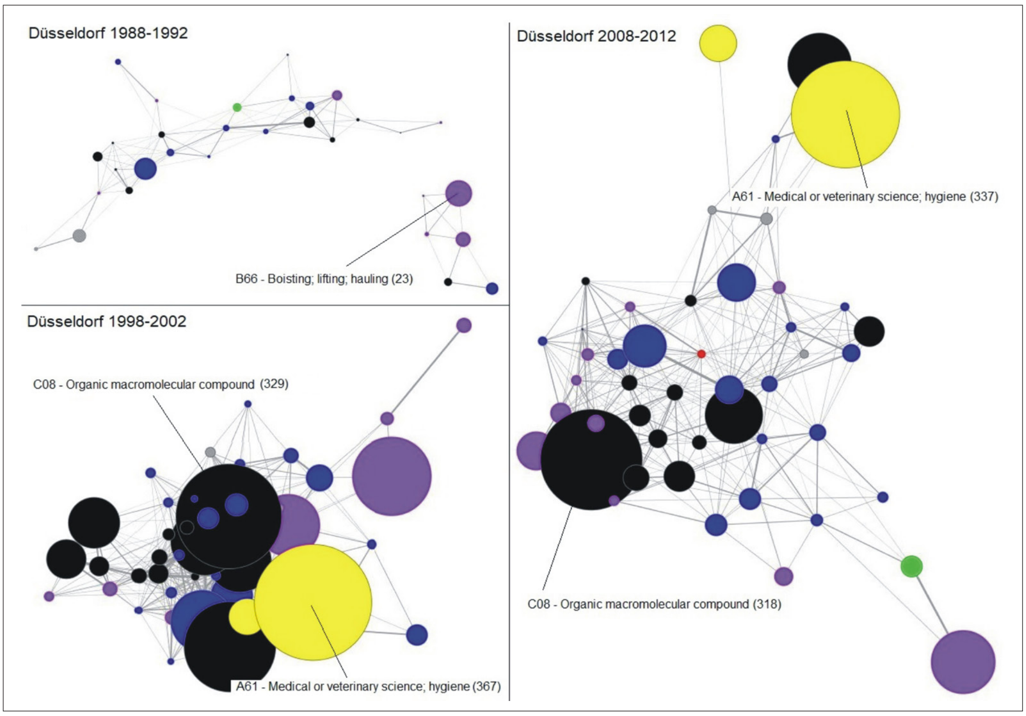

Fig. 4: Düsseldorf knowledge space (Note: The nodes are scaled to allow comparison between the periods. The numbers in brackets indicate the number of patents.)
Source: authors' elaboration using data from OECD (2016)

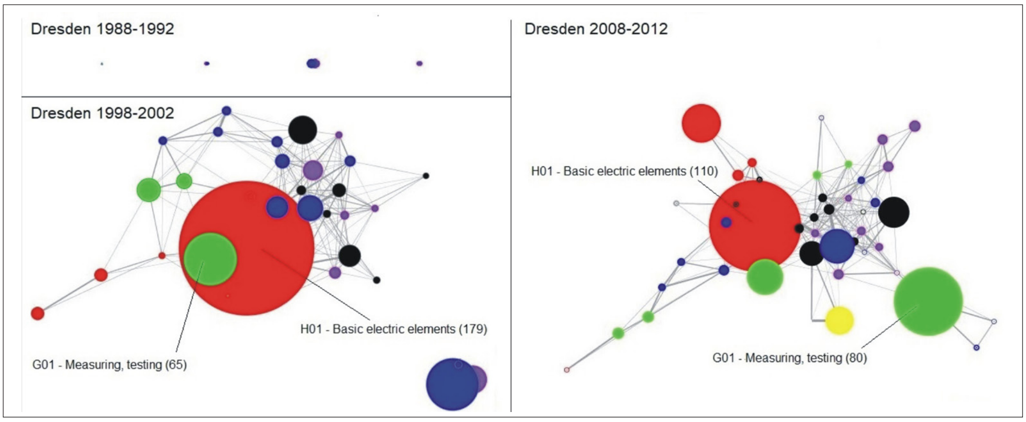

Fig. 5: Oberes Elbtal/Ostersgebirge knowledge space (Note: The nodes are scaled to allow comparison between the periods. The numbers in brackets indicate the number of patents.)
Source: authors' elaboration using data from OECD (2016)

large R&D investment, reaching 4.1% of GDP (OECD, 2017), stemming from national cross-subsidies as well as European structural funds. This can be related to the emergence of several high-tech parks and innovative companies such as Sunfire, a Dresden-based firm focusing on the conversion of chemical energy from a gaseous fuel into electricity. We can thus expect a further rise in the Chemicals, materials category. The average knowledge relatedness has increased significantly from the early period, with a decline in the last period. This can signify diversification to new technological fields, for example, energy-related ones, which are a national priority also due to the ´Energiewende´ (German energy transition).

4.4 Smart specialisation strategies in German regions

German states have experience with regional innovation policies, but the RIS3 are the first legally binding framework documents. It is an evidence-based regional innovation strategy, which includes the already-existing structures, processes and experiences. In Germany, there are large variations between the regions, affected by the size, history and the decentralised education and research system. The knowledge space as described above confirms the large heterogeneity between German regions. Taking the case of Bavaria, the innovation policy in Munich focuses on the support of start-ups and regional clusters, and particularly the promotion of networking among SMEs. This is in line with the "Bavarian Cluster Campaign", which started in 2006. Kiese (2012) has identified 19 clusters in Bavaria. In terms of the smart specialisation policy, the sectoral focus of the Bavarian policy is rather broad, although there is a move towards a more system-oriented regional strategy development process (Baier et al., 2013). Whereas priorities have been set at the state level and are listed in the EU Eye@RIS3 tool, the main Bavarian document on research and innovation from 2011 does not mention smart specialisation nor define priority sectors (Bayerische Staatsregierung, 2011). The major target areas in Bavaria are ICT, biotechnology, efficient production systems and clean technologies, as well as innovative technology-based services. If we look at patent classes where Bavaria has a revealed technology advantage, more traditional sectors are leading (see Tab. 2). Nonetheless, the RIS3 priority sectors are in general the technological areas in Munich which have risen and become more related over the examined period (see above). Since the strategic document did not explicitly describe all smart specialisation principles, a special supporting paper has been published recently by the Bavarian government (European Commission, 2018).

The North-Rhine Westphalia Innovation strategy is derived from the smart specialisation concept (EFRE NRW, 2014). The first innovation strategy in North-Rhine Westphalia was passed in 2006 and revised in 2010, and prior to the RIS3, prospective industries were already identified. The RIS3 document in North-Rhine Westphalia has been widely discussed with stakeholders, and it has incorporated previous innovation policies. Priorities set for this region include health, life sciences, media and creative industries, as well as ICT, and the energy and environmental industry. Similar to Bavaria, North-Rhine Westphalia has values of RTA in more traditional sectors such as metallurgy, although it is more difficult to relate services such as creative industries to patent classes. Overall, RIS3 priorities are set for the whole state and the document does not allow the researcher to use lower geographical levels. Several of RIS3 priorities are the technology areas, with significant growth potential in Düsseldorf.

Unlike the case of Bavaria, no large-scale R&D strategies were implemented in Saxony. Although Saxony did not introduce an innovation strategy in the 2000s, its 1992 "Guidelines for Technology Policy" had already identified nine technology fields with potential, and its policies incorporated a "process of entrepreneurial discovery" before such a requirement had been raised externally. Thus, Saxony has been successfully implementing smart specialisation strategies years before the term was coined (Kroll et al., 2016). Further, the ex-ante conditionality of RIS3 contributed to the fact that the policy bears a stronger smart specialisation approach. Defined key enabling technologies of the state are related to its industrial orientation and include ICT, biotechnology, nanotechnology, new materials or microelectronics and photonics (Freistaat Sachsen, 2013). The match between RTA in patents and RIS3 priorities is stronger than in the two previously discussed states (see Tab. 2). Smart specialisation strategies can only be successful when all relevant stakeholders are involved and they also need to integrate well with pre-existing strategies and policies. This requires that regional governments act as mediators as well as arbitrators (Kroll et al., 2016). This can be problematic in Saxony, where clusters, which often serve as implementation vehicles, are absent (Koschatzky et al. 2017). On the other hand, highly innovative Bavaria does not seem to stress smart specialisation in its innovation policies.

The choice of priority technology areas is weakly described in the two other regions. In the Saxony Innovation Strategy, it is based on innovation intensity and the sales of new products, while in North-Rhine Westphalia the choice is based mostly upon employment shares in industries. Thus, there is no unified methodology for the identification of prospective industries. Specific to Germany is that the RIS3 strategies are set for large regions. There are 11 regions in the EU S3 platform; thus Germany has the same number of RIS3 regions as Sweden. As an example, the population of North-Rhine Westphalia is almost 18 million, i.e. 1.8 times that of Sweden. Hence, the inevitable question is whether a finer geographical level of aggregation would not be more appropriate.

Bavaria		North-Rhein Westphalia		Saxony	
RTA in patent classes	RIS3 priorities	RTA in patent classes	RIS3 priorities	RTA in patent classes	RIS3 priorities
Instrument details	Efficient production technologies (robotics…)	Furnaces, kilns, ovens	Machine and plant engineering	Crystal growth	New materials
Writing or drawing implements	Life sciences	Sewing, embroidering, tufting	Life sciences	Generating or transmitting mechanical vibrations	ICT and digital communication
Explosive or thermic compositions	ICT	Metallurgy of iron	Health	Nanotechnology	Nanotechnology
Bookbinding, albums	Innovative technology-based services	Locks, keys, safes	Media and creative industries	Horology	Microelectronics including organic and polymer electronics
Footwear	Clean technologies	Oils, detergents, candles	ICT	Headwear	Biotechnology
Nuclear physics/ engineering	New materials, nano- and micro-technology	Metallurgy other	New materials	Weaving	Photonics
Musical instruments, acoustics		Mechanical metal-working	Energy and environmental industry	Hydraulic engineering	Advanced production technologies

Tab. 2: RIS3 priorities and RTA in patents classes in Bavaria, North-Rhine Westphalia and Sachsen (Note: Grey cells indicate the match between RIS3 priorities and patent classes with RTA.)
Source: European Commission, 2018; OECD, 2016

In summary, German states do have experience with regional innovation policies. As their regional RIS3 strategies document, their attitude towards smart specialisation can be reluctant. This is because they often prefer practically proven policies to new unproven EU guidelines, which can be viewed as inappropriate for the German context (Kroll et al., 2016).

Technological specialisation is affected by processes of creative destruction, which affect the connections between technologies and leads to the entry/selection/exit of companies to/from industries, with exit and selection leading to a rise in specialisation (Kogler et al., 2017). Therefore, smart specialisation policies need to be frequently re-assessed. Kogler et al. (2017) confirm that regions are more likely to enter technology classes that are close to existing core knowledge, and exit technology classes that are further from the core in the knowledge space. Technological diversification in the region is also affected by extra-regional linkages. When these knowledge inflows are related to existing regional specialisation, they foster growth (Ponds et al., 2009). The smart specialisation concept also promotes technological diversification into closely-related sectors to the existing dominant technologies in line with evolutionary economic geography (Boschma and Frenken, 2011). The knowledge space can thus be used to identify complementarities within a region's knowledge base.

In terms of prospective industries, the most indistinct categories in Germany's knowledge space are Electronics and Instruments, in line with the increasing digitisation and automatisation in the global economy. Germany is lagging behind in Electronics in comparison to the European average (in relative terms), however, and it should also pay more attention to the service sector, particularly ICT, although it is already a priority based on the Tech strategy. Greater focus on Electronics and ICT should be more preferred in areas which are already strong in this sector such as Upper Bavaria (Munich). Overall, smart specialisation policy recommendations should vary in different places since no 'one-size-fits-all' policy works, and they need to engage with local entities to become a partnership-based policy process of discovery and learning – on the part of both policy makers and entrepreneurs (McCann and Ortega-Argilés, 2015). The marked variations of RIS3 strategies in German states highlight the methodological shortcomings of the smart specialisation policy. This is not only related to the identification of prospective industries, but also to the choice of the most appropriate geographical level for policies.

5. Conclusions

Germany is a large country with important variations between the regions in terms of their size, economic activity and innovation output. Machinery and transportation industries have increased their significance since the 1988–1992 period. Core technological regions such as Baden-Württemberg, Bavaria and North Rhein-Westphalia have increased their dominance over the period and account for almost 74% of German EPO applications. At the NUTS2 level, the most innovative regions are Upper Bavaria, Stuttgart and Düsseldorf. The differences between East and West Germany are still profound, with the former Eastern states accounting for just 6% of EPO applications.

Over the more than twenty years examined (1988–1992, 1998–2002 and 2008–2012), specialisation in Germany measured by the average relatedness measures increased by 10% (particularly in Consumer goods and Electronics), despite a slight decline over the last two periods. Kogler et al. (2017) found increasing specialisation in EU15 NUTS2 regions over the whole period from 1981 to 2005. There is, however, considerable heterogeneity in terms of knowledge relatedness in German regions. Both at the NUTS1 and NUTS2 level, half of the regions have witnessed a decrease in specialisation, from both the former East and West Germany. There are also differences between highly innovative regions, with some of them being highly specialised, others being more diversified. Further research is thus needed to analyse whether the decline in specialisation in the last decade is specific only to Germany as a whole, or whether the pace of specialisation has slowed or stopped also in other countries.

The detailed analysis of the evolution of the knowledge space in three planning regions (Munich, Düsseldorf, Oberes Elbtal/Osterzgebirge) has demonstrated the changes in their technological trajectories over the twenty years, as well as in the levels of knowledge relatedness (specialisation). We have also identified the heterogeneity of their policy framework conditions – leading to variations in the smart specialisation strategies in German regions. In highly innovative Bavaria, it was largely absent although a new document reflecting smart specialisation guidelines has been elaborated recently. In Saxony and North-Rhine Westphalia, the way of choosing strategic sectors differs (employment shares vs. innovation intensity and new products) and is not described in detail. Further, the population size of German RIS3 regions is highly variegated and in three of these regions exceeds 10 million. This points to insufficiently developed smart specialisation methodology.

We believe that more focus should be given to the theory, as well as finding new tools for the identification of prospective industries. This needs to be based on in-depth analyses of the actual status quo and be regularly reassessed. The relatedness measures and the knowledge space could be used to identify sectors closest to the knowledge core, because there is a high probability that regions will enter these sectors compared to those that are further apart in the knowledge space and such sectors foster growth (Kogler et al., 2017). Further, diversification into more complex technologies is associated with greater economic benefits (Balland et al., 2017). This could be very useful particularly in Saxony, due to its on-going re-structuring and lower experience with innovation policies compared to the former Western German states. In Germany, there has already been an increasing overlap of Electronics and Instruments categories. This is in line with greater automatisation and digitalisation. Furthermore, in manufacturing-oriented Germany, a focus on ICT services should be further developed, particularly in regions with already existing capabilities, such as Munich.

There are differences between countries and industries in terms of propensity to patent, and services are in general underestimated in patents. Although in Germany such industries, where the propensity to patent is the highest, dominate, in peripheral regions patenting is very low. Using the concepts of knowledge relatedness and complexity would guarantee a region's technological diversification opportunities on the basis of embeddedness, relatedness and connectivity. For such purposes, patent data should be best combined with other indicators to overcome its limitations. Smart specialisation policies also need to reflect extra-regional linkages within global production networks, particularly in export-oriented Germany. Overall, special attention should be given to peripheral regions in the EU, regions where establishing effective smart specialisation policy is even more complicated.

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References:

ACS, Z., AUDRETSCH, D. B. (1989): Patents as a measure of innovative activity. Kyklos, 42(2): 171–180.

AGHION, P., HOWITT, P. (1990): A model of growth through creative destruction (No. 3223). Cambridge, National Bureau of Economic Research.

ARCHIBUGI, D., PIANTA, M. (1992): Specialization and size of technological activities in industrial countries: The analysis of patent data. Research Policy, 21(1): 79–93.

ASHEIM, B. T., GERTLER, M. S. (2005): The geography of innovation: regional innovation systems. In: Fagerberg, J., Mowery, D. C., Nelson, R. R. [eds.] (2005): The Oxford handbook of innovation (pp. 291–317). Oxford, Oxford University Press

AUDRETSCH, D. B., FELDMAN, M. P. (1996): R&D spillovers and the geography of innovation and production. The American economic review, 86(3): 630–640.

BAIER, E., KROLL, H., ZENKER, A. (2013): Templates of smart specialization: Experiences of place based regional development strategies in Germany and Austria. (Working Papers Firms and Region, R5/2013). Karlsruhe, Fraunhofer Institute for Systems and Innovation Research ISI [online] [cit. 10.05.2018]. Available at: https://www.econstor.eu/bitstream/10419/74482/1/745637779.pdf

BALLAND, P. A., RIGBY, D. (2017): The geography of complex knowledge. Economic Geography, 93(1): 1–23.

BALLAND, P. A., BOSCHMA, R., CRESPO, J., RIGBY, D. L. (2017): Relatedness, knowledge complexity and technological opportunities of regions: A framework for smart specialisation. Papers in Evolutionary Economic Geography. 17.17. Utrecht, Utrecht University.

BATHELT, H., MALMBERG, A., MASKELL, P. (2004): Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation. Progress in human geography, 28(1): 31–56.

BAYERISCHE STAATSREGIERUNG (2011): Gesamtkonzept für die Forschungs-, Technologie- und Innovationspolitik der Bayerischen Staatsregierung. [online] [cit. 10.05.2018]. Available at: http://s3platform.jrc.ec.europa.eu/documents/20182/229963/DE_Bayern_RIS3_201105_Final.pdf/dc9a6e62-c1c1-4a2d-b624-7fccf3fa0988)

BEAUDRY, C., SCHIFFAUEROVA, A. (2009): Who's right, Marshall or Jacobs? The localization versus urbanization debate. Research policy, 38(2): 318–337.

BEISE, M., STAHL, H. (1999): Public research and industrial innovations in Germany. Research policy, 28(4): 397–422.

BOSCHMA, R. (2005): Proximity and innovation: a critical assessment. Regional studies, 39(1): 61–74.

BOSCHMA, R., FRENKEN, K. (2011): The emerging empirics of evolutionary economic geography. Journal of economic geography, 11(2): 295–307.

BOSCHMA, R., IAMMARINO, S. (2009): Related variety, trade linkages, and regional growth in Italy. Economic Geography, 85(3): 289–311.

BOSCHMA, R., MINONDO, A., MIKEL, N. (2013): Related variety and regional growth in Spain, Papers in Regional Sciences, 91 (2): 241–256.

BRESCHI, S., LISSONI, F., MALERBA, F. (2003): Knowledge-relatedness in firm technological diversification. Research Policy, 32(1): 69–87.

BRÜLHART, M.; TRAEGER, R. (2005): An account of geographic concentration patterns in Europe. Regional Science and Urban Economics, 35(6): 597–624.

COHEN, W. M., LEVINTHAL, D. A. (1990): Absorptive capacity: A new prospective on learning and innovation. Administrative science quarterly, 128–152.

COHEN, W. M., GOTO, A., NAGATA, A., NELSON, R. R., WALSH, J. P. (2002): R&D spillovers, patents and the incentives to innovate in Japan and the United States. Research policy, 31(8–9): 1349–1367.

CORONADO, D., FLORES, E. MARTÍNEZ, M. Á. (2017). The role of regional economic specialization in the production of university-owned patents. Annals of Regional Science. 59(2): 513–533.

CYTOSCAPE (2017): Cytoscape Manuals [online]. Available at: http://www.cytoscape.org/manual/

EFRE NRW (2014): Regionale Innovationsstrategie des Landes Nordrhein Westfalen im Rahmen der EU-Strukturfonds 2014–2020 [online]. Available at: https://www.efre.nrw.de/fileadmin/user_upload/Programmtexte/Regionale_Innovationsstrategie.pdf

EUROPEAN COMMISSION. (2016): RIO Country Report 2016: Germany [online]. Available at: https://rio.jrc.ec.europa.eu/en/file/10849/download?token=H_FUucsh

EUROPEAN COMMISSION (2018): Smart Specialization Platform [online]. Available at: s3platform.jrc.ec.europa.eu

FORAY, D., DAVID, P. A.; HALL, B. (2009): Smart specialisation–the concept. Knowledge economists policy brief, 9(85): 100.

FREISTAAT SACHSEN (2013): Innovationsstrategie des Freistaates Sachsen [online]. Available at: http://www.innovationsstrategie.sachsen.de/download/Innovationsstrategie_des_Freistaates_Sachsen.pdf

FRENKEN, K., BOSCHMA, R. A. (2007): A theoretical framework for evolutionary economic geography: industrial dynamics and urban growth as a branching process. Journal of economic geography, 7(5): 635–649.

GERTLER, M. S. (2003): Tacit knowledge and the economic geography of context, or the undefinable tacitness of being (there). Journal of economic geography, 3(1): 75–99.

GRILICHES, Z. (1998): R&D and productivity. Cambridge, National Bureau of Economic Research Books.

GRUPP, H. (1998). Foundations of the Economics of Innovation. Books. Edward Elgar Publishing.

HALL, B. H., JAFFE, A. B., TRAJTENBERG, M. (2001): The NBER patent citation data file: Lessons, insights and methodological tools (No. 8498). Cambridge, National Bureau of Economic Research.

HIDALGO, C. A., KLINGER, B., BARABÁSI, A. L., HAUSMANN, R. (2007): The product space conditions the development of nations. Science, 317(5837): 482–487.

IAMMARINO, S., MCCANN, P. (2006): The structure and evolution of industrial clusters: Transactions, technology and knowledge spillovers. Research policy, 35(7): 1018–1036.

JOO, S. H., KIM, Y. (2010): Measuring relatedness between technological fields. Scientometrics, 83(2): 435–454.

KIESE, M. (2008): Mind the Gap: regionale Clusterpolitik im Spannungsfeld von wissenschaft, politik und praxis aus der perspektive der neuen politischen Ökonomie. Zeitschrift für wirtschaftsgeographie, 52(1): 129–145.

KIESE, M., WROBEL, M. (2011): A public choice prospective on regional cluster and network promotion in Germany. European Planning Studies, 19(10): 1691–1712.

KIESE, M. (2012): Regionale Clusterpolitik in Deutschland: Bestandsaufnahme und interregionaler Vergleich im Spannungsfeld von Theorie und Praxis. Marburg, Metropolis.

KOGLER, D. F., RIGBY, D. L., TUCKER, I. (2013): Mapping knowledge space and technological relatedness in US cities. European Planning Studies, 21(9): 1374–1391.

KOGLER, D. F., ESSLETZBICHLER, J., RIGBY, D. L. (2017): The evolution of specialization in the EU15 knowledge space. Journal of Economic Geography, 17(2): 345–373.

KOGLER, D., WHITTLE, A. (2018): The Geography of Knowledge Creation: Technological Relatedness and Regional Smart Specialization Strategies. In: Paasi, A., Harrison, J., Jones, M. [eds.] (2018): Handbook on the Geographies of Regions and Territories. Cheltenham, Edward Elgar Publishing.

KOSCHATZKY, K., KROLL, H., SCHNABL, E., STAHLECKER, T. (2017): Cluster policy adjustments in the context of smart specialization? Impressions from Germany. The Life Cycle of Clusters: A Policy Prospective, 173.

KROLL, H., BÖKE, I., SCHILLER, D., STAHLECKER, T. (2016): Bringing owls to Athens? The transformative potential of RIS3 for innovation policy in Germany's Federal States. European Planning Studies, 24(8): 1459–1477.

LETEN, B., BELDERBOS, R., VAN LOOY, B. (2007): Technological diversification, coherence, and performance of firms. Journal of Product Innovation Management, 24(6): 567–579.

MARTIN, R., SUNLEY, P. (2006): Path dependence and regional economic evolution. Journal of economic geography, 6(4): 395–437.

MASKELL, P., MALMBERG, A. (2007): Myopia, knowledge development and cluster evolution. Journal of Economic Geography, 7(5): 603–618.

MORGAN, K. (2015): Smart Specialisation: Opportunities and Challenges for Regional Innovation Policy, Regional Studies 49(3): 480–482.

McCANN, P., ORTEGA-ARGILÉS, R. (2015): Smart specialization, regional growth and applications to European Union cohesion policy. Regional Studies, 49(8): 1291–1302.

NAUWELAERS, C., MAGRO, E., ARANGUREN, M. J., NAVARRO, M., WILSON, J., TRIPPL, M., HEALY, A. (2014): Smart specialization for regional innovation. Underpinning effective strategy design: Reflection paper. Workpackage 4. Seventh Framework Programme.

NEFFKE, F., HENNING, M., BOSCHMA, R. (2011): How do regions diversify over time? Industry relatedness and the development of new growth paths in regions. Economic Geography, 87(3): 237–265.

OECD (2011): OECD Science, Technology and Industry Scoreboard 2011: Innovation and Growth in Knowledge Economies. Paris, OECD.

OECD (2013): Innovation-driven Growth in Regions: The Role of Smart Specialisation [online]. Available at: http://www.oecd.org/sti/inno/smart-specialisation.pdf#page113

OECD (2016): OECD REGPAT database [online]. Available at: https://www.oecd-ilibrary.org/science-and-technology/the-oecd-regpat-database_241437144144

OECD (2017): Innovation and technology statistics [online]. Available at: https://data.oecd.org/innovation-and-technology.htm

ORTEGA–ARGILÉS, R. (2012): The transatlantic productivity gap: a survey of the main causes. Journal of Economic Surveys, 26(3): 395–419.

PAVITT, K. (1982): R&D, patenting and innovative activities: a statistical exploration. Research Policy, 11(1): 33–51.

PETERS, B. (2008): Innovation and firm performance: An empirical investigation for German firms. Springer Science & Business Media.

PONDS, R., OORT, F. V., FRENKEN, K. (2009): Innovation, spillovers and university–industry collaboration: an extended knowledge production function approach. Journal of Economic Geography, 10(2): 231–255.

RIGBY, D. L., ESSLETZBICHLER, J. (1997): Evolution, process variety, and regional trajectories of technological change in US manufacturing. Economic Geography, 73(3): 269–284.

RIGBY, D. L. (2015): Technological relatedness and knowledge space: entry and exit of US cities from patent classes. Regional Studies, 49(11): 1922–1937.

SANTOALHA, A. (2016): New Indicators of Smart Specialization: A related diversification approach applied to European Regions .Working Paper No. 20161220. Centre for Technology, Innovation and Culture, University of Oslo.

SAXENIAN, A. (1996): Regional advantage. Harvard University Press.

SCHANKERMAN, M., PAKES, A. (1985): Estimates of the Value of Patent Rights in European Countries During thePost-1950 Period. Economic Journal, 96(384): 1052–1076.

SCHERER, F. M. (1982): Inter-industry technology flows and productivity growth. The review of economics and statistics, 627–634.

SONN, J. W.; STORPER, M. (2008): The increasing importance of geographical proximity in knowledge production: an analysis of US patent citations, 1975–1997. Environment and Planning A, 40(5): 1020–1039.

SUEDEKUM, J. (2006): Concentration and specialization trends in Germany since re-unification. Regional Studies, 40(8): 861–873.

TANRIVERDI, H., VENKATRAMAN, N. (2005): Knowledge relatedness and the performance of multibusiness firms. Strategic Management Journal, 26(2): 97–119.

TEECE, D. J., RUMELT, R., DOSI, G., WINTER, S. (1994): Understanding corporate coherence: Theory and evidence. Journal of economic behavior & organization, 23(1): 1–30.

VLČKOVÁ J., NOSEK, V., NOVOTNÝ, J. LUPÍŠEK, A. (2015): Carbon dioxide emissions embodied in international trade in Central Europe between 1995 and 2008. Moravian Geographial Reports 23(4): 2–13.

VLČKOVÁ, J., KASPŘÍKOVÁ, N. (2015): Knowledge relatedness and knowledge space based on EPO patents. Prague economic papers, 2015(4): 399–415.

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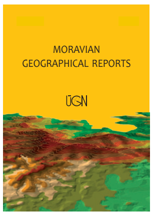

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DE GRUYTER OPEN

A cohort perspective on the fertility postponement transition and low fertility in Central Europe

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Abstract

Fertility postponement and the concomitant decline in fertility levels are the most prominent trends in the demographic behaviours of the former Eastern Bloc countries in Central Europe. A number of studies have analysed period fertility development but the cohort perspective is often neglected. The postponement transition has evolved over a long time span and affected many cohorts, so the cohort approach is appropriate for studying long-term changes in fertility tempo and quantum. A cohort analysis engenders an analysis in detail of the onset, dynamics and ultimate extent of this process. Using the cohort benchmark model, we have been able to pinpoint differences in postponement and recuperation levels and have combined it with projection scenarios. Thus we have been able to model the hypothetical trajectory of the completed cohort fertility rate. Our analysis highlights differences in the timing of the onset of the postponement transition, its trajectory and extent, as well as in the recuperation of postponed childbearing. These findings suggest differences in completed fertility across the selected four Central European countries are likely to continue and perhaps increase.

Keywords: *cohort fertility, postponement transition, low fertility, Central Europe (the Czech Republic, the former GDR, Hungary and Slovakia)*

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1. Introduction

The geographical and political division of Cold War Europe gradually gave rise to two types of population exhibiting two different reproductive paradigms (Decloly and Grasland, 1993; Monnier and Rychtaříková, 1992; Ní Bhrolchaín, 1993). By the mid-1980s, the populations east of the Iron Curtain were characterised by early motherhood and childbearing, a two-child family model, low levels of childlessness and short reproductive spans (e.g. Frejka et al., 2008; Sobotka, 2002, 2003).

In the last four decades, childbearing postponement has become the European norm (Frejka, 2008, 2011; Frejka and Sardon, 2004, 2006, 2007; Kohler, Billari and Ortega, 2002; Sobotka, 2004). Since the late 1980s and early 1990s, postponement has been a key aspect of reproductive behaviours in the former Eastern Bloc as well (e.g. Frejka and Sobotka, 2008; Sobotka, 2002, 2003, 2004, 2011; Křesťanová, 2016). The total fertility rate dropped to its 'lowest-low' (1.3 children per woman, see Kohler, Billari and Ortega, 2002; Billari and Kohler, 2004), and then stabilised at a very low level (up to 1.5 children per woman). This process began in Central European countries before spreading to other parts of Eastern Europe, and so they exhibit a specific pattern (e.g. Sobotka, 2004). The consequences of reproductive aging have been felt in Hungary and the former GDR for more than three decades, and for more than two decades in the Czech Republic and Slovakia. In the former GDR, the response to the collapse in living conditions following the fall of the Berlin Wall (Conrad, 1996; Dorbritz, 2008; Eberstadt, 1994; Witte and Wagner, 1995) was particularly severe, but other countries also saw fertility rates drop to below 1.5. These Central European countries now exhibit the low fertility patterns typically found both in Europe and across the world.

The long-term nature of the changes in the intensity and overall character of fertility indicates that these are not temporary transitions but rather long-term shifts in both the tempo and quantum of fertility (e.g. Sobotka et al., 2011a, 2011b). As Frejka (2008, p. 156) has noted, the transformation of family and reproductive behaviours in

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Central Europe can be best observed by looking at changing fertility age patterns in successive cohorts.

The primary goal of this paper is to analyse the changes and identify differences in cohort fertility associated with the consequences of the postponement transition affecting the generations born in the 1970s and early 1980s. We pinpoint the onset, extent and dynamics of these changes and look at the effects on overall completed fertility.

The decision to investigate Central European countries (the Czech Republic, the former GDR, Hungary and Slovakia) was made for a number of reasons. Firstly, we sought to assess the postponement transition in the former Eastern Bloc countries, as demographic behaviours there differ markedly from those in Western Europe. Early motherhood and relatively low fertility in the 30 and over age groups are particularly important. These two primary characteristics have undergone the most dramatic and dynamic changes in the past 25 years. The sampled Central European countries have been at the forefront of these demographic changes in the Eastern Bloc as a whole. Additionally, we wanted to focus on populations where the onset of the recuperation phase could be clearly identified, which is the case for all of these countries. Lastly, we required a full set of input data (see 3. Research methodology, below) so as to obtain as complete and detailed a picture as possible.

We expect to find that long-term changes in period fertility are reflected in a fall in the completed cohort fertility rate and in new fertility age patterns. Unlike the post-war convergence trend in family and reproductive behaviours (see Sobotka, 2002), we assume that the new conditions will result in increasingly diverse fertility patterns across the former socialist countries in Central Europe. The main differentiating factor is likely to be recuperation of deferred childbearing. Period fertility over the last quarter century would suggest that the recuperation process has probably been most successful in the Czech Republic and former GDR. Slovakia, and especially Hungary, are likely different.

2. Theoretical background

2.1 Fertility patterns in the socialist reproductive model

From the 1960s to the 1980s, reproductive behaviours in post-socialist Central and Eastern Europe were characterised by relatively stable, uniform and organised life patterns. The specific political, economic and social conditions of the second half of the twentieth century created very different family and reproductive environments – compared to Western Europe (see Brzozowska, 2015; Sobotka, 2002, 2004, 2011). The socialist state and lack of market forces created a relatively predictable and risk-free environment with guaranteed employment, job security, free education, health care and so forth (Frejka et al., 2008; Sobotka, 2002; Frejka, 2008). Self-realisation options outside family life were restricted by the authoritarian political régime (Kučera, 1992; Sobotka, 2002, 2004, 2011).

According to Sobotka (2004, 2011), the stability of the socialist demographic model was based on a combination of institutional and cultural factors. Education was completed at a relatively early age and few attended tertiary education (university places were limited, e.g. Kantorová, 2004), while the absence of unemployment, low wage differences and labour force shortage all reduced economic uncertainty. The family constituted a safe area in which people could express themselves and become an important source of social capital. It led to very strong norms in family life and children (Kučera, 1992; Sobotka, 2011). For many young people in socialist Central Europe, early marriage and motherhood were the only means of achieving independence (Frejka, 1980; Kučera, 1992; van de Kaa, 1994). The specific character of the socialist reproductive model was also encouraged and reinforced by numerous pro-natalist social and population policies (e.g. Brzozowska, 2015; Frejka, 1980; Kocourková, 2002; Kučera, 1992; Sobotka, 2011). These varied widely from one country to another and considerably reduced the cost of raising children (David and McIntyre, 1981; Frejka, 1980, 2008). Frejka (2008, p. 155) points out that early marriage and motherhood were encouraged by various other factors, such as the limited career options, restricted choice of leisure activities, lack of travel opportunities and the difficulties of obtaining large-item consumer goods.

Furthermore, in Central Europe, sexual morals and behaviours were liberalised under socialism (Sobotka, 2011). The early age of sexual debut, related to the lack of knowledge of and availability of modern contraception, led to a high proportion of pre-marital conceptions (Sobotka, 2011), while non-marital births were rare. Abortion rates were high as abortion became a "special form of ex-post contraception" (Frejka, 1983; Kučera, 1992). Its long-term use led to the emergence of a specific abortion culture (Stloukal, 1999). These and other factors meant that childbearing postponement held little appeal (Sobotka, 2002, 2011). Consequently, one of the main features of the socialist reproductive model was early family life (e.g. Šprocha, 2016) and early childbearing. In this relatively homogenous fertility profile, childbearing was concentrated within a narrow maternal age span (Potančoková et al., 2008; Sobotka, 2004). Although the two-child family model dominated, in several Central European countries (for example in Hungary and Slovakia) a significant number of women had more than two children. This was partly a result of the higher fertility of the Roma population (e.g. Sobotka, 2002; Šprocha, 2017).

According to Monnier and Rychtaříková (1992), in the mid-1980s there were large demographic differences between Eastern and Western Europe. The Hajnal Line that ran from St. Petersburg to Trieste and had divided Europe historically, culturally and in terms of nuptiality and family behaviour, came to be replaced by political boundaries (Ní Brolcháin, 1993).

2.2 Postponement transition and rapid fertility change

The collapse of state socialism in 1989 and the subsequent social and economic transformation caused profound and dramatic changes. The demographic response to the new conditions was prompt. Fertility rates fell in all of the former socialist Central European countries during the first years of post-communism (e.g. Dorbritz, 2008; Kotowska et al., 2008; Potančoková et al., 2008; Sobotka et al., 2008; Spéder and Kamarás, 2008). The Czech Republic, the former GDR, Slovakia and Hungary experienced several years of lowest-low fertility (see Kohler et al., 2002). This dramatic transformation in reproductive behaviour led to them being categorised amongst the countries with the lowest fertility in the world (Sobotka, 2004, 2011).

There were two main sets of factors behind this rapid and radical transformation in reproductive and family behaviour (see Frejka and Sobotka, 2008; Sobotka et al., 2003; Sobotka, 2004,). The first set of factors relates to the abrupt change in living conditions (Philipov, 2003) following the collapse of the state bureaucracy, caused by the social and economic crisis of the 1990s (Philipov, 2003; Philipov and Dorbritz, 2003; Sobotka and Frejka, 2008). The second set concerns the impact of the combined political, social, cultural and normative changes (often referred to as the second demographic transition, e.g. Lesthaeghe, 2010; van de Kaa, 1987, 1997) which brought the post-communist countries closer to those in Western Europe (Billingsley, 2010; Sobotka, 2004; Sobotka and Frejka, 2008). As many researchers have noted (e.g. Frejka and Sobotka, 2008; Lesthaeghe and Surkyn, 2002; Sobotka, 2004), structural and cultural factors often act simultaneously or in tandem with each other.

Changes in norms and values do not take place in isolation from broader economic and social developments (Frejka and Sobotka, 2008, p. 10). Lesthaeghe and Surkyn (2002) add that the impact of 'crisis factors' and cultural factors may change over time. When the economic situation improves, norms and values can become more important – and vice versa. According to Frejka and Sobotka (2008), this pathway was typical of the former Eastern Bloc countries. Initially – and especially among socially disadvantaged segments – the change in structural conditions in society led to different family behaviour patterns. These gradually became accepted and were adopted by other social groups, which in turn led to wider changes in attitudes (Frejka and Sobotka, 2008, p. 10–11).

The postponement of the reproductive transition and emergence of new life paths – leaving the parental home, domestic and economic independence, marriage and parenthood – became widespread among young people born in the 1970s and 1980s in the former Eastern Bloc (e.g. Frejka and Sardon, 2004; Kotowska et al., 2008; Potančoková et al., 2008; Sobotka et al., 2008). Prolonged education, female emancipation and changing family behaviours made early motherhood unattractive in the new social, political and economic conditions (Sobotka, 2010). Fertility and first-birth postponement have now become the most prominent features of fertility patterns in developed societies (Sobotka, 2004). As indicated by several researchers (e.g. Frejka and Sardon, 2004, 2005, 2007; Kohler et al., 2002; Sobotka, 2004, 2011) delayed parenthood is now a universal European fertility trend in countries with very diverse cultural, social and economic conditions (Sobotka, 2010, p. 129). In addition, Kohler et al. (2002) have pointed out that childbearing in later life is a distinctive character of a 'postponement transition' towards a late-fertility regime. The main feature of the second demographic transition is no longer a decline in fertility to below replacement level, but the postponement of fertility (Lesthaeghe and Neels, 2002).

In comparison with Western European countries, delayed parenthood is a relatively recent phenomenon in post-communist Central Europe, where early childbearing was the reproductive norm until the 1980s (Sobotka, 2004). Although all former socialist countries have been affected by the fertility postponement transition, change has been most rapid in Central Europe and the Baltic countries (Frejka and Sobotka, 2008; Sobotka, 2004, 2011).

As Frejka (2008, p. 157) has noted, during the political and economic transition childbearing strategies changed rapidly from one generation to the next. Fertility among women born in the first half of the 1960s was only marginally affected by the fall of communism, as childbearing had largely been completed in this group by the end of the 1980s. Cohorts born in the second half of the 1960s, especially those born towards the end of that decade, had started childbearing under socialism but had adopted different reproductive strategies to previous generations (Frejka, 2008, p. 156). In general, it is thought that there was no pronounced transition effect among this group. The situation regarding the cohorts born in the first half of the 1970s was quite different. Women born in the second half of the 1970s and the early 1980s started their reproductive period under very different conditions. The family and reproductive behaviours exhibited by this group show a significant decline in fertility rates at a younger age, a strong propensity to postpone important life transitions and to catch up on delayed reproductive intentions later in life (Frejka, 2008; Sobotka et al., 2011a; Šprocha, 2014).

As noted above, the postponement transition in the former Eastern Bloc countries has been ongoing for almost three decades and has affected many cohorts. This means that a cohort approach is a useful method of analysis. Postponement and recuperation are interconnected and embedded in the complex unfolding of the life cycle (Sobotka et al., 2011a, p. 10). The cohort perspective has been used to analyse the postponement transition in Western countries (e.g. Bosveld, 1996; Frejka and Calot, 2001; Frejka and Sardon, 2004; Lesthaeghe, 2001). In this paper we use the latest benchmark model developed by Sobotka et al. (2011a); the next section provides greater details.

3. Research methodology

3.1 Database

Two types of data are used in this analysis. The main part concerns the cohort approach and for that, cohort rates for ages 15–49 were obtained from the Human Fertility Database (2018). There are data available for the Czech Republic and Hungary up to 2014, for the former GDR up to 2013 and for Slovakia up to 2009. But there are serious problems with the data for other post-communist Central European countries (Poland and Slovenia). As noted above, our analysis is based on data from the Human Fertility Database (HFD), which is a repository of high quality that has been subjected to data checks. For Poland, the HFD website indicates that high levels of outward migration have rendered the official population statistics problematic, and warns that fertility indicators for cohorts born after 1965 should be used with caution as they are likely to be underestimated[1]. Moreover, the data on Slovenia lacks cohort age-specific fertility rates for women born in the 1950s and 1960s. We were therefore forced to eliminate Poland and Slovenia from our analysis.

The database does not include the most recent data for Slovakia; however, the Slovak Statistical Office (SO) provided cohort age-specific fertility rates up to 2014. In the end, we were able to assemble time series data sets containing cohort age-specific rates for the 1935 generation and onwards for the Czech Republic, Slovakia and Hungary, and for 1937 onwards for the former GDR.

The second type of data comprises information from the Human Fertility Database (2018) on cohort mean age at first birth. We then used the cohort age specific rate time

[1] http://www.humanfertility.org/cgi-bin/country.php?country=POL&tab=si [cit. 08.01.2018]

series to calculate the cohort completed fertility rates for each country. Considering the very low fertility rates in the 40 and over age groups, we have assumed that the 1974 cohort is the boundary cohort with the presumed completed fertility. Additionally, we used the cohort age specific rates to calculate mean age at birth, the lower- and upper-quartile and the inter-quartile range, in order to analyse the age-concentration of cohort fertility and associated intergenerational changes.

3.2 Research methods

In our analysis of the cohort fertility transition in relation to fertility postponement, we employed a basic version of the more sophisticated benchmark cohort model used by Sobotka et al. (2011a, 2011b). This approach assumes that the fertility postponement transition occurs in two subsequent and interconnected stages: postponement and recuperation (see Fig. 1). The postponement phase is characterised by a decrease in the fertility rate compared with the benchmark cohort. It is then assumed that deferred reproduction occurs during the recuperation phase (Sobotka et al., 2011a, 2011b). This approach thus enables us to analyse the stages of fertility postponement, to identify both the rate at which fertility was postponed and the rate at which recuperation took place, and finally to ascertain the level of total decline in completed fertility at the end of the reproductive lifespan.

Following Sobotka et al. (2011a), as our benchmark cohort we selected the cohort in which fertility postponement can clearly be identified, because one of the primary signs of fertility postponement is a change in the timing of cohort fertility. Sobotka et al. (2011a) suggest that the benchmarking should be performed against a cohort exhibiting stable growth in cohort mean age at first birth. We calculate this to be the 1965 cohorts in Slovakia and the Czech Republic. Fertility postponement began earlier in Hungary and the former GDR, so we selected the 1960 cohort for these countries (see also Sobotka et al. 2011a, 2011b).

In the model of postponement fertility transition, the gap in cohort fertility between the analysed cohort and the benchmark cohort gradually increases in the lower age brackets until it reaches its maximum point. The model then assumes that the postponed births materialise later on, during the recuperation phase. Depending on how pronounced the postponement phase is and how successful the recuperation phase is (as measured at the end of the reproductive period), there is (or may be) a difference in completed fertility. The nature of the process thus provides us with four indicators to analyse it. Following Sobotka et al. (2011a, 2011b) we constructed four indicators:

1. The postponement measure is the maximum difference in cumulated fertility between the benchmark cohort and the analysed cohort.

$$P_a = \sum_{x=12}^{m-1} (f_x^a - f_x^b)$$

where P_a is the postponement measure, f_x^a is the age-specific fertility rate of cohort a (analysed) at age (x), f_x^b is the age-specific fertility rate of cohort b (benchmark) at age (x), m is the age at which the gap between the cumulated fertility rate of the benchmark cohort and the analysed cohort reaches the maximum (Sobotka et al. 2011a).

2. The recuperation measure (R_a) is the absolute fertility increase in the cohort analysed, from the age at which maximum postponement is reached until end of reproductive age (or age 40). In cohort analyses, age 40 is often used as the upper limit, since fertility rates are very low in older age groups.

$$R_a = \sum_{x=m}^{40} (f_x^a - f_x^b)$$

3. The final difference (FD_a) is the total difference in completed fertility of the analysed cohort at end of reproductive age (or at age 40) compared to the benchmark cohort.

$$FD_a = P_a - R_a$$

4. The recuperation index (RI_a) is the degree of recuperation relative to fertility decline at younger ages, computed as:

$$RI_a = \frac{R_a}{|P_a|} \cdot 100$$

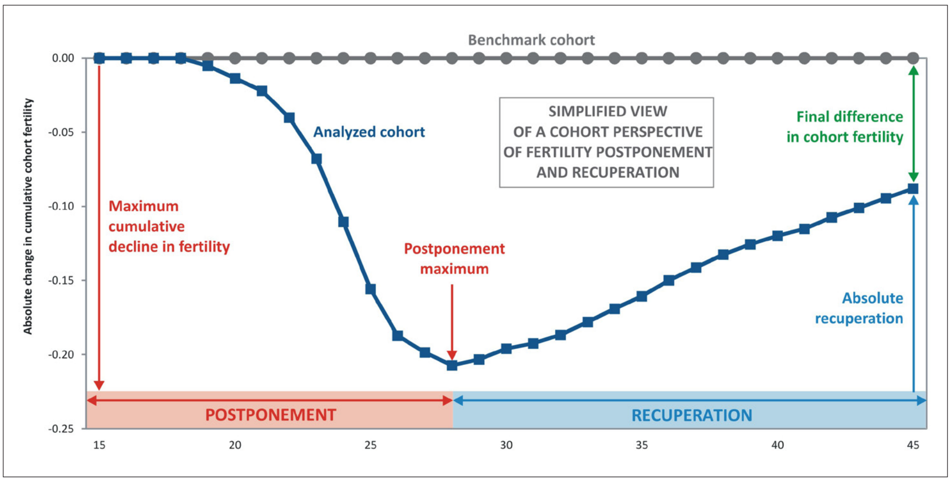

Fig. 1: Simplified view of a cohort perspective of fertility postponement and recuperation
Source: Sobotka et al. (2011a)

This indicator runs from 0–100%, where 0% indicates that none of the deferred births materialise and, conversely, 100% indicates full recuperation of postponed reproduction among women in that cohort. In certain cases, the recuperation index can exceed 100%. This is referred to as "overcompensation" (Sobotka et al., 2011a).

Country, (benchmark cohort; completed cohort fertility)	Cohort	Absolute fertility decline (children per woman)	Absolute recuperation at age 40 (children per woman)	Recuperation Index (%)	Permanent decline (children per woman)
Czech Republic (1965; 1.95)	1967	– 0.08	0.04	50.4	– 0.04
	1970	– 0.23	0.16	67.8	– 0.07
	1972	– 0.39	0.27	68.7	– 0.12
	1974	– 0.54	0.39	71.3	– 0.16
	1976	– 0.72	.	.	.
	1978	– 0.85	.	.	.
	1980	– 0.91	.	.	.
	1982	– 0.96	.	.	.
	1985	– 0.99	.	.	.
Former GDR (1960; 1.80)	1962	– 0.11	0.03	32.8	– 0.07
	1964	– 0.25	0.09	37.1	– 0.16
	1966	– 0.40	0.18	44.5	– 0.22
	1968	– 0.54	0.28	52.4	– 0.26
	1970	– 0.67	0.36	54.3	– 0.31
	1972	– 0.74	0.45	61.4	– 0.29
	1974	– 0.79	0.49	63.5	– 0.28
	1976	– 0.85	.	.	.
	1978	– 0.87	.	.	.
	1980	– 0.87	.	.	.
	1982	– 0.88	.	.	.
	1985	– 0.89	.	.	.
Hungary (1960; 2.02)	1962	– 0.04	0.06	142.2	0.02
	1964	– 0.08	0.06	74.3	– 0.02
	1966	– 0.11	0.07	60.4	– 0.04
	1968	– 0.18	0.08	46.2	– 0.10
	1970	– 0.30	0.15	47.8	– 0.16
	1972	– 0.44	0.20	44.8	– 0.24
	1974	– 0.57	0.25	42.8	– 0.33
	1976	– 0.69	.	.	.
	1978	– 0.77	.	.	.
	1980	– 0.86	.	.	.
	1982	– 0.92	.	.	.
	1985	– 0.98	.	.	.
Slovakia (1965; 2.04)	1967	– 0.06	0.03	57.5	– 0.02
	1970	– 0.20	0.10	49.4	– 0.10
	1972	– 0.34	0.16	46.1	– 0.18
	1974	– 0.48	0.24	48.7	– 0.25
	1976	– 0.66	.	.	.
	1978	– 0.79	.	.	.
	1980	– 0.87	.	.	.
	1982	– 0.93	.	.	.
	1985	– 1.00	.	.	.

Tab. 1: Selected indicators of postponement and recuperation of cohort fertility
Note: (.) data cannot yet be calculated
Sources: Human Fertility Database (2018), SOSR (2014); own calculations

These four key indicators of the postponement transition (see Tab. 1) were used to formulate projection scenarios of cohort fertility. Four model scenarios of the recuperation index were created for any female cohort and any country for which we know the recuperation measure. The first is a constant scenario using a fixed recuperation index from the last known cohort (1974, or 1973 for the former GDR). The remaining three scenarios model the development of completed cohort fertility based on the hypothetical continued rise of the recuperation index from the last empirically derived value up to the 1985 cohorts. Three linear inter-cohort gradual growth rates of the recuperation index were used. In the 10% model, the recuperation index had increased by 10% by the 1985 cohort (compared to 1974, or 1973 for the former GDR). A similar approach was also applied in the 25% and 50% models (with an adequate rate of growth). We only considered scenarios in which the recuperation index increases because changes in fertility over the last decade do not suggest a further decline.

4. Empirical analysis and findings

4.1 Differences and changes in cohort fertility

Marked differences in completed cohort fertility can be observed in the oldest cohorts in the countries analysed. At one end of the spectrum is Slovakia (see Fig. 2), where women born in the first half of the 1930s had on average 2.7–2.8 children. At the other end of the spectrum are Hungary and especially the former GDR, which both exhibit much lower and stable completed cohort fertility rates below the threshold of 2.0 children per woman (Dorbritz, 2008; Frejka and Sardon, 2004; Frejka and Sobotka, 2008; Sobotka et al., 2008; Spéder and Kamaras, 2008). Fertility in the younger cohorts also differs by country. Similar trends can be seen in cohorts as late as those of the 1960s and early 1970s.

In the former GDR, the completed cohort fertility rate for women born in the 1930s and 1940s began to drop from 2 children per woman to 1.8 in the cohorts born in the late 1940s and early 1950s. It increased slightly, partly because of the pro-natalist measures adopted in 1976, but only to a limited extent (see Frejka and Sardon, 2004). After the fall of the Berlin Wall, nearly all the cohorts born in the 1960s and early 1970s exhibited substantial changes (see Dorbritz, 2008). Completed cohort fertility rates dropped to below 1.5 and stabilised to become the lowest of all the countries analysed (Fig. 2).

In the Czech Republic, the completed cohort fertility rate held at 2.0–2.1 children per woman for much of the cohort and did not fall below 2.0 until the cohorts of the early 1960s (Sobotka et al., 2008). The decline is also evident in younger cohorts and in women born in the first half of the 1970s, ultimately dropping to 1.8 children per woman (Fig. 2). In Hungary, the completed cohort fertility rate remained at levels below 2.0 children per woman for the 1940s cohorts and did not recover until the cohorts born in the late 1950s and early 1960s, with the introduction of the government's pro-natalist policies in 1973 and even then only slightly (Spéder and Kamarás, 2008).

In contrast, Slovakia remained in the group of countries with the highest completed cohort fertility rate in Europe (Frejka and Sardon, 2004). Nonetheless, the completed cohort fertility rate in Slovakia was declining slowly (Potančoková et al., 2008). The 1968 cohort exhibited levels below 2.0 children per woman.

One of the primary characteristics of reproductive behaviours in the Eastern Bloc countries had been early motherhood (Fig. 2). This long-term trend was first disrupted by the cohorts of the early 1960s (Hungary and the former GDR: see Sobotka et al., 2011a, 2011b) and then by the generations born in the mid-1960s (Slovakia and the Czech Republic). Subsequent cohorts exhibited a sharp increase in cohort mean age at first birth.

Women born in the 1950s and most of the 1960s typically concentrated reproduction into a brief period when they were in their twenties (between 20 to 24 years of age) (see Fig. 3). While there were some differences between the 20-24 and 25–29 age groups in terms of completed cohort fertility (see for example the former GDR), 80–90% of all reproduction in the late 1950s and early 1960s cohorts had been completed by the age of 30. This changed, however, with subsequent cohorts. Firstly, there was a significant drop in fertility among women younger than 25. This was even more dramatic in the former GDR, where cohort fertility also fell temporarily in the 25–34 age group (see also Dorbritz, 2008). This was a reflection of the impact on fertility of the profound political and societal shifts in the late 1980s and early 1990s.

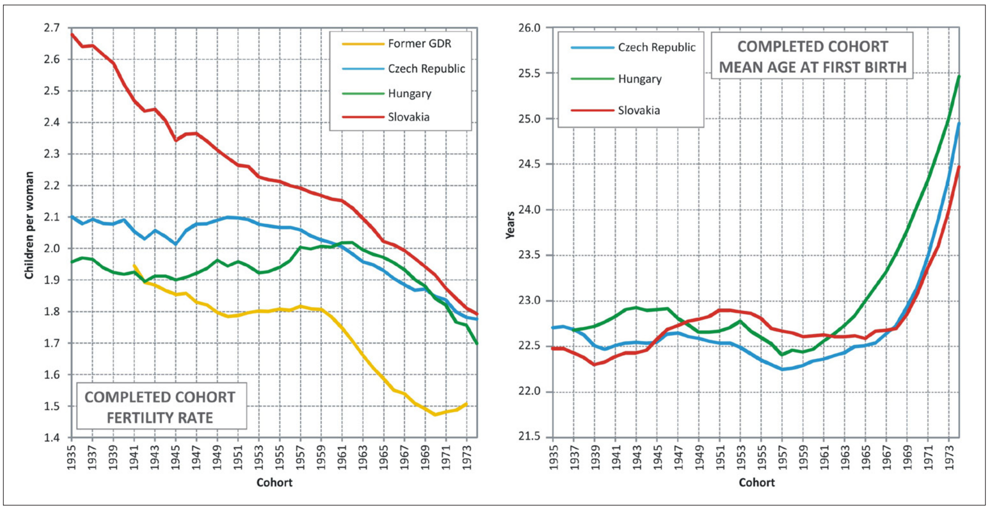

Fig. 2: Completed cohort fertility rate and cohort mean age at first birth
Note: Cohort mean age at first birth not available for the former GDR
Sources: Human Fertility Database (2018), SOSR (2014); own calculations

This phenomenon was specific to the former GDR. Fertility ceased to decline in younger age groups in the former GDR, however, stabilising somewhat earlier (in the early 1970s cohorts) than in the other countries in the late 1970s and early 1980s cohorts.

All the populations show a gradual increase in fertility among the older age groups. There are, however, differences in the pace and extent to which this occurred: at one end of the spectrum is the Czech Republic (and to some degree the former GDR) where women seemed able – for the most part – to catch up on deferred reproduction; at the other end of the spectrum are Slovakia and Hungary where this was not always the case (see below). This is reflected in the change in the cohort fertility maximums: in the Czech Republic, these were reached by the 30–34 age group, whereas in the other countries, the cohort fertility rates for the 25–29 and 30–34 age groups were equalised.

This is also evident in the changes in the extent to which the various age groups contribute to completed cohort fertility. The role played by the 30 plus age group is used as an indirect indicator of fertility postponement (e.g. Lesthaeghe and Moors, 2000). In the former GDR, the contribution of

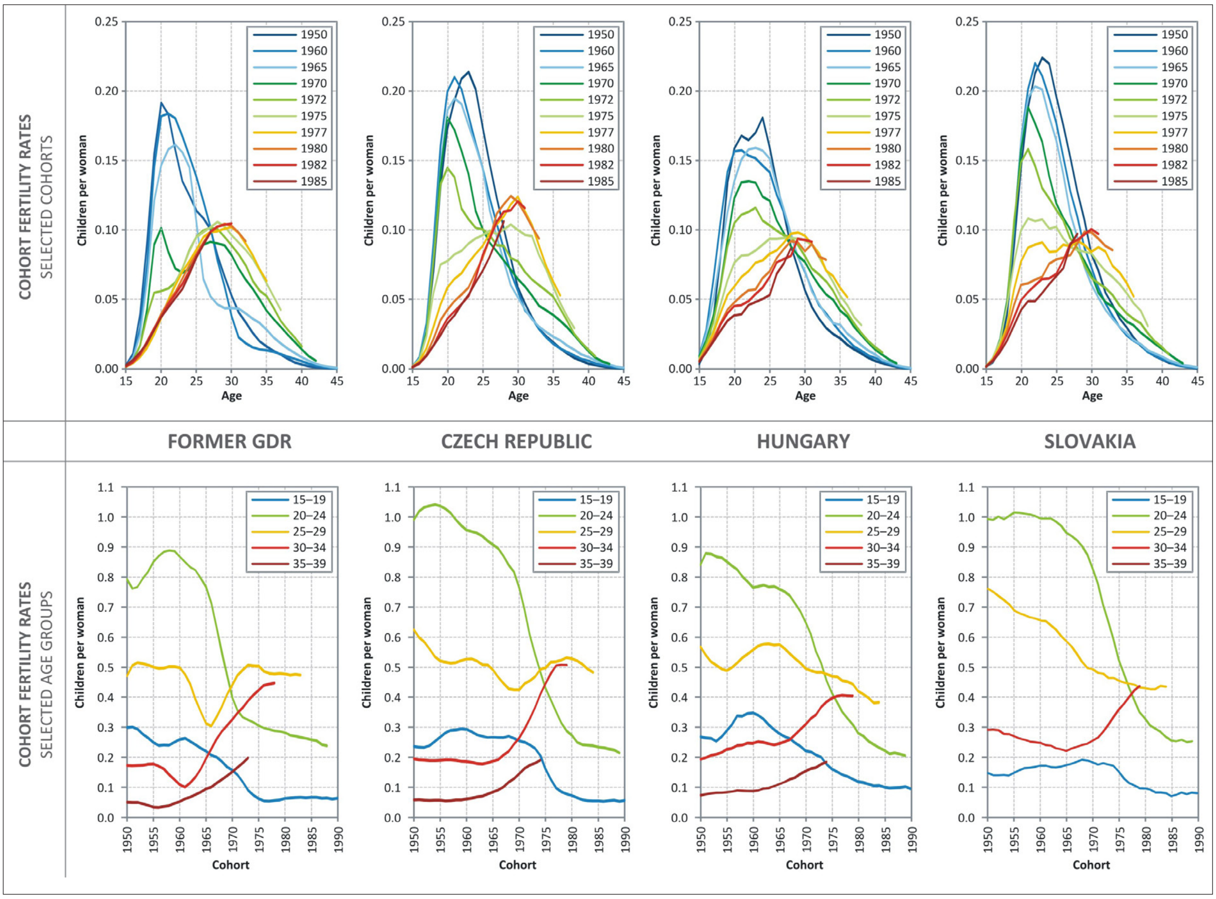

Fig. 3: Cohort fertility rates for selected cohorts and long-term cohort fertility rates for five age groups
Sources: Human Fertility Database (2018), SOSR (2014); own calculations

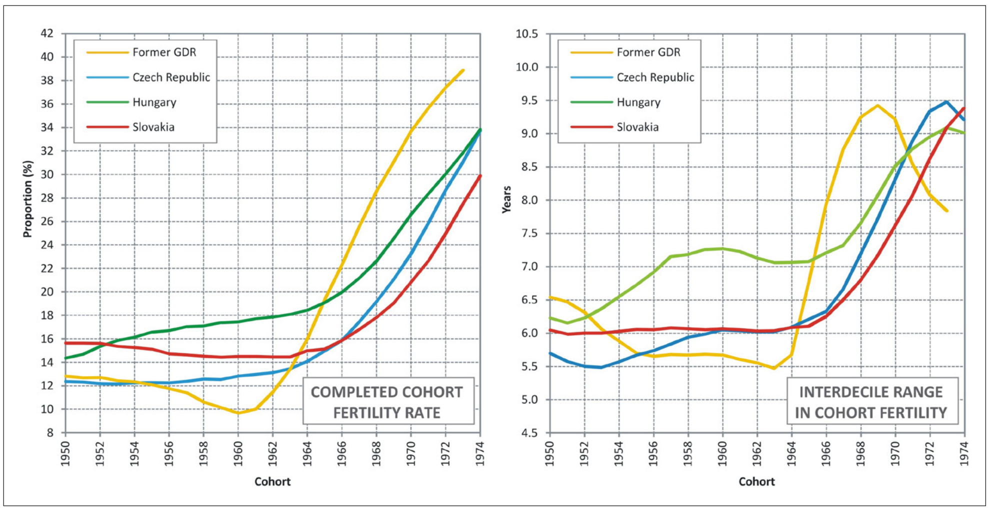

Fig. 4: Contribution to completed cohort fertility rate at age 30 and over and the inter-decile range in cohort fertility
Sources: Human Fertility Database (2018), SOSR (2014); own calculations

this age group rose from 10% in the 1961 cohort to 39% in the 1973 cohort. Similar, albeit smaller, increases can also be observed in the Czech Republic and Hungary (34%), as well as in Slovakia (30%) (see Fig. 4).

The inter-quartile range data confirm our earlier observation that the cohorts born in the 1950s and the early 1960s largely concentrated their fertility into a narrow age span (see Fig. 4). With the younger cohorts, however, the picture begins to change, and starting with the early 1970s cohorts clear differences in reproductive strategies can be observed. The inter-quartile range shifts also reflect the changing dynamics of the postponement transition. For example, 50% of cohort fertility among Czech women born in the early 1950s occurred within the narrowest time span recorded for all the countries analysed (approximately 5.5 years). The concentration of fertility in Central Europe culminated in the early 1960s cohorts in the former GDR (an inter-quartile range of 5.4–5.6 years). This was partly a result of the pro-natalist measures adopted in 1976 which shifted fertility into even younger age groups, but which also – somewhat paradoxically – led to a significant drop in fertility among the 30 plus age groups, which occurred after the fall of the Berlin Wall.

These cohorts also exhibit the lowest cohort mean age at birth of all the populations in question and the lowest contribution of their age group to the completed cohort fertility rate (Fig. 4). On the other hand, the cohorts from the second half of the 1960s in the former GDR and the early 1970s in the Czech Republic were among the populations with the most marked age differences in cohort fertility.

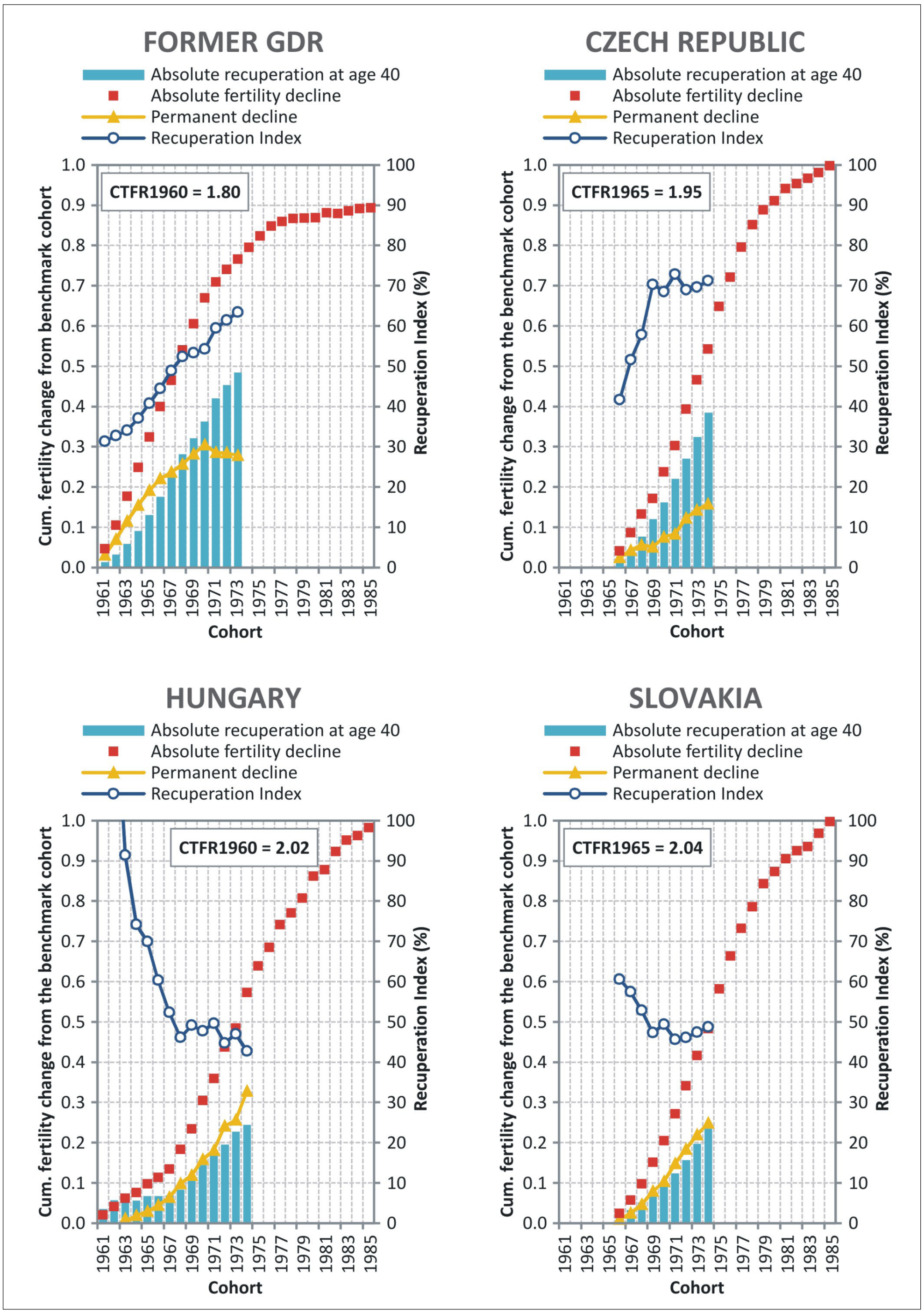

Fig. 5: Graphs showing postponement and recuperation
Sources: Human Fertility Database (2018), SOSR (2014); own calculations

As Figure 4 shows, Hungary exhibited age differences in reproduction relatively early on. It should be noted that over the long-term, the width of the inter-quartile range has been affected by shifts in the upper quartile of cohort fertility, with the lower quartile remaining stable and at a low level in all the populations analysed (19.9–22.5 years).

Once again the former GDR is the only exception here: its lower quartile values rose sharply in the 1971–1973 cohorts, which caused the inter-quartile range to narrow. We can assume that the shifting of the lower quartile into later age groups is the result of childbearing postponement in subgroups of women who would traditionally have become mothers at a very early age. It is likely that the bimodal distribution of cohort fertility rates in the youngest cohorts in both Hungary and Slovakia is due to the size of this group and its specific reproductive behaviour (containing mainly Roma women) (see Fig. 3).

4.2 Cohort perspective on postponement transition

In the countries analysed, cohort fertility postponement can first be observed in Hungary and the former GDR. But, there seems to be no connection between the timing and total extent or rate. In the former GDR, the differences between the analysed cohort and the benchmark cohort clearly broaden out until the early 1970s cohorts and from that point on postponement slows down (Fig. 5). This confirms our observation that the post-1989 political and social changes had the most profound impact on reproduction among women born in the 1960s and the early 1970s. In Hungary (Fig. 5), fertility postponement among women born in the first half of the 1960s began slowly and only picked up speed in the generations born in the early 1970s. This increase in the rate of fertility postponement is especially pronounced in these cohorts in Slovakia and the Czech Republic, but younger cohorts also experienced a moderate slowing of postponement rates. Generally speaking, in all the populations analysed, the younger the cohort is, the slower the rate of postponement. This leads us to conclude that in these Central European countries fertility postponement is now slowing.

By the age of 27 or 28 (postponement maximum), women born in the mid-1980s in the Czech Republic, Slovakia and Hungary had on average one child less than women in the benchmark cohorts (1965 or 1960). By comparison, the difference was 0.9 in the former GDR (Fig. 5).

It is apparent that the difference between the completed cohort fertility rate of each cohort analysed and the completed cohort fertility rate of the benchmark cohort relates to the recuperation rate. Given the age of the cohorts, however, we can only analyse the recuperation index and absolute recuperation at age 40 for cohorts starting in the early 1970s. The highest recuperation index percentages (70–73%) can be found in the Czech Republic in the generations born in the late 1960s and the early 1970s (Fig. 5). In comparison, the lowest recuperation index values are found in Hungary and Slovakia (both 43–50%). Absolute recuperation is very similar. The most significant increase in cohort fertility among the older age groups was observed in the former GDR and the Czech Republic, while the weakest recovery in reproduction is found in Slovakia and Hungary. The smallest total decline in cohort fertility can be observed in the Czech Republic as it has the highest recuperation rate. The distinctive long-term postponement of cohort fertility age in the former GDR (when compared with Hungary) led to the largest decrease in completed cohort fertility being achieved by women born in the 1960s and the very early 1970s. Where the younger cohorts are concerned, however, Hungary seems to have experienced the largest permanent decline in cohort fertility. It is worth noting that the level of permanent decline in completed cohort fertility is also increasing significantly in Slovakia (Fig. 5).

Having analysed the total postponement rates for the generations of women born between 1975 and 1985, we can now turn to the calculations of permanent decline and the cohort total fertility rate, which relate primarily to recuperation levels.

It is immediately apparent that had there not been a change in recuperation (constant scenario), the completed fertility rate would have continued to decline in the 1975–1985 cohorts in all the populations. That decline would have been slowest in the Czech Republic and the former GDR, but would have accelerated considerably in Slovakia and Hungary. In this scenario, the youngest cohorts in Hungary would have had the lowest completed cohort fertility of all the countries (Fig. 6). Whereas in the Czech Republic and former GDR, a gradual 10% increase in the recuperation index among the 1975 to 1985 cohort would have stabilised completed cohort fertility and led to a slight increase in the 1980s cohorts. In Hungary and Slovakia, though, it would merely have slowed the decline (Fig. 6). It

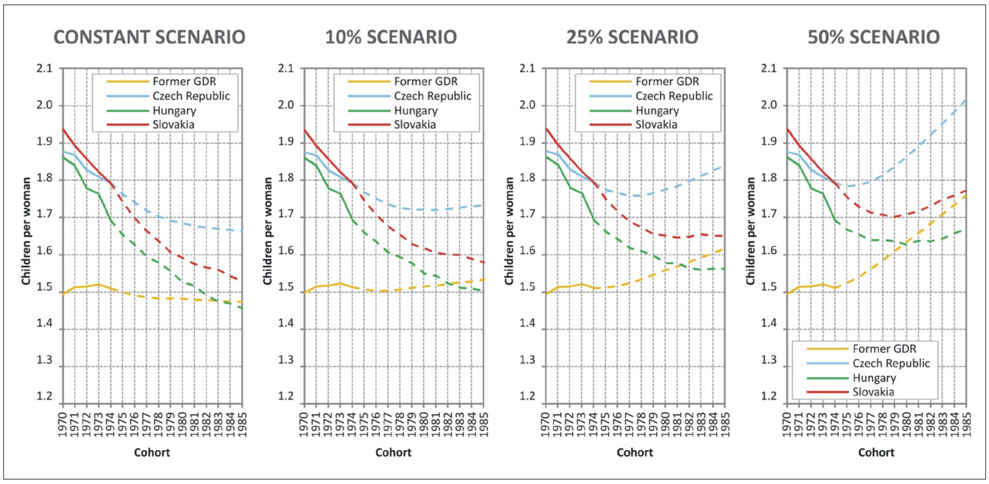

Fig. 6: Observed and projected completed cohort fertility rate in various scenarios
Note: Dashed line indicates projected values
Sources: Human Fertility Database (2018), SOSR (2014); own calculations

seems that a faster rate of recuperation would be required for a noticeable increase in completed cohort fertility to have occurred in the Czech Republic and former GDR, and indeed this is borne out by the data obtained from the scenarios where we increased the recuperation index until the 1985 cohort by 25% and 50% respectively (in comparison with the 1974 cohort). In Hungary and Slovakia, the 25% scenario would have stabilised completed cohort fertility among women born in the first half of the 1980s. Only a very high increase in the recuperation rate would have resulted in a significant rise in completed cohort fertility (still lower than that in the Czech Republic and former GDR).

5. Conclusions

This analysis has indicated stable long-term differences in completed cohort fertility in the Central European countries, as well as a number of common features in reproduction among women who largely fulfilled their reproductive plans. These are early motherhood, the predominance of the two-child family model and the concentration of fertility into a narrow age span. After the collapse of the Eastern Bloc, these reproductive patterns were disrupted by changes in life conditions and norms, and new ones emerged involving fertility postponement.

These significant changes in fertility rate and onset can be observed in all Central European countries after 1989 and they are also reflected in the cohort indicators, especially the increase in cohort mean age at first birth. Despite the inter-country differences in the onset, rate and ultimate extent of fertility postponement, it has evidently affected all the populations and increasingly so with each cohort. In general, the fastest rates of fertility postponement can be found in those generations of women who were in their reproductive prime when the collapse of communism triggered large-scale societal changes. In the younger cohorts (especially the mid-1980s ones), the postponement rate decreases and the first phase of the postponement transition concludes. Completed cohort fertility seems to depend on how successful the 1975–1985 cohorts will be in fulfilling their deferred reproductive plans. Despite other differences in the extent of fertility postponement, the rate of recuperation seems to be the primary differentiator here. Of the countries analysed, the populations of the former GDR and the Czech Republic have been most successful in that respect, while in Hungary and Slovakia there is still a risk of a sharp decline in cohort fertility for the generations of women born in the late 1970s and early 1980s.

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References:

BILLARI, F. C., KOHLER, H. P. (2004): Patterns of Low and Lowest-Low Fertility in Europe. Population Studies, 58(2): 161–176.

BILLINGSLEY, S. (2010): The Post-Communist Fertility Puzzle. Population Research Policy Review, 29(2): 193–231.

BOSVELD, W. (1996): The ageing of fertility in Europe. A comparative demographic-analytic study. Doctoral dissertation. PDOD Publications, Amsterdam, Thesis Publishers.

BRZOZOWSKA, Z. (2015): Female Education and Fertility under State Socialism in Central and Eastern Europe. Population, 70(4): 689–725.

CONRAD, C., LECHNER, M., WERNER, W. (1996): East Germany Fertility after Unification: Crisis or Adaptation? Population and Development Review, 22(2): 331–358.

DECLOLY, J. M., GRASLAND, C. (1993): Boundaries, political systems and fertility in Europe. Population: An English Selection, 5: 101–118.

DORBRITZ, J. (2008): Germany: Family diversity with low actual and desired fertility. Demographic Research, 19: 557–598.

EBERSTADT, N. (1994): Demographic Shocks After Communism: Eastern Germany, 1989–93. Population and Development Review, 20(1): 137–152.

FREJKA, T. (1980): Fertility trends and policies: Czechoslovakia in the 1970s. Population and Development Review, 6(1): 65–93.

FREJKA, T. (1983): Induced Abortion and Fertility: A Quarter Century of Experience in Eastern Europe. Population and Development Review, 9(3): 494–520.

FREJKA, T. (2008): Overview Chapter 2: Parity distribution and completed family size in Europe: Incipient decline of the two-child family model? Demographic Research, 19: 47–72.

FREJKA, T. (2011): The Role of Contemporary Childbearing Postponement and Recuperation in Shaping Period Fertility Trends. Comparative Population Studies – Zeitschrift für Bevölkerungswissenschaft, 36(4): 927–958.

FREJKA, T., CALOT, G. (2001): Cohort reproductive patterns in low fertility countries. Population and Development Review, 27(1): 103–132.

FREJKA, T., SARDON, J. P. (2004): Childbearing Trends and Prospects in Low-Fertility Countries. A Cohort Analysis. European Studies of Population, Vol. 13. Dordrecht/Boston/London, Kluwer Academic Publishers.

FREJKA, T., SARDON, J. P. (2006): First birth trends in developed countries: Persisting parenthood postponement. Demographic Research, 15: 147–180.

FREJKA, T., SARDON, J. P. (2007): Cohort birth order, parity progression ratio and parity distribution trends in developed countries. Demographic Research, 16: 315–374.

FREJKA, T., SOBOTKA, R. (2008): Overview Chapter 1: Fertility in Europe: Diverse, delayed and below replacement. Demographic Research, 19: 15–46.

FREJKA, T., SOBOTKA, T., HOEM, J. M., TOULEMON, L. (2008): Summary and general conclusions: Childbearing Trends and Policies in Europe. Demographic Research, 19: 5–14.

HUMAN Fertility Database. Max Planck Institute for Demographic Research (Germany) and Vienna Institute of Demography (Austria) [online] [cit. 15.01.2018]. Available at: www.humanfertility.org

KANTOROVÁ, V. (2004): Education and entry into motherhood: The Czech Republic during state socialism and the transition period (1970–1997). Demographic Research, Special Collection 3, Article 10: 243–274.

KOCOURKOVÁ, J. (2002): Leave arrangements and childcare services in Central Europe: policies and practices before and after the transition. Community, Work & Family, 5(3): 301–318.

KOHLER, H.VP., BILLARI, F. C., ORTEGA, J. A. (2002): The emergence of lowest-low fertility in Europe during the 1990s. Population and Development Review, 28(4): 641–680.

KŘESŤANOVÁ, J. (2016): Analýza vývoje plodnosti na území České republiky po roce 1950 do současnosti za využití dekompozičních metod. Demografie, 58(2): 142–158.

LESTHAEGHE, R. (2001): Postponement and recuperation: Recent fertility trends and forecasts in six Western European countries. Paper presented at the IUSSP Seminar on "International Perspectives on Low Fertility: Trends, Theories and Policies", Tokyo, March 21–23, 2001.

LESTHAEGHE, R. (2010): The Unfolding Story of the Second Demographic Transition. Population and Development Review, 36(2): 211–251.

LESTHAEGHE, R., MOORS, G. (2000): Recent Trends in Fertility and Household Formation in the Industrialized World. Review of Population and Social Policy, 9: 121–170.

LESTHAEGHE, R., NEELS, K. (2002): From the first to the second demographic transition: an interpretation of the spatial continuity of demographic innovation in France, Belgium and Switzerland. European Journal of Population, 18(4): 325–360.

LESTHAEGHE, R., SURKYN, J. (2002): New forms of household formation in Central and Eastern Europe: Are they related newly emerging value orientations? In: Economic Survey of Europe 2002/1 (pp. 197–216) Economic Commission for Europe, United Nations, New York and Geneva.

MONNIER, A., RYCHTAŘÍKOVÁ, J. (1992): The division of Europe into East and West. Population: An English Selection, 4: 129–160.

NÍ BHROLCHAÍN, M. (1993): East-West marriage contrasts, old and new. In: Blum, A. J., Rallu, L. [eds.]: European Population II. Demographic Dynamics (pp. 461–479). Montruge, John Libbey Eurotext.

PHILIPOV, D., DORBRITZ, J. (2003): Demographic consequences of economic transition in countries of central and eastern Europe. Population studies, No. 39, Strasbourg: Council of Europe Publishing.

POTANČOKOVÁ, M., VAŇO, B., PILINSKÁ, D., JURČOVÁ, D. (2008): Slovakia: Fertility between tradition and modernity. Demographic Research, 19: 973–1018.

SOBOTKA, T. (2002): Ten years of rapid fertility changes in the European post-communist countries: Evidence and interpretation. Working paper WP 02-1. Population Research Centre, University of Groningen.

SOBOTKA, T. (2003): Re-Emerging Diversity: Rapid Fertility Changes in Central and Eastern Europe after the Collapse of the Communist Regimes. Population, 58(4–5):451–485.

SOBOTKA, T. (2004): Postponement of Childbearing and Low Fertility in Europe. Amsterdam: Dutch University Press.

SOBOTKA, T. (2010): Shifting Parenthood to Advanced Reproductive Ages: Trends, Causes and Consequences. In: Tremmel, J. C. [ed.]: A Young Generation under Pressure? (pp. 129–153). Berlin, Springer Verlag.

SOBOTKA, T. (2011): Fertility in Central and Eastern Europe after 1989. Collapse and gradual recovery. Historical Social Research (Special issue Fertility in the 20th Century: trends, policies, theories, discourses), 36(2): 246–296.

SOBOTKA, T., ZEMAN, K., KANTOROVÁ, V. (2003): Demographic Shifts in the Czech Republic after 1989: A Second Demographic Transition View. European Journal of Population, 19: 249–277.

SOBOTKA, T., ŠŤASTNÁ, A., ZEMAN, K., HAMPLOVÁ, D., KANTOROVÁ, V. (2008): Czech Republic: A rapid transformation of fertility and family behaviour after the collapse of state socialism. Demographic Research, 19: 403–454.

SOBOTKA, T., ZEMAN, K., LESTHAEGHE, R., FREJKA, T. (2011a): Postponement and Recuperation in Cohort Fertility: New Analytical and Projection Methods and their Application. European Demographic Research Papers.

SOBOTKA, T., ZEMAN, K., LESTHAEGHE, R., FREJKA, T., NEELS, K. (2011b): Postponement and Recuperation in Cohort Fertility: Austria, Germany and Switzerland in a European Context. Comparative Population Studies – Zeitschrift für Bevölkerungswissenschaft, 36(2–3): 417–452.

SPÉDER, Z., KAMARÁS, F. (2008): Hungary: Secular fertility decline with distinct period fluctuation. Demographic Research, 19: 599–664.

STATISTICAL OFFICE OF THE SLOVAK REPUBLIC (SOSR) (2014): Statistical Report on Birth 2009–2014, Primary database.

STLOUKAL, L. (1999): Understanding the 'abortion culture' in Central and Eastern Europe. In: David, H. P., Skilogiannis, J. [eds.]: From Abortion to Contraception: A Resource to Public Policies and Reproductive Behaviour in Central and Eastern Europe from 1917 to the Present (pp. 23–37). Westport, Connecticut, Greenwood Press.

ŠPROCHA, B. (2014): Odkladanie a rekuperácie plodnosti v kohortnej perspektíve v Českej republike a na Slovensku. Demografie, 56(3): 219–233.

ŠPROCHA, B. (2016): Transformácia sobášnosti slobodných v Českej a Slovenskej republike v prierezovom a kohortnom. Demografie, 58(3): 230–248.

ŠPROCHA, B. (2017): Rómska populácia na Slovensku a kohortná plodnosť rómskych žien podľa výsledkov sčítania obyvateľov, domov a bytov 2011. Demografie, 59(2): 118–131.

VAN DE KAA, D. (1987): Europe's second demographic transition. Population Bulletin, 42(1): 1–57.

VAN DE KAA, D. (1997): Options and Sequences: Europe's demographic pattern. Journal of the Australian Population Association, 14(1): 1–28.

WITTE, J. C., WAGNER, G. G. (1995): Declining Fertility in East Germany after Unification: A Demographic Response to Socioeconomic Change. Population and Development Review, 21: 387–39.

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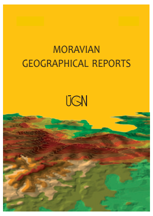

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Discovering extinct water bodies in the landscape of Central Europe using toponymic GIS

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Abstract

Due to global climate change and anthropogenic pressures on the landscape, one of the current geographical problems is retention of water in agricultural landscapes. One possibility to tackle this issue is the construction of artificial water bodies, which has historical traditions in the form of fishponds in Central European landscapes. Unfortunately, many such water bodies were transformed into arable lands during the 18th and 19th centuries. In this study, the identification and spatial distribution of these extinct water bodies is subject to examination, using place names in a GIS environment. Some 375 place names were selected from the official database of place names in the Czech Republic. This set of names was compared to current maps, as well as to old maps from the Habsburg monarchy from 1783–1880 (1st, 2nd and 3rd Military Survey). The map resources were used to find out if a place name was related to an extinct fishpond, and in which period the pond ceased to exist. Using spatial statistics, the existence of areas with a high concentration of place names referring to extinct ponds is demonstrated. It has also been established that areas linked to fishpond extinction in the same period now face more frequent droughts. Thus, the set of place names can be used to identify not only extinct water bodies, but also to serve as being potentially useful in other analyses using GIS, as well as in the public sphere (reclamation).

Keywords: *place names; toponyms; historical landscape; ponds; GIS; Czech Republic*

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1. Introduction

Current European landscapes are witness to dynamic changes (Vos and Meekes, 1999), subject to anthropogenic pressures evidenced by many factors, such as the growing landscape impacts of urbanisation, industrialisation and intensive commercial farming on the one hand (e.g. Feranec et al., 2010), while rural landscapes are left idle due to their economic unprofitableness on the other hand (Lieskovsky et al., 2015). Either way, traditional European landscapes, which were created and acquired characteristic and stable structures for centuries, begin to vanish dramatically with the onset of intensive commercial agriculture and continuing urbanisation (Špulerová et al., 2017).

The monitoring and assessment of current anthropogenic activities on the landscape is connected to an increasing scientific interest in the historical landscape and its form, which is frequently used as a starting point for the comparison of the degree and intensity of changes (Haase et al., 2007; Van Eetvelde and Antrop, 2009). In addition, such research serves as a foundation for scenarios for its future development in connection with planning (Gaynor and McLean, 2008; Marcucci, 2000), or as a source of inspiration for its reconstruction or revitalisation (Spens, 2006; Stein et al., 2010). Specific parts of historical landscapes are subject to investigation in this article: artificial water bodies in the form of ponds or fishponds serving as small water reservoirs, which had been built for various purposes across most of Central Europe to a great extent since the Middle Ages (Jankowski, 2006; Squatriti, 2000). Many of them ceased to exist, however, with the onset of industrialisation and modern agriculture (Bičík, 2010; Lipský, 2001). Those that survive can play an important part in ecology (Jeffries, 1991) and hydrology (Smith et al., 2002), as well as in cultural terms (Rees, 1997). The restoration of some extinct fishponds, which could help maintain water in the agricultural landscape (David and Davidová, 2015), is being discussed in relation to increasing anthropogenic pressures on the landscape and their negative impact on its ecology and water capacity (Bastian et al., 2006; Šantrůčková et al., 2017), together with the changing climate and the increased probability of extreme hydrological phenomena (droughts) (Zahradníček et al., 2015).

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As a consequence, research on the historical extent of water areas is essential. Many studies apply the set of current and old maps for this purpose (e.g. Havlíček et al., 2014; Skaloš et al., 2011; Šantrůčková et al., 2017). These are mainly regional studies, however, as processing an area the size of a country is very demanding time- and capacity-wise (Pavelková et al., 2016). Therefore, current place names are used here as a primary indicator of the former existence of artificial water bodies.

We assume that place names are the basic building blocks of cultural landscapes (Penko Seidl, 2011) and they can be seen, apart from the actual naming of a location that facilitates orientation in space, as remnants of the symbolic processes of landscape anthropomorphism and space socialisation (McNiven, 2008). Thus, they bear historical information of some relations of facts which might have occurred during the process of naming a location or a specific object. They are basically "the storehouses of cultural information about people's relationship with the land" (Hunn, 1996, p. 22). Place names referring to fishponds could provide relevant information: with respect to their historical distribution; their spatial pattern concerning the former distribution of ponds (Pavelková et al., 2014); and their stability and the longevity of place names in the landscape (Calvo-Iglesias et al., 2012).

2. Theoretical background

2.1 Place names, geography and toponymic GIS

The study of place names represents quite a broad interdisciplinary scientific field where linguists, historians, ecologists, sociologists, folklorists and psychologists can meet (Jett, 1997; Senft, 2008). It might seem that the potential relations between place names and material and social phenomena in specific landscapes and at specific times would initiate a number of geographic studies, but research on place names in geography is often perceived as marginal (Rose-Redwood et al., 2010). This partly occurs as traditional perceptions of place names (emphasising etymology or linguistics), which are applied mostly in historical and cultural geography connected with the history of settlements or the historical appearance of landscape (Darby, 1957; Hoskins, 1969; Stewart, 1945), has been exhausted to a degree (David and Mácha, 2014; Zelinsky, 1997), and apart from regional curiosities, it as not brought any new advances in theory or method. Therefore, such studies have often been connected to a mere collection of local curiosities of antiquarian empiricism (Rose-Redwood et al., 2010). Moreover, many of the alleged connections between place names and historical processes in the landscape have been shown to be fallible (Johnson, 2008, p. 110). In addition, there might be a relation to the simple fact that the linguistic significance of individual words changes in time (Roberts and Wrathmell, 2002).

Since the 1990s, geographic research on place names has changed significantly – with connections to the so-called "critical turn" in Human Geography. This new approach sees place names as social producers of space (Rose-Redwood et al., 2010). The 'catch-all' phrase "critical toponymies" has inspired a number of geographical studies which deal with place names with respect to the concerns of critical human geography, in the sense of their roles in politically and socially motivated space (re)organisation or power distribution (e.g. Alderman, 2002; Azaryahu, 2012; Creţan and Matthews, 2016; Karimi, 2016; Myers, 1996; Rose-Redwood, 2008; Yeoh, 1996). The role that place names play in creating the relationship of a person to space based on personal significance and memories (Radding and Western, 2010), regional identification (Machar, 2014; Semian, 2012; Semian et al., 2016), or the potential to be used commercially (Light and Young, 2015), is also being discussed with respect to new approaches to the perception of place names.

The broader application of Geographical Information Systems (GIS) methods to the study of place names can be seen towards the end of the 2000s (Wang et al., 2006). Many authors consider this change as new opportunities in the study of place names (Goodchild, 2004; Wang et al., 2014), especially in relation to possible applications of spatial statistics to the sets of place names, aiming at discovering their spatial patterns. As a principal reason, it is possible to analyse a large number of place names at various scales and to connect them to other attributes, human or environmental. There is often no need for their collection and classification, largely due to applications of existing place name dictionaries (Wang et al., 2014) or even better, national digital databases of place names and gazetteers (Cox et al., 2002; Feng and Mark, 2017; Wang et al., 2006). Place names can then be analysed with more detailed connections to their surroundings using some basic tools of GIS software, combining the place name databases with other types of available geo-data (digital elevation models, river networks, land cover, regional boundaries, population data, etc.). Overlapping place names and GIS can thus provide a unique connection for their qualitative and quantitative (spatial-analytical) potential, which can be applied both in both historical and cultural geography (Fuchs, 2015a). Hence, Fuchs (2015b) applies the term "toponymic GIS", which can be used in most studies thusly oriented. It is basically an analogy to 'historical GIS' (Bailey and Schick, 2009; Gregory and Ell, 2007; Knowles, 2002), which includes the analysis of both spatial and temporal data series acquired from historical resources – both at a scale and volume not known previously, such that the processing of such sources was too slow or too complicated in the past (Holdsworth, 2002).

Moreover, it is our belief that there is a close relation between Toponymic GIS and Historical GIS. The GIS application in historical research is widely applied by historical geographers (Gregory and Healey, 2007) in their studies of historical landscapes and change. Place names represent a significant source in the historical geography or environmental history of landscapes (King et al., 2007; Pospelov and Smolitskaya, 1986). Thus, the subjects of study of historical GIS and toponymic GIS may meet and overlap on this issue. Applying GIS methods to the study of place names introduces a new impulse for traditional approaches. The results of spatial analyses could support or complement the theoretical concepts through which we perceive place names. First of all, the previous hypotheses on connections between place names and certain landscape phenomena are easy to capture in GIS and can be verified (Chen et al., 2014; Wang et al., 2006). Not only can these connections be studied on far wider levels and on more numerous statistical data sets, but they can also be applied on an international level with inputs of a set of place names in different languages (Grădinaru et al., 2012). One example of applying place names, GIS and local geographical factors connected with ethnology, is a study in ethno-physiography (Derungs and Purves, 2014; Feng and Mark, 2017; Mark and Turk, 2003), or in ethno-pedology (Capra et al., 2015; Capra et al., 2016).

This case study deals with place names with reference to traditional historical-geographic approaches to their study in relation to historical landscapes, with new possibilities provided by the GIS methods applied to current place name databases. We follow the above-mentioned studies in that spirit and do not view them through the prism of critical toponymies.

2.2 Place names and historical landscape research

Interest in place names has also increased among scientific disciplines in recent years, to a great extent because place names are understood to be parts of historical landscapes (Rippon, 2013), as well as serving as special study materials and sources of a large amount of environmental information (David, 2008; Sousa et al., 2010). They are amply utilised in bio-geographical research on the historical distributions of selected species and their relations to specific landscape features (Aybes and Yalden, 1995; Boisseau and Yalden, 1998; Cox et al., 2002; Moore, 2002). In addition, they play the role of indicators of past use and the manner of landscape cultivation (Calvo-Iglesias et al., 2012; Conedera et al., 2007; Holl and Smith, 2007; Siderius and de Bakker, 2003), or they serve together with other sources as evidence of the overall management of natural resources (Lawson et al., 2005).

The above-mentioned studies use place names as a source of information about historical landscapes; however, let us not forget that place names do have a strong role per se and help create the atmosphere of local landscapes and their character in the rural space (Rippon, 2013). Penko Seidl et al. (2015) observe that landscape consists of three basic layers: historical, geographical (from the perspective of physical-geographical configuration) and cognitive (the manner in which people perceive and interpret landscapes). Place names penetrate all of the presented layers from this perspective. It is through them that the specific identity of places is created (Tilley, 1994), which is part of the relation formed between a person and a given place or landscape, while perceiving their historical continuity (Ingold, 2000).

In this context, knowledge of local place names should lead local residents to consider their significance and origin, as confirmed by a number of local studies. Our research focuses on the current place names that can inspire local people to consider the landscape and the way water was managed in the past. Therefore, we decided to combine the current place name databases with information on the appearance of historical landscapes acquired from old maps. Thus, this approach differs from studies which use old maps as the resource for place names for the purposes of landscape research (Loffler, 2000; Sousa and García-Murillo, 2001; Sousa et al., 2010; Spens, 2006).

3. Geographical context of the study

The present study uses Toponymic GIS and applies the procedures to the set of place names connected to ponds (fishponds), as examples of artificial water bodies. The Czech Republic was selected as the area of interest for this study. Its history of pond construction is long and ponds were widely spread here and became an important landscape phenomenon, mainly since the 1450s (Pavelková et al., 2016; Semotanová, 2009). Similar to other countries, Czech ponds fulfilled various roles, most of all as places to keep fish. That is the reason why the term pond merged with the term fishpond no matter what the purpose was (Pavelková et al., 2014). Resulting from socio-economic changes, most of fishponds (approximately two-thirds) were drained and turned into farm land. The process of pond abolishment occurred in two main waves: the first (major) one took place in the second half of the 18th century and it was connected with the transition to new procedures in farming and also with the Enlightenment reforms of society. The second wave occurred in the first half of the 19th century and was caused by attempts to increase the amount of soil available to grow sugar beet. Evidence of extinct ponds can be found, however – in the field (remnants of dykes and canals: Klápště, 2016), archives and old maps (Frajer et al., 2013; Skaloš et al., 2011), as well as in current place names.

And this research project focuses on the place names referring to extinct ponds. We follow two principal assumptions:

1. fish-farming is mentioned as one of the best-known human historical impacts on the landscape of the Czech lands (Semotanová, 2009), such that the abolishing of ponds as important elements of both the current and the historical farm landscapes must have been reflected in folk toponymy; and
2. as the wave of ponds abolished in the Czech lands (at the turn of the 19th century) coincides with the emergence of the first modern land cadastres in the Habsburg monarchy (Josephinian cadastre 1789; Stabile cadastre 1823), it is highly likely that many of these place names were standardised and are still used in map works. A number of these place names might thus be old and refer to several centuries-old facts (Calvo-Iglesias et al., 2012; Dohnal, 2016).

4. Aims and research questions

The aim of this study is to apply Toponymic GIS to evaluate the spatial distribution of current place names referring to extinct ponds and, using old maps to determine the relative time of the extinction of these water landscape elements, thus to ascertain the age of the place name. Our research tried to answer three essential questions:

1. Is it possible to identify extinct ponds in the Czech Republic using the current place names and old maps?;
2. How old is the event (the existence of the pond) that the place names refer to?; and
3. Is it possible to trace tendencies in the spatial concentration of the place names? Do areas of frequent occurrences of those place names overlap with the areas which currently face water shortages?

To answer these questions, we use data from the current database of the Geographical names of the Czech Republic (GEONAMES) and old maps of the Habsburg monarchy.

5. Data and Methods

5.1 Basic data

The database GEONAMES, managed by the Czech Office for Surveying, Mapping and Cadastre (ČÚZK), provided the main source of data for this study. The database was launched in the 1970s and its aim is to standardise geographical names in order to create and issue state map works. The database started the process of digitisation in 1997, completed in 2005. It has been regularly updated since then (ČÚZK, 2015). The database is available for GIS software through Web Map Service (WMS) or through the web Geoportal (http://geoportal.cuzk.cz/geoprohlizec/). The database distinguishes the categories of place names related to traffic, land and ground, borderlines, protected areas, waters, residence and constructions. Downloading GIS layers with geographical names is charged. Processing the place names from the database took place in December 2015 and January 2016, partial adjustments were carried out in January 2017.

Maps from the Habsburg monarchy era, specifically the 1st Military Survey (at a scale of 1:28,000, from 1764–1783), the 2nd Military Survey (1:28,800; 1842–1852), and the special maps of the 3rd Military Survey (1:75,000; 1876–1880) were used as historical map sources, which allowed the detection of existing ponds. Historical maps are available through the web map browsers of the Geoinformatics Laboratory, University of J. E. Purkyne (oldmaps.geolab.cz) and the project Mapire (mapire.eu), which allow access to the historical maps from the Habsburg monarchy era (Timár et al., 2010). Sporadically, maps from the Stabile cadastre (1:2,800; 1824–1843) were used; they are also available via the web Geoportal ČÚZK. The selected historical cartographic sources are widely used by scientists from the perspective of researching water elements and their development in the landscape (Brůna et al., 2010; Havlíček et al., 2014; Petrovszki and Mészáros, 2010; Skaloš and Engstová, 2010).

5.2 Selection of place names

The selection of potential place names was an important step as they could refer to the existence of extinct ponds in the whole of the Czech Republic. The selected place name was "dyke", due to our consideration that a dyke had commonly been the only relict left after the extinct fishpond, which had also become a kind of landscape memento. Therefore, it might have contributed to the genesis of place names referring to the history of the local landscape. Moreover, dykes as the essential construction components were central to historical expert literature on ponds (Svanberg and Cios, 2014). The selection included variations of the plural of "dyke" ("hráze") and also some of the possible prepositional phrases referring to the direction or location of a dyke. The second-place name selected was the term "fishpond" itself. It was, however, necessary to proceed very cautiously here as it estimated the number of small water reservoirs to be 25,000 in total in the Czech Republic (Benešová, 1996), which often bear the popular name of fishpond. It is obvious that a large number of place names connected to "fishpond" will refer to large water areas. Therefore, the variations were selected which referred to the location (in the fishpond or at the fishpond), which might logically refer to a location of an extinct fishpond. An overview of all the selected place names and their variations is given in Table 1. We only focused on landscapes outside of urban areas which are sometimes called field names (Penko Seidl, 2011) or minor names (Imazato, 2010).

5.3 Methods of place name analysis

Based on the representative selection of the place names, respective place names were searched in the database GEONAMES using the Geoportal ČÚZK. Only the place names from the group "field and ground" were used with reference to field names. Each location carrying the representative place name was entered into a point GIS layer (using the program ArcGIS 10.4), and then it was assigned other attributes. First, it was visually confronted with the current map (or an orthophoto map). If the location matched an existing fishpond, it fell in the category "PRES" (Presence). Otherwise, another comparison of the above-mentioned historical maps took place with the aim of ascertaining whether there was a fishpond in the respective location in the past and in which map it was last recorded. Thus, the approximate age of the place name was determined or how old the landscape fact was that it refers to (Fig. 1).

In this manner, several relative time categories arose:

i. "B1MS" (Before 1st Military Survey) – the first military survey only recorded the dyke of an extinct fishpond, the fishpond itself had ceased to exist;
ii. "1MS" (1st Military Survey) fishpond was recorded for the last time in the first military survey and ceased to exist after that; analogous are then the categories
iii. "2MS" (2nd Military Survey); and
iv. "3MS" (3rd Military Survey).

An independent category ("NA") comprised those ponds which do not exist at present and their previous existence cannot be documented in the old maps. The issue of availability of the selected historical maps on the one hand and the spatial deviation in the case of geo-referencing the GIS environment on the other (Timár, 2004), were dealt with by applying the web map browser at the Mapire.eu portal. Not only are all the historical maps made available there – but they are also tessellated and geo-referenced. Moreover, the web interface allows the blending of individual surveys or their display in a synchronized view (two historical maps simultaneously). If a map of a medium scale was unclear, the detailed maps of the Stabile cadastre were used (it preceded the 2nd military survey) using the Geoportal ČÚZK.

The last step was the spatial analysis of the selected place names in the GIS environment. The cluster analysis of the STATISTICA system was used to define clusters of place names. The data was entered into the analysis in the form of a matrix of Euclidean distances obtained from ArcGIS: the nearest neighbour method was used for this analysis, as it gradually clusters the points with the closest distances. The authors' focus of interest, after the clusters had been created, was whether the relative representation of the individual place names (the place names relating to extinct ponds comprised one category) in the clusters was similar

Basic place name	Variations
CZ Rybník / Rybníky	Na rybníce, Na rybníku, Na rybníkách, V rybníce, V rybníkách
EN Fishpond / Fishponds	At the fishpond, At the Ponds, In the fishpond, In the Ponds
CZ Hráz / Hráze	K hrázi, K hrázce, Na hrázi, Na hrázce, Od hráze, Pod hrází, Pod hrázemi, U hráze, U hrázky, Za hrází, Za hrázkou, Za hrázemi
EN Dyke / Dykes	To the Dyke, To the Little Dyke, From the Dyke, Below the Dyke, Below the Dams, At the Dyke, At the Little Dyke, Beyond the Dyke, Beyond the Little Dyke, Beyond the Dams

Tab. 1: An overview of the selected place names (CZ – Czech name; EN – English equivalent)
Source: authors' elaboration

Fig. 1: Categories of place names based on a comparison with an old map
Source: authors' elaboration based on the maps from MAPIRE (2018)

to heir relative distribution throughout the Czech Republic. Therefore, Pearson's chi-square test was used for the most frequent clusters. A wide range of methods can be used for other spatial analyses (see Derungs and Purves, 2016; Luo et al., 2000; Qian et al., 2016; Wang et al., 2006; Wang et al., 2014). The methods of the Floating Catchment Area (FCA) with the search window set at 10 km and a Kernel density for the set of place names outside of the "NA" category were used. The spatial pattern of place names referring only to extinct ponds was further analysed using the Inverse Distance Weighing (IDW) procedure, where the place names referring to extinct ponds achieved the values of (1) and of (0) for the existing ponds. To determine the spatial concentration of place names according to the defined categories, cluster analysis was carried out in the SatScan software; this software is widely used for the given purposes (Wang et al., 2006), as here.

6. Results

Our criteria were met by 375 place names in the Czech Republic (ca. 78,800 km^2). Almost nine in ten (86%) place names (in the categories "B1MS", "1MS", "2MS", "3MS", "PRES") could prove a relation to an existing or extinct fishpond; no spatial relation to a fishpond could be proved in the remaining 14% (category "NA"). In other words, no existing fishpond could be found in their vicinity and its existence was not validated by old maps. The largest number of place names (159 in total) referred to ponds which had only been recorded within the 1st Military Survey ("1MS" category). This means that they ceased to exist between 1783–1842. Together with place names that refer to ponds extinct prior to the issue of this source (i.e. prior to 1783; category "B1MS"), this group comprises 58% of place names whose connection to a fishpond could be demonstrated. In total, both of these categories amount to approximately 50% of the total set of the studied place names (the details are illustrated in Fig. 2).

The spatial analysis of place names ascertained that the studied place names create spatial clusters typical for the distribution of individual categories. If any area is connected to one category of place names, it might be an area of mass pond extinction in the given period currently experiencing drought issues. The cluster analysis was stopped at 45 clusters, 8 of which contained more than 10 place names, 5 of which contained more than 20 place names (Fig. 3). Five of the most frequent place names (A [87 place names], B [60], C [42], D [28], E [21]), which were the only ones containing all the place name categories ("NA", extinct, "PRES") were tested using the Pearson's chi-square test. The concord of the relative representation of the individual types of place names in the input file was tested. The test in the case of the A, B, C and E clusters proved anomalies in the distribution of the individual categories, namely at the level of significance $\alpha = 0.05$. Cluster A contained more extinct ponds (more than 81% of all place names in this cluster). Cluster B contained a higher concentration of

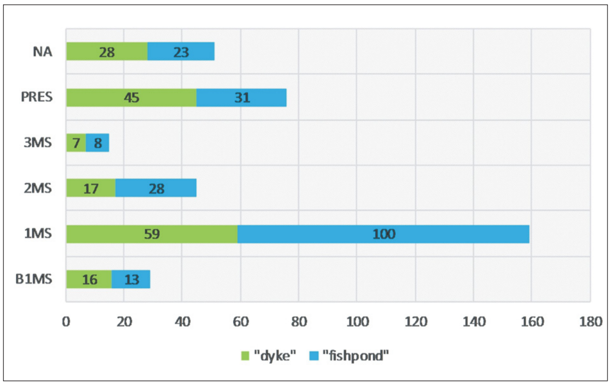

Fig. 2: Frequency of place names with the base of "dyke" and "pond/fishpond" referring to ponds in individual time categories.
Source: authors' calculations

the "PRES" category (more than 41%, which is more than double in comparison with the distribution of the "PRES" category in the entire Czech Republic). On the contrary, cluster C contained the "NA" category place names in a significant number (more than 35%). Cluster E contained a very similar structure of distribution of individual place names as cluster B (specifically, more than 38% of place name distribution referring to existing ponds).

In the next step, we dealt with particular types of place names as defined in the method ("B1MS", "1MS", "2MS", "3MS", "PRES"), and we did not work with the "NA" category where no relation to an existing or extinct fishpond could be proved. Using the cluster analysis in the program SaTScan the areas were limited where statistically significant (level of significance α = 0.05) above-average occurrence of one type of place names appeared. This resulted in two clusters of place names of category "B1MS" and one cluster each for categories "1MS" and "PRES" (Fig. 4).

The base of the map with the cluster analysis results comprises the Kernel density analysis, which is another method used to determine areas with an above-average occurrence of place names in referring to extinct or existing

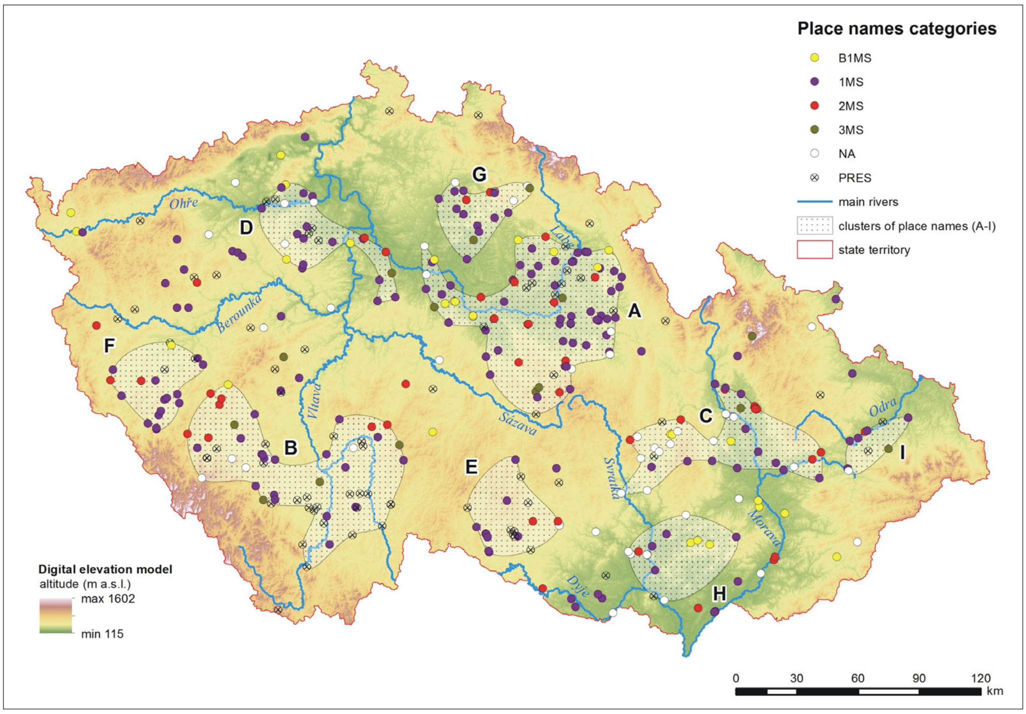

Fig. 3: Place names categories and spatial clusters following the nearest neighbour method
Source: authors' elaboration; ArcČR (2017)

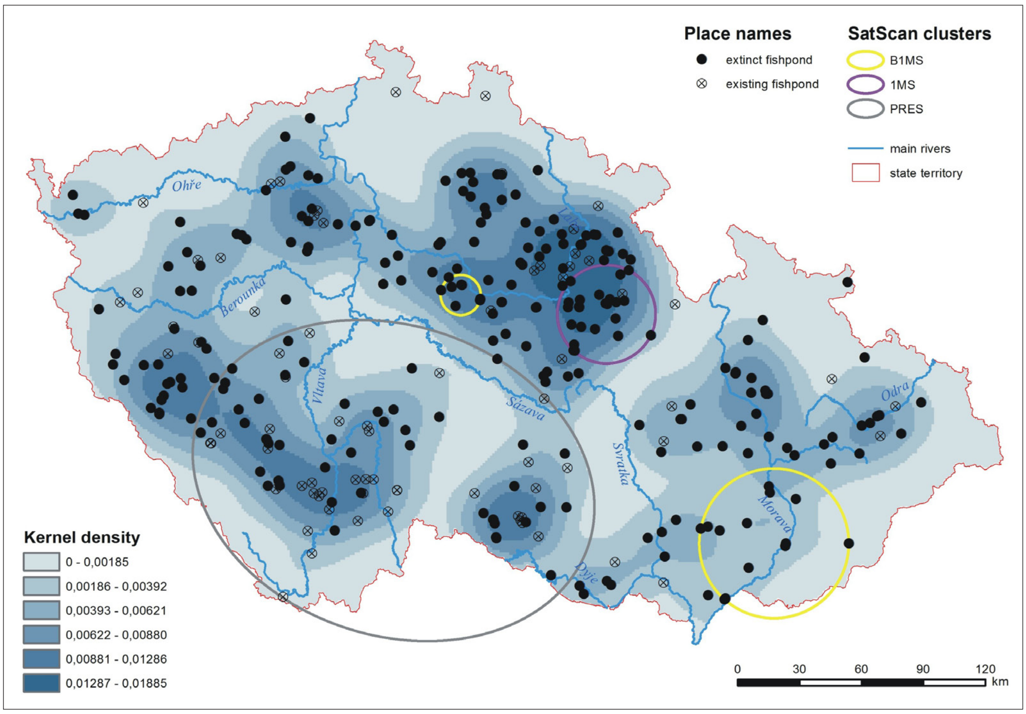

Fig. 4: Kernel density and SaTScan cluster analysis of place names with relation to fishponds
Source: authors' elaboration; ArcČR (2017)

ponds. The spatial connection of place names to the existing or extinct ponds is also shown in the IDW and FCA result (see Fig. 5).

7. Discussion

7.1 Discussion of the results

The results of the place name analysis provided some answers to the research questions outlined above: four points can be discussed.

(1) It is possible in most cases to trace the connection between the place name and an extinct fishpond whose existence can be validated using the selected set of old maps of the Habsburg monarchy. Furthermore, the references to extinct ponds prevail over references to those which still exist. Thus, the current place name may in the case of research of extinct ponds, be a significant indicator of their location in the landscape. We reached similar conclusions to those of Calvo-Iglesias et al. (2012), who detected successfully the specific field system based on place names, or those of Fagúndez and Izco (2016) who used a case study in Galicia to show the significance of phyto-toponyms as explicit geographical indicators of bio-cultural diversity.

(2) Our results also show that place names refer to the former water bodies that existed in the distant past. Most of them (62%) refer to ponds which had ceased to exist by the 1850s. Moreover, 12% of place names referring to extinct fishponds were recorded in the B1MS category, i.e. they had already been extinct in the 1st Military Survey, where only the remnants of their dykes were apparent. They are often hard to identify in the old maps and often blend with depiction of other ground formations. The place names facilitate the discovery of the existence and location of a fishpond. They might thus be the bearers of historical information of landscape elements which ceased to exist 170 years ago at minimum. Such ages of place names are not exceptional in the Czech lands. Ignoring the names of significant landscape elements (mountains and rivers) whose age might go back to the early Middle Ages, the ages of a number of field names are shown to be up to 300 years – depending on the historical written resources which prove their existence (Olivová-Nezbedová, 1995). Dohnal (2016) establishes in his case study that approximately 17% of local names were shown to have existed as early as the 17th or 18th century and have survived to the present day. Penko Seidl (2018) determines in her study of south-western Slovenia that almost 25% of place names found in the 200-year-old historical resources have survived to the present time.

This is even more valuable in the case of extinct ponds, however, considering the fact that their connection to a real object in the landscape does not exist any longer (Olivová-Nezbedová, 1995). Moreover, the form of the Czech landscape has been changing dynamically in the last 200 years (due to industrialisation, urbanisation, socialist collectivisation, post-socialist reconstruction), which had a negative impact on the conservation of place names. Therefore, the surviving place names are rather unique, as their original areas were changed by the different land use (Havlíček et al., 2014; Skaloš et al., 2011) or mechanical field changes were carried out which might have destroyed all tangible traces of an original fishpond (Kopp et al., 2015). A number of such place names resisted these dramatic changes, such that they may comprise a living part of local histories (Fagúndez and Izco, 2016) and be inseparable parts of the cultural heritage in the landscape (Piko-Rustia, 2012).

(3) Spatial analyses have demonstrated that the set of the studied place names connected to well-known fishpond areas (Semotanová, 2009) can or could be found in the lowlands along major rivers and their tributaries: for the extinct ponds, this holds true mainly along the Elbe and the Morava Rivers. The area of South Bohemia – the most traditional fishpond area which is still preserved today and presents a significant example of historical cultural landscapes – exhibits some interesting results. Its analysed place names refer to the current fishponds, as has been shown also by cluster analyses (Figs. 3 and 4). This fact appears highly

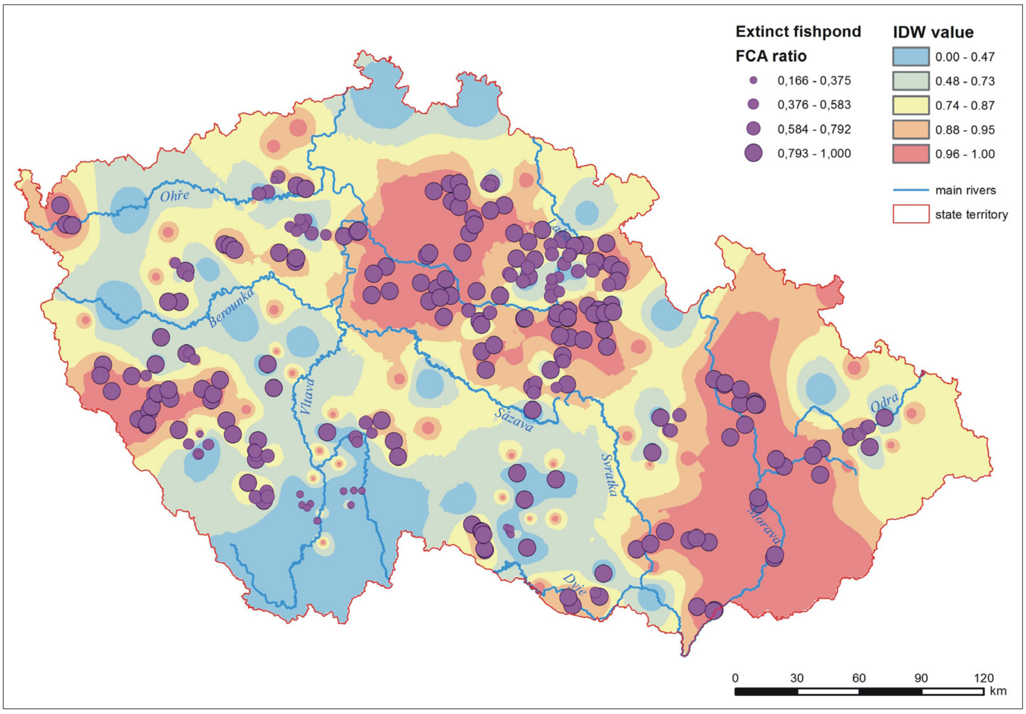

Fig. 5: Results of an FCA and IDW application on the set of place names
Source: authors' elaboration; ArcČR (2017)

logical (there is a high concentration of water areas), but we can also consider the results with respect to the phenomenon stated by Šmilauer (1963) for place names referring to inanimate nature. Naming objects in the landscape was usually connected with something extraordinary that stood out from its surroundings. If we apply this assertion to fishponds, their drainage and extinction could be a strong enough motive for the local inhabitants to create an imaginary cultural reference in the form of a place name in the location of the extinct fishpond, or the fishpond was such a distinctive landscape element that it had served for generations as a landmark and the place names related to it had survived despite its drainage. Logically, it would be more appropriate not to use general place names referring to fishponds in a location with high concentrations of them, as it might be confusing. In the case of abolished ponds, however, a higher number of place names referring to them may be expected as abolished fishponds would be rare in these areas. Nevertheless, our analyses did not ascertain this assumption for the above-mentioned region of South Bohemia.

The cluster analysis and the subsequent Pearson chi-square test demonstrated the rarity of the clusters A, B, C and E. As for cluster A, a number of references to extinct fishponds in the place names can be connected to the extensive fishpond system which was constructed along the Elbe River, primarily related to the aristocratic family of Pernštejn at the turn of the 16^{th} century (Lochman, 1970). These fishponds located in the fertile alluvial soils were being gradually drained from the 1750s, as demonstrated by the occurrences of clusters of the categories "B1MS" and "1MS" (Fig. 4). Resulting from the revolution in agriculture and its intensification, other fishponds were drained during the 19^{th} century in this area. The rarity of clusters B with a high occurrence of place names referring to existing fishponds located in South Bohemia was discussed above (a similar situation to cluster E), the results of cluster analysis using the program SatScan (Fig. 4) show a higher concentration of place names in the category "PRES" in this location.

The large number of place names of the category NA in cluster C then may be related to the place names from the input set which bore the name "dyke", as they might not have been connected to a fishpond but could have referred to an anti-flood dyke. There is a relatively high number of such dykes along the central course of the Morava River (so-called rustic dykes or peasant's dams; Simon et al., 2014). Such a connection could only be demonstrated through more thorough regional research, however.

(4) The last but not least point of discussion is the significance of research of the relations of place names to the extinct fishponds. As was mentioned in the introduction, current European landscapes are undergoing intensive changes, similar to those for the whole environment. The Central European region is widely discussed with respect to the theme of unsatisfactory landscape water regimes, among others in connection with coping with increasing periods of droughts (Štěpánek et al., 2016). The restoration of small water reservoirs as one of the most valuable natural elements of the cultural landscape (Waldon, 2012) may provide a possible solution (David and Davidová, 2015; Rozkošný et al., 2014). The results of the research of Trantinová (2015), surveying the representatives of more than 100 municipalities in the Czech Republic, show that almost 30% of mayors believe (in relation to a better water retention in the landscape) that investments should go to the maintenance of the existing fishponds or restoration of the extinct ones. It is interesting that most mayors are not aware of the existence of extinct fishponds from old maps (22%) – but rather from general awareness of them in the municipality (47%), part of which is also the knowledge of local place names as part of regional and local identity (Šrámková, 2016). For example, Siderius and de Bakker (2003) state that the knowledge of place names linked to the land allowed farmers to find the correct manner of farming in specific locations.

In this context, Fagúndez and Izco (2016) indicate that the justification for the protection of historical place names is important because they represent complex historical relationships between local people and their environment. We assume that place names may contribute to an expansion of awareness of historical landscape elements, fishponds in this case, and provoke the local inhabitants and authorities to consider or act for the restoration of some of them, aiming at an improved water regime in the landscape. The restoration of a reservoir has already started or is being planned in a number of places in the original location of a fishpond (Rozkošný et al., 2014). Knowledge of local environmental history is vital in the case of revitalisation or preservation projects, as shown in many studies (Ravit et al., 2017; Stevenson, 2017). Moreover, the results of cluster analyses suggest that many areas with occurrences of place names referring to extinct fishponds, are in areas which have been detected as high-risk with respect to the degree of drought threats. In addition, climatic models of future landscape water regimes also place them in areas with negative values of water regime (Fig. 6). Interestingly, they are clusters (A, D) with a higher frequency of place names of the categories B1MS and 1MS, i.e. those referring to the period of the first wave of pond abolishment when the ponds were dried hastily. Inhabitants at that time were aware of this fact. As (Roubík, 1937) states in his historical study, the governor of the Kouřim Region addressed the state authorities as early as 1792 to ask for restoration of fishponds as their draining had led to the loss of moisture in the landscape and "the danger is imminent that the Czech lands will become as dry as Italy" (Roubík, 1937).

7.2 Discussion of the methods used in this study

Although the results of the spatial analyses showed the connections of the sampled place names to extinct ponds, it is necessary to realise that it was a selection out of a very high number of place names that could be considered. In particular, various prepositional phrases with the term "fishpond", which are numerous in the database GEONAMES (e.g. Beyond the Fishpond, Below the Fishpond, To the Fishpond) were disregarded under the assumption that they refer to existing ponds rather than to extinct ones. Processing the whole set of potential place names connected generally to fishponds would be complicated as it would be necessary to visually compare each individual place name with the situation in the old maps. Automatic processing in GIS is currently impossible. It would require complete access to the layer of place names in the database GEONAMES, combined with the vectorised layer of fishponds of all the old maps that were used. Such a layer only exists for the 2^{nd} Military Survey for the Czech Republic (Pavelková et al., 2016), although our research has demonstrated the importance of surveying an historical landscape, especially for the 1st Military Survey. Its more precise processing in GIS could, however, be difficult with respect to the absence of geodetic data (Demek et al., 2008; Petrovszki and Mészáros, 2010).

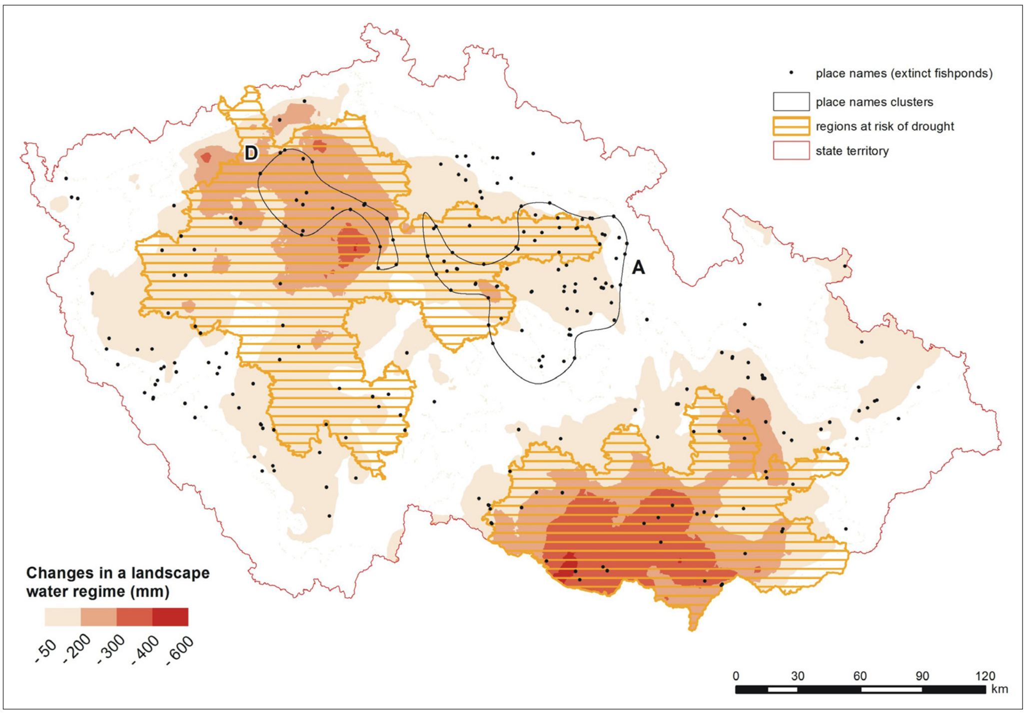

Fig. 6: Extinct fishponds and prediction of changes in landscape water regime
Sources: ArcČR (2017); authors' elaboration based on the data from AgriClim model – CzechGlobe (2017); T. G. Masaryk Water Research Institute (2017); ArcČR (2017)

Place names themselves present another methodological issue. As pointed out by Conedera et al. (2007), a place name is commonly reduced to a point for the purposes of GIS analyses although it refers to an area, whose boundary may be arguable and rather vague. Thus, more place names may in practice refer to one landscape fact, e.g. in neighbouring villages (Penko Seidl, 2011) or the imaginary boundary of an area within the field name is familiar only to the local inhabitants (Penko Seidl et al., 2015). An issue concerning automatic GIS processing is what buffer zone to set? Where does the location of a place name begin and end? We suggest that this is one of the key issues of Toponymic GIS. We realise that the connection of place names and GIS cannot be seen as a simple translation between place names and coordinates (Goodchild, 2004). While GIS analyses allow the researcher to discover the spatial-quantitative context, it is necessary to interpret the context with respect to the qualitative aspect of place names which might, despite original expectations, prove to be multifocal or ambiguous (Conedera et al., 2007). They might have been included in the input analysis by mistake or be left out (Luo et al., 2010).

In our case, it was the troublesome category "NA", which may have referred to the types of dykes other than those of a fishpond, or it may have referred to a fishpond whose traces had specific name of an extinct fishpond; such place names are very difficult to discover without detailed historical micro-regional information. It is also necessary to bear in mind the fact that the input database GEONAMES is being continuously updated and that it is at the same time an official collection of current place names stated in the basic maps of the Czech Republic, i.e. the resource which standardised the place names or documents while commonly ignoring the living place names which are used by the local inhabitants (David and Mácha, 2014). It is, however, the only available source which maps the place names for the whole country. A combination of current place names and old maps proved to be successful in our research, especially if the old maps were part of a set of the so-called comparative cartographic sources (Skaloš et al., 2011), which display the same landscape in different time intervals at an adequate scale. It is necessary to emphasise in this respect, however, how essential it is to make available these historical cartographic works to the wider scientific community (Fuchs, 2015a).

Despite the fact that the quantitative analyses of place names in GIS in our study presented relevant results, some rather misleading interpretations should be avoided. As for the FCA analysis, we agree with Wang (2015) that the selection of the right setting of the window size leading to an appropriate spatial smoothing is vital. The search radius in our case was set to 10 km. The results were greatly inaccurate with higher levels of setting as is shown in Figure 7, where in an occurrence of a place name referring to an existing fishpond the IDW indicated low levels, but it is sufficient in the FCA analysis that only one place name appears in the search radius which refers to an extinct fishpond and the FCA ratio achieves high values.

8. Conclusion

In this study we have carried out a spatial analysis of the relationship between place names in the rural landscape and the extinct artificial water bodies (ponds, fishponds) using GIS. For this purpose, we used the current official Geographic Names database of the Czech Republic (GEONAMES), in combination with current and old maps. Using the old maps allowed not only the discovery of the connections of place names to extinct fishponds but also their comparison to various time periods, and allowed the determination of the age of such a datum. Our example showed that 66% of the selected set of place names are connected to an extinct pond, 20% to an existing one, and in 14% of the sample no connection to a fishpond was identified. Thus we can determine – albeit with a degree of caution – that field names containing words such as "fishpond" or "dyke" may indicate

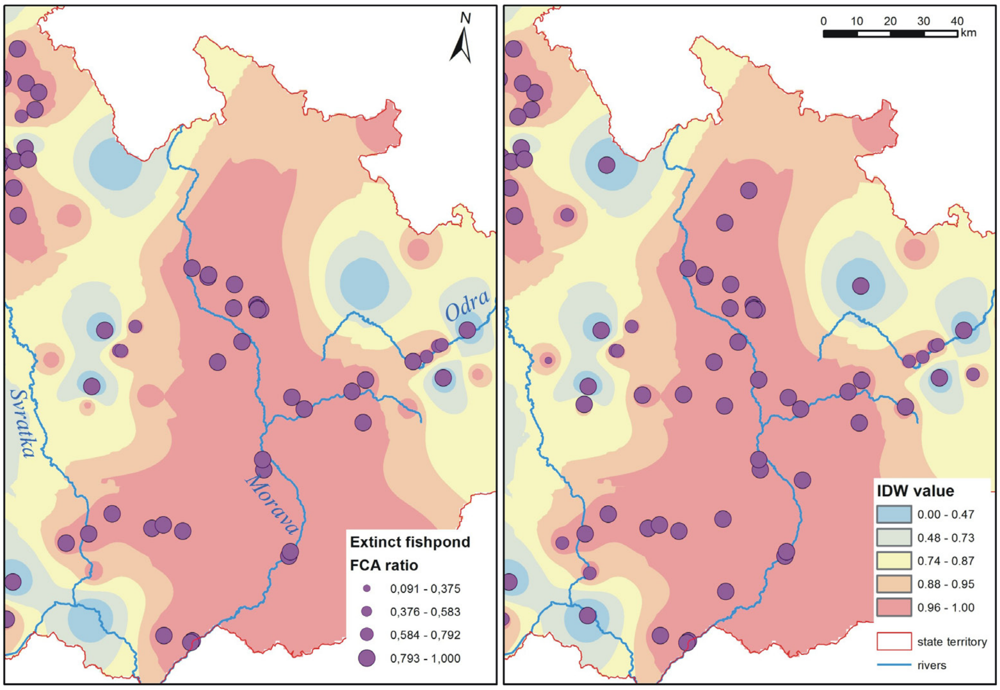

Fig. 7: Comparison of the FCA results for the window size 10 km (left) and 20 km (right)
Source: authors' elaboration; ArcČR (2017)

a small extinct water reservoir. Moreover, one half of the total number of place names referred to reservoirs which had ceased to exist in the 18th century or earlier, based on the old maps. Spatial analyses discovered regional clusters of place names referring to fishponds which had ceased to exist in a specific period. Many of these clusters are connected to the first wave of mass abolishment of fishponds in the second half of the 18th century and are located in areas which today struggle with a negative water balance in the landscape and with drought.

Overall, the results of the analyses indicated the great potential for the use of place names combined with GIS, labelled as Toponymic GIS by Fuchs (2015b). It can be used to process a large number of place names and to explore their spatial distribution and relations at a large scale. At the same time, we believe that this connection gives a new impulse to traditional geographic approaches that work with place names, especially in connection with the exploration of historical landscape features and their links to the contemporary landscape. Place names can thus be a useful indicator to discover the historical form of landscapes and their functioning, which we can learn from and be inspired to adopt various measures face-to- face with the current dramatic changes in European landscapes and the overall environment. Our researched place names could be a source of awareness of a large number of existing small water reservoirs which were an integral part of the historical landscapes of Central Europe, and whose restoration might help to solve the issues of negative water regimes in the landscape.

Acknowledgements

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References:

ALDERMAN, D. H. (2002): Street names as memorial arenas: The reputational politics of commemorating Martin Luther King Jr. in a Georgia County. Historical Geography, 29: 99–120.

ARCČR (2017): Digital geographical database 1:500,000 ArcČR 500 Version 3.2 [cit. 29.01.2018]. ArcDATA Prague. Available at: http://download.arcdata.cz/data/ArcCR_500-3.2-Popis-dat.pdf

AYBES, C., YALDEN, D. W. (1995): Place-name evidence for the former distribution and status of Wolves and Beavers in Britain. Mammal Review, 25(4): 201–226.

AZARYAHU, M. (2012): Renaming the past in post-Nazi Germany: insights into the politics of street naming in Mannheim and Potsdam. Cultural Geographies, 19(3): 385–400.

BAILEY, T. J., SCHICK, J. B. M. (2009): Historical GIS: Enabling the Collision of History and Geography. Social Science Computer Review, 27(3): 291–296.

BASTIAN, O., KRÖNERT, R., LIPSKÝ, Z. (2006): Landscape diagnosis on different space and time scales – a challenge for landscape planning. Landscape Ecology, 21(3): 359–374.

BENEŠOVÁ, J. (1996): Generel rybníků a nádrží České republiky. Vodní hospodářství, 2(3): 59–62.

BIČÍK, I. (2010): Vývoj využití ploch v Česku. Praha, Česká geografická společnost.

BOISSEAU, S., YALDEN, D. W. (1998): The former status of the Crane Grus grus in Britain. Ibis, 140(3): 482–500.

BRŮNA, V., KŘOVÁKOVÁ, K., NEDBAL, V. (2010): Historical landscape structure in the spring area of the Blanice River, Southern Bohemia – An example of the importance of old maps. Acta Geodaetica et Geophysica Hungarica, 45(1): 48–55.

CALVO-IGLESIAS, M. S., DÍAZ-VARELA, R. A., MÉNDEZ-MARTÍNEZ, G., FRA-PALEO, U. (2012): Using place names for mapping the distribution of vanishing historical landscape features: The Agras field system in northwest Spain. Landscape Research, 37(4): 501–517.

CAPRA, G. F., GANGA, A., BUONDONNO, A., GRILLI, E., GAVIANO, C., VACCA, S. (2015): Ethnopedology in the study of toponyms connected to the indigenous knowledge on soil resource. Plos One, 10(3): 1–20.

CAPRA, G. F., GANGA, A., FILZMOSER, P., GAVIANO, C., VACCA, S. (2016): Combining place names and scientific knowledge on soil resources through an integrated ethnopedological approach. Catena, 142: 89–101.

CHEN, X. X., HU, T., REN, F., CHEN, D., LI, L., GAO, N. (2014): Landscape Analysis of Geographical Names in Hubei Province, China. Entropy, 16: 6313–6337.

CONEDERA, M., VASSERE, S., NEFF, C., MEURER, M., KREBS, P. (2007): Using toponymy to reconstruct past land use: a case study of 'brüsáda' (burn) in southern Switzerland. Journal of Historical Geography, 33: 729–748.

COX, J. J., MAEHR, D. S., LARKIN, J. I. (2002): The Biogeography of Faunal Place Names in the United States. Conservation Biology, 16(4): 1143–1150.

CREŢAN, R., MATTHEWS, P. W. (2016): Popular responses to city-text changes: street naming and the politics of practicality in a post-socialist martyr city. Area, 48(1): 92–102.

CZECHGLOBE (2017): Changes in a landscape water regime_Norway_CZE prediction 2050 middle emission – IPSL [cit. 29.01.2018]. CzechGlobe. Available at: http://www.klimatickazmena.cz/en/?l=33&m=155&f=3

ČÚZK (2015): Geonames – Introduction [cit. 12.02.2017]. Czech Office for Surveying, Mapping and Cadastre. Available at: http://geoportal.cuzk.cz/(S(dfe3kimfgsmj5wgcidpc4ian))/Default.aspx?mode=TextMeta&text=geonames_uvod&side=geonames&menu=26

DARBY, H. C. (1957): Place-Names and Geography: Review. The Geographical Journal, 123(3): 387–392.

DAVID, J. (2008): Environmental dimension of toponomastics. Acta Onomastica, 49(1): 98–106.

DAVID, J., MÁCHA, P. (2014): Názvy míst: paměť, identita, kulturní dědictví. Ostrava, Host.

DAVID, V., DAVIDOVÁ, T. (2015): Analysis of Available Retention Volume in Extinct Ponds – Case Study for Blanice River Catchment. Agriculture and Agricultural Science Procedia, 4: 79–87.

DEMEK, J., HAVLÍČEK, M., CHRUDINA, Z., MACKOVČIN, P. (2008): Changes in land-use and the river network of the Graben Dyjsko-svratecký úval (Czech Republic) in the last 242 years. Journal of Landscape Ecology, 1(2): 22–51.

DERUNGS, C., PURVES, R. S. (2014): From text to landscape: locating, identifying and mapping the use of landscape features in a Swiss Alpine corpus. International Journal of Geographical Information Science, 28(6): 1272–1293.

DERUNGS, C., PURVES, R. S. (2016): Characterising landscape variation through spatial folksonomies. Applied Geography, 75: 60–70.

DOHNAL, M. (2016): Local names, their stability and relation to history of landscape. A case study of the village of Bernartice near the city of Milevsko. Historická geografie, 42(1): 43–82.

FAGÚNDEZ, J., IZCO, J. (2016): Diversity patterns of plant place names reveal connections with environmental and social factors. Applied Geography, 74: 23–29.

FENG, C.-C., MARK, D. M. (2017): Cross-Linguistic Research on Landscape Categories Using GEOnet Names Server Data: A Case Study for Indonesia and Malaysia. The Professional Geographer: 1–12.

FERANEC, J., JAFFRAIN, G., SOUKUP, T., HAZEU, G. (2010): Determining changes and flows in European landscapes 1990–2000 using CORINE land cover data. Applied geography, 30(1): 19–35.

FRAJER, J., KLADIVO, P., GELETIČ, J. (2013): Reconstruction of extinct ponds using old maps, historical cadastres and the Digital Terrain Model of the Czech Republic of the 5th Generation. Acta Universitatis Palackianae Olomoucensis, Facultas Rerum Naturalium, Geographica, 44(1): 59–69.

FUCHS, R., VERBURG, P. H., CLEVERS, J. G. P. W., HEROLD, M. (2015): The potential of old maps and encyclopaedias for reconstructing historic European land cover/use change. Applied Geography, 59: 43–55. doi:10.1016/j.apgeog.2015.02.013.

FUCHS, S. (2015a): An integrated approach to Germanic place names in the American Midwest. The Professional Geographer, 67(3): 330–341.

FUCHS, S. (2015b): Toponymic GIS – Role and potential of place names in the context of geographic information systems and GIS. Kartographische Nachrichten, 2015(6): 330–337.

GAYNOR, A., MCLEAN, I. (2008): Landscape Histories: Mapping Environmental and Ecological Change Through the Landscape Art of the Swan River Region of Western Australia. Environment and History, 14(2): 187–204.

GOODCHILD, M. F. (2004): GIScience, geography, form, and process. Annals of the Association of American Geographers, 94(4): 709–714.

GRĂDINARU, I., IOSEP, I., POCIASK-KARTECZKA, J., BRANCELJ, A., MÁCHA, P. (2012): Study of the occurrence and distribution of "Iezer" and "Bolătău"-based toponyms in Romania and their counterparts from Poland, the Czech Republic and Slovenia. GEOREVIEW: Scientific Annals of Stefan cel Mare University of Suceava. Geography Series, 21(1): 68–79.

GREGORY, I. N., ELL, P. S. (2007): Historical GIS: technologies, methodologies, and scholarship. Vol. 39, Cambridge, Cambridge University Press.

GREGORY, I. N., HEALEY, R. G. (2007): Historical GIS: structuring, mapping and analysing geographies of the past. Progress in Human Geography, 31(5): 638–653.

HAASE, D., WALZ, U., NEUBERT, M., ROSENBERG, M. (2007): Changes to Central European landscapes –

analysing historical maps to approach current environmental issues, examples from Saxony, Central Germany. Land use policy, 24(1): 248–263.

HAVLÍČEK, M., PAVELKOVÁ, R., FRAJER, J., SKOKANOVÁ, H. (2014): The Long-Term Development of Water Bodies in the Context of Land Use: The Case of the Kyjovka and Trkmanka River Basins (Czech Republic). Moravian Geographical Reports, 22(4): 39–50.

HOLDSWORTH, D. W. (2002): Historical geography: the ancients and the moderns–generational vitality. Progress in Human Geography, 26(5): 671–678.

HOLL, K., SMITH, M. (2007): Scottish upland forests: History lessons for the future. Forest Ecology and Management, 249(1): 45–53.

HOSKINS, W. G. (1969): The making of the English landscape. London, Hodder and Stoughton.

HUNN, E. (1996): Columbia Plateau Indian Place Names: What Can They Teach Us? Journal of Linguistic Anthropology, 6(1): 3–26.

IMAZATO, S. (2010): Semiotic principles of naming methods for folk plot names: The cases of three Japanese villages that underwent agricultural land readjustment in Shiga Prefecture. Japanese Journal of Human Geography, 62(3): 5–26.

INGOLD, T. (2000): The Perception of the Environment: Essays in livelihood, dwelling and skill. London, Routledge.

JANKOWSKI, G. (2006): Changes in time and space of pond farming in the area of Rudy Wielkie (Poland). Moravian Geographical Reports, 14(3): 19–25.

JEFFRIES, M. (1991): The ecology and conservation value of forestry ponds in Scotland, United Kingdom. Biological Conservation, 58(2): 191–211.

JETT, S. C. (1997): Place-naming, environment, and perception among the Canyon de Chelly Navajo of Arizona. Professional Geographer, 49(4): 481–493.

JOHNSON, M. (2008): Ideas of landscape. Oxford, Blackwell Publishing.

KARIMI, A. (2016): Street fights: The commodification of place names in post-Taliban Kabul city. Annals of the American Association of Geographers, 106(3): 738–753.

KING, D. N. T., GOFF, J., SKIPPER, A. (2007): Māori environmental knowledge and natural hazards in Aotearoa – New Zealand. Journal of the Royal Society of New Zealand, 37(2): 59–73.

KLÁPŠTĚ, J. (2016): Hospodaření s vodou ve středověké vsi ve Spáleném u Vyžlovky na Černokostelecku. Archeologické Rozhledy, 68(1): 119–134.

KNOWLES, A. K. (2002): Past time, past place: GIS for history. Redlands, California, ESRI Press.

KOPP, J., FRAJER, J., PAVELKOVÁ, R. (2015): Driving Forces of the Development of Suburban Landscape – A Case Study of the Sulkov Site West of Pilsen. Quaestiones Geographicae, 34(3): 51–64.

LAWSON, I. T., CHURCH, M. J., MCGOVERN, T. H., ARGE, S. V., WOOLLET, J., EDWARDS, K. J., GATHORNE-HARDY, F. J. et al. (2005): Historical ecology on Sandoy, Faroe Islands: palaeoenvironmental and archaeological perspectives. Human Ecology, 33(5): 651–684.

LIESKOVSKY, J., BEZAK, P., SPULEROVA, J., LIESKOVSKY, T., KOLEDA, P., DOBROVODSKA, M., BURGI, M., GIMMI, U. (2015): The abandonment of traditional agricultural landscape in Slovakia – Analysis of extent and driving forces. Journal of Rural Studies, 37: 75–84.

LIGHT, D., YOUNG, C. (2015): Toponymy as Commodity: Exploring the Economic Dimensions of Urban Place Names. International Journal of Urban & Regional Research, 39(3): 435–450.

LIPSKÝ, Z. (2001): Present land use changes in the Czech cultural landscape: driving forces and environmental consequences. Moravian Geographical Reports, 9(2): 2–14.

LOFFLER, H. (2000): The designations of bodies of water in the "Seewinkel"(Burgenland Austria) and their meaning. Mitteilungen der Österreichischen Geographischen Gesellschaft, 142: 315–328.

LOCHMAN, Z. (1970): The Opatovice channel and its historico-geographical development. Sborník Československé společnosti zeměpisné, 75(3): 219–233.

LUO, W., HARTMANN, J., LI, J., SYSAMOUTH, V. (2000): GIS Mapping and Analysis of Tai Linguistic and Settlement Patterns in Southern China. Annals of GIS, 6(2): 129–136.

LUO, W., HARTMANN, J. F., WANG, F. (2010): Terrain characteristics and Tai toponyms: A GIS analysis of Muang, Chiang and Viang. GeoJournal, 75(1): 93–104.

MACHAR, I. (2014): Local place names as a part of landscape memory (case study from Haná region, Czech Republic). Acta Universitatis Carolinae, Geographica, 49(1): 61–69.

MARCUCCI, D. J. (2000): Landscape history as a planning tool. Landscape and Urban Planning, 49(1): 67–81.

MARK, D., TURK, A. (2003): Landscape categories in Yindjibarndi: Ontology, environment, and language. In: Kuhn, W., Wwrboys, M., Timpf, S. [eds.]: Spatial information theory. Foundations of geographic information science (pp. 28–45). Heidelberg, Springer.

MCNIVEN, I. J. (2008): Sentient sea: Seascapes as spiritscapes. In: David, B., Thomas, J. [eds.]: Handbook of landscape archaeology (pp. 149–157). Walnut Creek, United States, Routledge.

MOORE, P. G. (2002): Ravens (Corvus corax corax L.) in the British landscape: a thousand years of ecological biogeography in place-names. Journal of biogeography, 29(8): 1039–1054.

MYERS, G. A. (1996): Naming and placing the other: Power and the urban landscape in Zanzibar. Tijdschrift voor Economische en Sociale Geografie, 87(3): 237–246.

OLIVOVÁ-NEZBEDOVÁ, L. (1995): Pomístní jména v Čechách, jejich obecná charakteristika a jejich význam pro vědní obory. In: Olivová-Nezbedová, L., Knappová, M., Malenínská, J., Matúšová, J. [eds.]: Pomístní jména v Čechách. O čem vypovídají jména polí, luk, lesů, hor, vod a cest (pp. 15–34). Praha, Academia.

PAVELKOVÁ, R., FRAJER, J., HAVLÍČEK, M., NETOPIL, P., ROZKOŠNÝ, M., DAVID, V., DZURÁKOVÁ, M., ŠARAPATKA, B. (2016): Historical ponds of the Czech Republic: an example of the interpretation of historic maps. Journal of Maps, 12(sup1): 551–559.

PAVELKOVÁ, R., FRAJER, J., NETOPIL, P. [eds.]. (2014): Historické rybníky České republiky: Srovnání současnosti se stavem v 2. polovině 19. století. Prague, T. G. Masaryk Water Research Institute.

PENKO SEIDL, N. (2011): Field Names in Space and Time. Annals for Istrian and Mediterranean Studies. Series historia et sociologia, 21(2): 437–448.

PENKO SEIDL, N. (2018): Engraved in the Landscape: The Study of Spatial and Temporal Characteristics of Field Names in the Changing Landscape. Names: 1–14.

PENKO SEIDL, N., KUČAN, A., KASTELEC, D. (2015): Between the physical and perceptual: Toponyms in landscape typology, management and planning. Annals for Istrian and Mediterranean Studies. Series historia et sociologia, 25(3): 595–608.

PETROVSZKI, J., MÉSZÁROS, J. (2010): The Great Hungarian Plain in the sheets of the Habsburg military surveys and some historical maps – A case study of the Körös/Criş Drainage Basin. Acta Geodaetica et Geophysica Hungarica, 45(1): 56–63.

PIKO-RUSTIA, M. (2012): Slovenian field and house names in the Austrian inventory of intangible cultural heritage. Traditiones, 41(2): 213–226.

POSPELOV, Y. M., SMOLITSKAYA, G. P. (1986): Place-name evidence in the historical geography of Moscow. Soviet Geography, 27(7): 485–492.

QIAN, S., KANG, M., WENG, M. (2016): Toponym mapping: a case for distribution of ethnic groups and landscape features in Guangdong, China. Journal of Maps, 12(sup1): 546–550.

RADDING, L., WESTERN, J. (2010): What's in a name? Linguistics, geography, and toponyms. Geographical Review, 100(3): 394–412.

RAVIT, B., GALLAGHER, F., DOOLITTLE, J., SHAW, R., MUNIZ, E., ALOMAR, R., HOEFER, W., BERG, J., DOSS, T. (2017): Urban wetlands: restoration or designed rehabilitation? Aims Environmental Science, 4(3): 458–483.

REES, S. E. (1997): The historical and cultural importance of ponds and small lakes in Wales, UK. Aquatic Conservation: Marine and Freshwater Ecosystems, 7(2): 133–139.

RIPPON, S. (2013): Historic landscape character and sense of place. Landscape research, 38(2): 179–202.

ROBERTS, B. K., WRATHMELL, S. (2002): Region and place: a study of English rural settlement. London, English Heritage.

ROSE-REDWOOD, R., ALDERMAN, D., AZARYAHU, M. (2010): Geographies of toponymic inscription: new directions in critical place-name studies. Progress in Human Geography, 34(4): 453–470.

ROSE-REDWOOD, R. S. (2008): "Sixth Avenue is now a memory": Regimes of spatial inscription and the performative limits of the official city-text. Political Geography, 27: 875–894.

ROUBÍK, F. (1937): Úřední soupis rybníků v Čechách z r. 1786. Věstník Československé akademie zemědělské, 13: 882–889.

ROZKOŠNÝ, M., DZURÁKOVÁ, M., PAVELKOVÁ CHMELOVÁ, R., KONVIT, I. (2014): Development of small water reservoirs with water management restoration of the landscape with regard to areas of abandoned ponds. Acta Pruhoniciana, 107: 15–25.

SEMIAN, M. (2012): Name as a symbol of region. Historická geografie, 38(2): 335–352.

SEMIAN, M., CHROMÝ, P., KUČERA, Z. (2016): Name as a regional brand: The case of Local Action Groups in Czechia. Journal of Language and Politics, 15(6): 768–789.

SEMOTANOVÁ, E. (2009): The great transformations of the landscape in the early modern era. In: Pánek, J., Tůma, O. [eds.]: A history of the Czech Lands (pp. 41–45). Praha, Karolinum Press.

SENFT, G. (2008): Landscape terms and place names in the Trobriand Islands - the Kaile'una subset. Language Science, 30: 340–361.

SIDERIUS, W., DE BAKKER, H. (2003): Toponymy and soil nomenclature in the Netherlands. Geoderma, 111(3–4): 521–536.

SIMON, J., MACHAR, I., BUČEK, A. (2014): Linking the Historical Research with the Growth Simulation Model of Hardwood Floodplain Forests. Polish Journal of Ecology, 62(2): 273–288.

SKALOŠ, J., ENGSTOVÁ, B. (2010): Methodology for mapping non-forest wood elements using historic cadastral maps and aerial photographs as a basis for management. Journal of Environmental Management, 91(4): 831–843.

SKALOŠ, J., WEBER, M., LIPSKÝ, Z., TRPÁKOVÁ, I., ŠANTRŮČKOVÁ, M., UHLÍŘOVÁ, L., KUKLA, P. (2011): Using old military survey maps and orthophotograph maps to analyse long-term land cover changes – Case study (Czech Republic). Applied Geography, 31: 426–438.

SMITH, S., RENWICK, W., BARTLEY, J., BUDDEMEIER, R. (2002): Distribution and significance of small, artificial water bodies across the United States landscape. Science of the Total Environment, 299(1): 21–36.

SOUSA, A., GARCÍA-MURILLO, P. (2001): Can place names be used as indicators of landscape changes? Application to the Doñana Natural Park (Spain). Landscape Ecology, 16(5): 391–406.

SOUSA, A., GARCÍA-MURILLO, P., SAHIN, S., MORALES, J., GARCÍA-BARRÓN, L. (2010): Wetland place names as indicators of manifestations of recent climate change in SW Spain (Doñana Natural Park). Climatic change, 100(3): 525–557.

SPENS, J. (2006): Can historical names & fishers' knowledge help to reconstruct fish populations in lakes. In: Haggan, N., Neis, B., Baird, I. G. [eds.]: Fishers' knowledge in Fisheries Science and Management (pp. 329–349). Paris, UNESCO Publishing.

SQUATRITI, P. (2000): Working with water in medieval Europe: technology and resource-use. Leiden, Netherlands, Brill.

STEIN, E. D., DARK, S., LONGCORE, T., GROSSINGER, R., HALL, N., BELAND, M. (2010): Historical Ecology as a Tool for Assessing Landscape Change and Informing Wetland Restoration Priorities. Wetlands, 30(3): 589–601.

STEVENSON, C. I. (2017): Viewpoint: Introducing Environmental History into Vernacular Architecture

Considerations from New England's Historic Dams. Buildings & Landscapes-Journal of the Vernacular Architecture Forum, 24(2): 1–21.

STEWART, G. R. (1945): Names on the land: A historical account of place-naming in the United States. Boston, Houghton Mifflin.

SVANBERG, I., CIOS, S. (2014): Petrus Magni and the history of fresh-water aquaculture in the later Middle Ages. Archives of natural history, 41(1): 124–130.

ŠANTRŮČKOVÁ, M., DEMKOVÁ, K., WEBER, M., LIPSKÝ, Z., DOSTÁLEK, J. (2017): Long term changes in water areas and wetlands in an intensively farmed landscape: A case study from the Czech Republic. European Countryside, 9(1): 132–144.

ŠMILAUER, V. (1963): Úvod do toponomastiky, nauky o vlastních jménech zeměpisných. Praha, Státní pedagogické nakladatelství.

ŠPULEROVÁ, J., BEZÁK, P., DOBROVODSKÁ, M., LIESKOVSKÝ, J., ŠTEFUNKOVÁ, D. (2017): Traditional agricultural landscapes in Slovakia: why should we preserve them? Landscape Research, 42(8): 891–903.

ŠRÁMKOVÁ, M. (2016): Toponymic folk-tales as a source of cultural conscience. In: David, J. [eds.]: Place names. Cultural heritage and memory of places (pp. 70–77). Ostrava, Ostravská univerzita.

ŠTĚPÁNEK, P., ZAHRADNÍČEK, P., FARDA, A., SKALÁK, P., TRNKA, M., MEITNER, J., RAJDL, K. (2016): Projection of drought-inducing climate conditions in the Czech Republic according to Euro-CORDEX models. Climate Research, 70(2–3): 179–193.

T. G. MASARYK WATER RESEARCH INSTITUTE (2017): Delineation of regions at risk of droughts [cit. 29.01.2018]. T. G. Masaryk Water Research Institute. Available at: http://vuv.maps.arcgis.com/apps/webappviewer/index.html?id=7ac53a5a1316423b9e09ab7afe2b4fba

TILLEY, C. (1994): A phenomenology of landscape: places, paths, and monuments. Explorations in anthropology. Oxford/Providence, Berg.

TIMÁR, G. (2004): GIS integration of the second military survey sections – a solution valid on the territory of Slovakia and Hungary. Kartografické listy, 12: 119–125.

TIMÁR, G., BISZAK, S., SZÉKELY, B., MOLNÁR, G. (2010): Digitized Maps of the Habsburg Military Surveys – Overview of the Project of ARCANUM Ltd. (Hungary). In: Jobst, M. [eds.]: Preservation in Digital Cartography (pp. 273–283). Berlin-Heidelberg, Springer.

TRANTINOVÁ, M. (2015): Udržitelné hospodaření s půdními a vodními zdroji. In: Rozkošný, M., Pavelková, R., David, V., Trantinová, M. [eds.]: Zaniklé rybníky v České republice: případové studie potenciálního využití území (pp. 25–42). Praha, Výzkumný ústav vodohospodářský T. G. M.

VAN EETVELDE, V., ANTROP, M. (2009): Indicators for assessing changing landscape character of cultural landscapes in Flanders (Belgium). Land Use Policy, 26(4): 901–910.

VOS, W., MEEKES, H. (1999): Trends in European cultural landscape development: perspectives for a sustainable future. Landscape and Urban Planning, 46(1): 3–14.

WALDON, B. (2012): The conservation of small water reservoirs in the Krajeńskie Lakeland (North-West Poland). Limnologica-Ecology and Management of Inland Waters, 42(4): 320–327.

WANG, F. (2015): Quantitative Methods and Socio-Economic Applications in GIS. New York, CRC Press.

WANG, F., HARTMANN, J., LUO, W., HUANG, P. (2006): GIS-Based Spatial Analysis of Tai Place Names in Southern China: An Exploratory Study of Methodology. Annals of GIS, 12(1): 1–8.

WANG, F., ZHANG, L., ZHANG, H., ZHANG, G. (2014): Mapping and spatial analysis of multiethnic toponyms in Yunnan, China. Cartography and Geographic Information Science, 41(1): 86–99.

YEOH, B. S. A. (1996): Street-Naming and Nation-Building: Toponymic Inscriptions of Nationhood in Singapore. Area, 28(3): 298–307.

ZAHRADNÍČEK, P., TRNKA, M., BRÁZDIL, R., MOŽNÝ, M., ŠTĚPÁNEK, P., HLAVINKA, P., ŽALUD, Z. et al. (2015): The extreme drought episode of August 2011–May 2012 in the Czech Republic. International Journal of Climatology, 35(11): 3335–3352.

ZELINSKY, W. (1997): Along the frontiers of name geography. The Professional Geographer, 49(4): 465–466.

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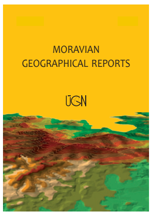

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An integrated AHP and PROMETHEE approach to the evaluation of the attractiveness of European maritime areas for sailing tourism

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Abstract

As a subject of scientific investigation, evaluations of the attractiveness of tourist destinations have had a relatively long history, particularly among geographers and regional economists. Based on mathematical and psychological principles and using methods that combine the Analytical Hierarchy Process (AHP) and the Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE) approach, this research project constructs an evaluation structure used for the assessment of European coastal and offshore areas for sailing tourism. A case study with a three-level evaluation structure has been defined and tested. It contains: at the top of the hierarchy an overall objective defined as the attractiveness of the European coastal and offshore areas for sailing tourism; six criteria of evaluation (on the second level); and ten coastal areas (at the bottom level). This structure covers almost all the coasts around Europe, as they were the subjects of evaluation and comparison. The evaluation was carried out by a group of experts who made the assessment taking into account previously determined criteria with weights. The findings indicate that the AHP-PROMETHEE method may be a useful tool to evaluate the attractiveness of different destinations. It can be also used for practical purposes, particularly to determine strengths and weaknesses, as well as the competitive position, of given coastal areas in relation to others.

Keywords: *AHP method; PROMETHEE method; evaluation; attractiveness of destinations for sailing tourism; European coastal and offshore areas*

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1. Introduction

The concept of the attractiveness of destinations (tourism attractiveness) is one of the most frequent issues studied in the theory of tourism and its adjacent disciplines in recent decades. Many authors have investigated this topic, resulting in a significant body of knowledge. They have focused on various aspects of attractiveness, with emphasis on the notion of tourism attraction as a foundation for the whole concept (see inter alia: Cohen, 1972; Cracolici and Nijkamp, 2009; Kim and Agrusa, 2005; Krešić, 2007; Kruczek, 2011; Leask, 2010; Lew, 1987; Omerzel and Mihalič, 2008; Pikkemaat, 2004; Ritchie and Crouch, 2005; Yoon and Uysal, 2005; Żemła, 2014).

This key concept of tourism attraction has usually been understood as those (tangible and intangible) attributes of destination, which, with their specific features, motivate tourists to visit a given area (Kreive and Prebeen, 2011). Additionally, apart from tourism attractions per se, factors such as transportation and accommodation (Cho, 2008; Gołembski, 2002; Rogalewski, 1974), along with destination image (Anholt, 2010; Gartner, 1989; Kim and Perdue, 2011) play an important role in relation to the attractiveness of tourism areas. Such a delineation of tourism attractiveness can be referred to as the 'supply-driven' approach, but the concept of attractiveness of destination may also be analysed from a 'demand-driven' perspective (Formica and Uysal, 2006). Under such an approach, attractiveness is a function of the tourists' perception of the ability of the destination to satisfy their needs and deliver personal benefits (Mayo and Jarvis, 1980).

The evaluation of tourist attractiveness as a subject of scientific investigation has had a relatively long history, particularly among geographers and regional economists. The latter have rather dealt with the evaluation of tourism competitiveness and the potential of destinations, and they have proposed and applied many methods (also those developed in other disciplines) which have been used for these purposes. Historically, the most popular methods concerned the 'supply-

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driven' approach and encompassed: grade and optimisation methods (since the 1970s – especially popular among Central and Eastern European geographers: Deja, 2001; Dubel, 2000; Husbands, 1983; Kożuchowski, 2005; Sołowiej, 1992; Ziółkowski, 2006), along with methods of multivariate comparative analysis and SWOT analysis (Zajadacz and Śmiałek, 2009). In recent decades, a set of multi-criteria decision- making tools have been intensively applied to the evaluation of tourist attractiveness. They take into account both the 'supply-driven' and 'demand driven' perspectives. Particular methods from the above-mentioned groups have been mainly used for the assessment of selected features of natural (Bartkowski, 1971; Deng, King and Bauer, 2002; Raymond and Brown, 2006; Sołowiej, 1992) and socio-cultural environments (Paprzycka, 2005), which are important for tourism development. The results of such assessments may constitute the basis for the valorisation of different areas as present or potential tourist destinations.

With regard to tourism in maritime and coastal environments, even at the beginning of the first decade of the 2000s, Hall (2001, p. 601) claimed that "marine and coastal tourism is one of the fastest growing areas within the world's largest industry. Yet despite increased awareness of the economic and environmental significance of marine and coastal tourism, it is only in recent years that a substantial body of research has emerged". Unfortunately, it seems that one cannot share the same opinion in relation to sailing tourism (as one of the forms of nautical tourism). Rather, it constitutes a minor subject of scientific investigation in the spectrum of nautical tourism's various issues (Lukovic, 2012; 2013). This is perhaps related to the fact that mainstream research has mainly dealt with the impact of tourism on coastal areas, as well as their adaptation to different tourists' and local societies' requirements (Balaguer et al., 2011; Charlier and De Meyer, 1992; Miossec, 1988; Qanir, 1989; Silveira and Santos, 2012; 2013; Worm, 1997). On the other hand, the seas and oceans themselves have constituted a relatively limited field of academic interest in tourism, mostly from the perspective of the marine environment, cruising tourism and the management of coastal waters areas (Papathanassis and Ross, 2015; Lück, 2007; 2008). Such a conclusion may also be derived from a content analysis of specialised journals, such as Ocean and Shorelines Management, Ocean and Coastal Management (Elsevier), the Journal of Coastal Research (Coastal Education and Research Foundation), Tourism in Marine Environments (Cognizant Communication Corporation), and Tourism Geographies (Routledge).

Coastal and offshore areas (as destinations for sailing tourism) have been rarely treated on a comparable level to other forms of maritime tourism. This is not fully understandable, since sea coasts have met the criteria with which tourist destinations can be distinguished and analysed for many decades. In recent years, among relatively infrequent publications (found mainly in the aforementioned international journals) where studies on maritime sailing tourism (carried out from different academic perspectives) have constituted the subject of interest, one can cite the following examples: Parrain's analysis of sailing routes and stopovers across the Atlantic (2011); a study of critical factors in the maritime yachting tourism experience (Mikulić, Krešić and Kožić, 2015); an estimation of the economic impacts of yachting in Greece by means of the tourism satellite account (Diakomihalis and Lagos, 2008); an analysis of recreational boaters' perceptions of scenic value in coastal waters off Rhode Island by Dalton and Thompson (2013); an analysis of incidents involving recreational boats in Spain (Otamendi and González de Vegas, 2014); a study of the impacts of recreational boating on the marine environment of Cap de Creus (Mediterranean Sea) conducted by Lloret et al. (2008); a study of nautical frequentation and marina management in the Bay of La Rochelle (Marrou, 2011); and Retičre's (2002) analysis of recreational sailing in the Solent and the Bay of Quiberon.

As one can see, most of these publications have been concerned with rather fragmentary research, devoted to particular places and with relatively narrow topics. In turn, only a minority of works has dealt with more general issues connected with problems which may be encountered in many different coastal and offshore destinations. Among such publications, one can note the following: Lee's (2001) analysis of the determinants of recreational boater expenditures on trips; Oram's (2007) and Marušić et al.'s (2008) studies on the positive and negative impacts of yachting tourism; a study devoted to the genetic, structural and functional aspects of maritime tourism space, published by Butowski (2014); and a simulation of yacht movements in enclosed bays by means of computer modelling (Genç, 2015). The environmental impacts of yachting tourism are among the most controversial. Certain authors argue that small and recreational vessels exert a significant pressure on the delicate ecological balance of maritime habitats (Davenport and Davenport, 2006; 2008, and Salmona and Verardi, 2001). On the other hand, it is also acknowledged that such vessels do not have a significant influence on the environment, especially when compared to the environmental impacts of large cruise ships (Mikulić, Krešić and Kožić, 2015, p. 33).

In addition, coastal and offshore tourist destinations in relation to sailing tourism have rarely been the subject of comparative studies. Paradoxically, they have constituted the main topic (but from a different perspective) of many publications issued for practical reasons. They primarily comprise pilot books and guides for sailors (e.g. for European waters: Atlantic Spain and Portugal (2006); Brandon and Marchment (2007); Buchanan (2009); Buttres and Du Port (2009); Cornell (2008); Heath (2006); Heikell (1998; 2006; 2007); Lawrence (2002); Navin (2003; 2004; 2006); Nickel and Harries (2009); South and West Coasts of Ireland (2006); Thompson and Thompson (2008); and the global publication in 2004 of Ocean Passages for the World). These are obviously not academic publications, but they can constitute a relevant source of information that may be used for the needs of scientific works, especially those which concern comparative studies among various maritime areas.

Taking into consideration the above-mentioned background factors, this study uses assessment procedures based on mathematical and psychological principles (combined AHP and PROMETHEE approaches: see below for definitions) to construct an evaluation platform for European coastal and offshore areas for sailing tourism. The aim of this research project is to contribute to the increased knowledge of European maritime areas as destinations for sailing tourism, as well as to the improvement of the methodological bases in studies of the evaluation of the attractiveness of coastal and offshore destinations.

2. The AHP and PROMETHEE methods as multi-criteria decision-making tools

The Analytical Hierarchy Process (AHP) method is a classical multi-criteria decision-making tool developed by the American mathematician T. L. Saaty in the 1970s, and it has been extensively studied and refined since then (1980, 1982, 1987, 1995 and 2008). It is a structured technique for organising and analysing complex problems based on mathematics and psychology. The method itself is based on a familiar way of thinking: instead of trying to define what is good and what is bad, it is usually much easier to compare one variant of some phenomenon or process to another.

In the AHP method, all factors affecting the decision-making process are structured into a tree hierarchy and assigned weights. It belongs to the set of variations on multi-attribute utility theory (MAUT), where the criteria are completely aggregated into a single utility function that takes the preferences of the decision makers into account (De Brucker, Verbeke and Macharis, 2004). The core of the AHP method is weighting criteria and indicators with pair-wise comparisons. It has received increasing attention in the associated literatures and has been used to address decision making and evaluations in a number of interdisciplinary contexts.

The standard AHP method is based on three principles:

1. construction of a hierarchy;
2. priority setting; and
3. logical consistency (Turcksin, Bernardini and Macharis, 2011, p. 955).

First, the hierarchy is used to break down the complex problem into its constituent elements. A hierarchy has at least three levels: the overall objective at the highest level; the (sub-) objectives (criteria) at an intermediate level; and the considered alternatives at the bottom level (Macharis et al., 2004; Dagdeviren, 2008). Secondly, the relative priorities of each element in the hierarchy are determined by comparing all the elements of the lower level against the criteria, with which a causal relationship is presumed to exist. The multiple pair-wise comparisons are based on a standardised comparison scale of 9 levels, where 1 = equal importance, 3 = moderate importance, 5 = higher importance, 7 = much higher importance, and 9 = complete dominance; the ratings of 2, 4, 6, and 8 are intermediate values; and 1/2, 1/3, 3/4, … 1/9 are reciprocals. The consistency of decision makers, as well as the hierarchy, can be evaluated by means of the consistency ratio (Wang and Yang, 2007). The whole procedure is explained in detail in Saaty (1987).

The Preference Ranking Organization METHod for Enrichment Evaluation (PROMETHEE), proposed by Brans, Mareschal and Vincke (1984) and further developed by Brans and Vincke (1985), as well as by Goumans and Lygerou (2000), is (similar to the AHP method) a set of multi-criteria decision aid methods. They can also be classified as outranking methods, which are based on the principle of pair-wise comparison of the actions. The term 'action' is used in the original description of the PROMETHEE method. It corresponds to the term 'alternative' in the AHP method. The European maritime areas, which are the subjects of research in this study, played the role of actions (using the original terminology of the PROMETHEE method).

The general aim of all multi-criteria decision-aid methods is to point out an action (alternative) optimising all criteria, which can be maximised and minimised. In the PROMETHEE group methods, one uses information concerning the level of preference of a given action in relation to the remaining actions, as well as information on the level at which the remaining actions are more preferred in relation to a given action. The research process is carried out in five stages:

1. the choice of a type of function of preference for each pair of actions (there are six functions of preference which can be chosen, depending on the types of criteria);
2. the determination of individual indexes of preference for all pairs of actions in each criterion;
3. the determination of multi-criteria indexes of preferences for all pairs of actions;
4. the determination of flows of domination for each action as well as profiles of alternatives; and
5. the determination of rankings of actions on the basis of domination flows (Cabała and Onderka, 2015).

3. Multi-criteria methods used in tourism (and nautical tourism) research

The evaluation of the tourism attractiveness of destinations is a strongly multi-criteria assessment process where various criteria are often subjective, somewhat abstract or unquantifiable (Shou et al., 2015). Additionally, these criteria should be analysed from both 'supply driven' and 'demand driven' perspectives. Therefore it is appropriate to apply specialised multi-criteria decision-making tools to this task, as they deal with tangible and intangible factors which can influence the assessment of the tourism attractiveness of destinations. Those tools (using mathematical algorithms) allow the transformation of subjective opinions of experts into more objective final results, including evaluations or rankings of compared areas. The usefulness of such tools also relies on the fact that they are supported by software applications, which help to conduct the research and interpret the obtained outputs.

Among frequent instances of applications from around the world, one can distinguish several examples: the ranking of tourist destinations with multi-criteria decision-making methods in Bosnia and Herzegovina, as presented by Göksu and Kaya (2014); a combined SWOT – AHP approach applied by Joe and Kim (as cited in Göksu and Kaya, 2014, 92) to develop a strategic plan for a tourist destination in Chuncheona (South Korea); a tourist attractions' preference evaluation using a Bayesian network and the AHP method proposed by Papić-Blagojević, Gajić and Djokić (2012); the tourist attractiveness of the Tatra National Park (Poland) measured using the PROMETHEE and Hellwig's method (Muszyńska-Kurnik, 2010); and the evaluation of tourist potential in Romania carried out by means of Principal Components Analysis and Hierarchical Ascendant Classification, (Iaţu and Bulai, 2010). The list can be completed by other examples of the application of multi-criteria methods in tourism research from the Spanish language literature, such as Mondéjar-Jiménez et al., (2010); Blancas, Guerrero and Lozano (2009); Brandis et al. (1998); Franco et al. (2009); Montis and Nijkamp (2006); Pérez et al. (2008); and Rozman et al. (2009).

The proper AHP and PROMETHEE approaches are probably the ones most popular among many multi-criteria techniques applied in tourism research. Moutinho, Rita and Curry (1996) examined the application of the AHP approach in a tourism context (Crouch, 2007; Papić-Blagojević, Gajić and Djokić, 2012, p. 10). Due to its advantages, the AHP method has been mainly employed in tourism studies addressing selection and/or evaluation issues, such as: natural attractions evaluation (Deng, King and Bauer, 2002); convention site selection (Chen, 2006; Filipović, 2007); hotel location choice (Chou, Hsu and Chen, 2008); online personalised attraction recommendation system (Huang and Bian, 2009); and tourism promotional effectiveness (Lai and Vinch, 2013). Using the case of Taiwan, Hsu, Tsai and Wu (2009) analysed preferences for tourists' choice of destination. Nekooee, Karami and Fakhari (2011) assessed the prioritisation of urban tourist attractions in Iran. And finally, Zhou et al. (2015) used the hybrid analytic hierarchy process (AHP) to evaluate resource-based destination competitiveness in West Virginia.

The PROMETHEE method (often in conjunction with its GAIA graphic plane – prepared for the visualisation of results) has also been used frequently in tourism research. In recent years, a number of works dealing with different aspects of tourism using this approach have been published. Among others, Ishizaka, Nemery and Lidouh (2013) carried out a location selection analysis for choosing a suitable borough in the region of Greater London to construct a large casino. Akkaya and Uzar (2013) and Uygurtürk and Korkmaz (2015) evaluated travel agencies operating in Turkey. And finally, Ranjan, Chatterjee and Chakraborty (2016) tried to quantify the tourism potential of Indian states.

The AHP and the PROMETHEE (and other multi-criteria) methods and tools were also applied in research connected with nautical tourism, but to a relatively limited extent. Over the last decade, among the few works which touch on these topics, one can point out the evaluation of natural and cultural attractions for sailing tourism by means of the AHP tool (Adamczyk and Nowacki, 2014), or the selection of locations for nautical tourism ports in the Northern Adriatic using the PROMETHEE approach, as proposed by Kovačič (2010).

4. Methodological scheme of the research

This research project on the evaluation of European coastal and offshore areas for sailing tourism was carried out taking into account both 'supply-driven' and 'demand-driven' approaches of tourism attractiveness. It encompassed four main stages:

1. the determination of:
   - the overall objective of research,
   - the criteria of evaluation, and
   - the selection of the areas (supply perspective) for further comparison;
2. setting-up a three-level hierarchical decision tree to clarify the process;
3. the weighting the criteria (demand perspective, using the AHP methodology); and
4. the evaluation and ranking of chosen areas (demand perspective, using the PROMETHEE methodology).

The overall objective is defined as determining the attractiveness of European coastal and offshore areas (destinations) for tourism. For the purpose of this research project, six criteria (Tab. 1) and ten areas (Tab. 2) were determined. In order to appropriately weight the criteria and

Criteria	Sub-criteria
Safety and comfort of navigation (S&C)	ports, marinas and natural shelters
	search and rescue systems (SAR)
	navigational and meteorological warnings
	maps (traditional and electronic), pilot books and guides for sailors
	weather conditions
	the intensity and organisation of navigation (e.g. occurrence of separation zones), buoyage and lights
Nautical conditions (NC)	the length of sailing season for recreational crafts
	nautical attractiveness and the level of nautical difficulty of a given area (meteorological and hydrological conditions: tides and currents, force and direction of prevailing winds, the height of waves, depths and shoals, etc.)
Tourist attractiveness of destinations (TA)	climate and weather conditions
	natural attractions (landscape, beaches, clear water, nature, natural parks and reserves, etc.)
	cultural attractions (towns, museums, exhibitions, monuments, architecture, people, local culture, events, etc.)
	degradation of the natural and cultural environments
Formalities (F)	required formal procedures (concerning the boat and crew members)
	the occurrence of water areas which are inaccessible for recreational sailing
Commercial offer for sailors (CO)	the level of prices
	the prices/quality relation
	the diversity of offer
	the cost of transportation
Accessibility and location of destinations (A&L)	the duration of travel to a destination
	the accessibility of different means of transport (plane, road, ferry)
	the location of destination (distance from main source areas)
	the location of destination in relation to other areas (the synergy or isolation effect)

Tab. 1: Criteria (and sub-criteria) applied in the evaluation process
Source: author's conceptualisation

Selected maritime area	Covered areas
The Baltic Sea (BS)	Danish straits, the Kattegat; coastal and island areas: Danish, Swedish, Ĺland Islands, Finnish, Russian, Estonian, Latvian, Lithuanian, Polish, German
The North Sea (NS)	the Skagerrak, coastal and island areas of eastern Britain, Shetland, Orkney, southern and western Norway (south of Ĺlesund), western and northern Denmark, Germany and the Netherlands
The Norwegian Sea and the Atlantic Ocean (Nw.S)	coastal and islands areas Norway (north of Ålesund), Faroe Islands, Iceland
The Irish Sea, the Celtic Sea, the Atlantic Ocean (ISA);	coastal and island areas of western Britain, the Hebrides, waters around Ireland
The English Channel, Bay of Biscay, Atlantic (ECBA)	southern coast of Britain, Channel Islands, the Bay of Biscay, western coast of the Iberian Peninsula
Atlantic Islands (AIs)	the Canaries, Madeira, the Azores
Western Mediterranean (WM)	the Tyrrhenian Sea; coastal and island areas of Spain, the Balearic Islands, France, Corsica, Sardinia, Sicily
Central Mediterranean (CM)	the Adriatic Sea, the Ionian Sea; coastal and island areas of Italy, Slovenia, Croatia, Montenegro, Albania, Greece, Malta
Eastern Mediterranean (EM)	the Aegean Sea, the Sea of Marmara (EM); coastal and island areas of Greece, Turkey, Cyprus
The Black Sea (Bl.S)	the coastal areas of Bulgaria, Romania, Ukraine, Russian Federation, Georgia, Turkey

Tab. 2: The geographical scope of chosen European coastal and offshore areas
Source: author's conceptualisation

then to use them for the evaluation of tourist attractiveness, a set of sub-criteria for each criterion was defined. In such a way, each criterion was qualitatively determined by the set of sub-criteria (in the full AHP procedure, the sub-criteria could constitute a fourth level of the hierarchy: this was not applied in this research).

The European coastal and offshore areas (as 'alternatives' in the AHP methods, and 'actions' in the PROMETHEE terminology) have been selected such that the coverage of all coasts, as well as coastal and offshore waters around Europe, are included as accessible for recreational crafts. The chosen areas should be (as much as possible) comparable in terms of their geographical extent and socio-economic potential. Many pilot books and sailing guides (some of them listed in section 1 of this paper), as well as the author's 30 years personal experience in such sailing, were taken into consideration to meet these requirements (Fig. 1, Tab. 2).

Based on the AHP methodology and using the above-mentioned assumptions, a three-level hierarchical decision tree was constructed. It allowed for the partition of the complex problem of the attractiveness of tourist destinations into particular factors presented at the 2nd and 3rd levels of the decision tree (Fig. 2).

The criteria selected for the evaluation of attractiveness of European coastal and offshore areas for sailing tourism were weighted using the AHP methodology. They were pair-wise comparisons carried out by a group of 24 sailors with little, average (e.g. qualified crew members) and extensive (e.g. skippers and sailing tourism organisers) experience in maritime sailing. Such a structure for this group of sailors allowed the researcher to take into account the different significances of particular criteria for less-experienced, medium-experienced and experienced sailors. The final weight assigned to each criterion constituted an average of all partial weights (Tab. 3).

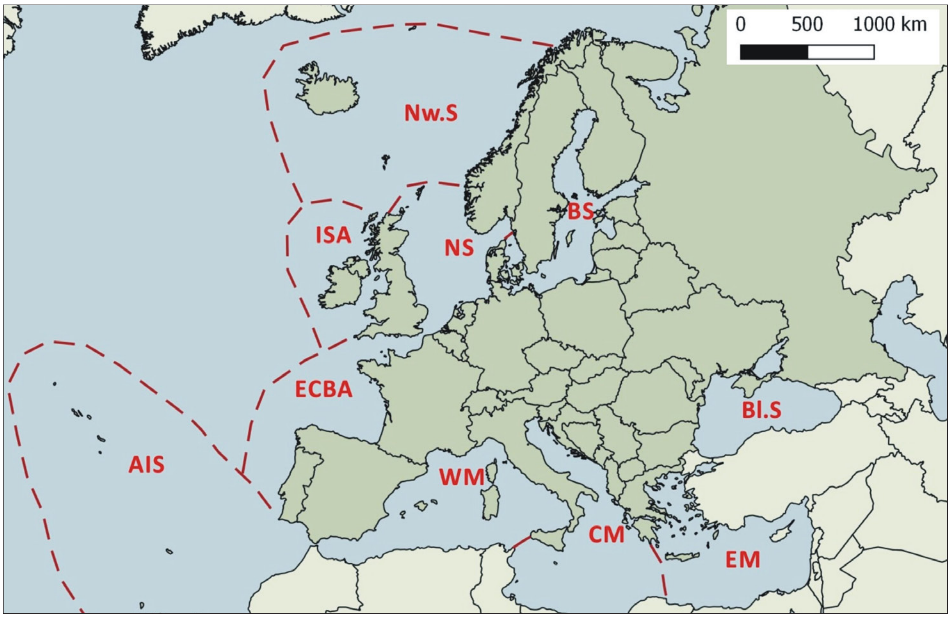

Fig. 1: European coastal and offshore areas as alternatives in the evaluation process
Source: author's elaboration

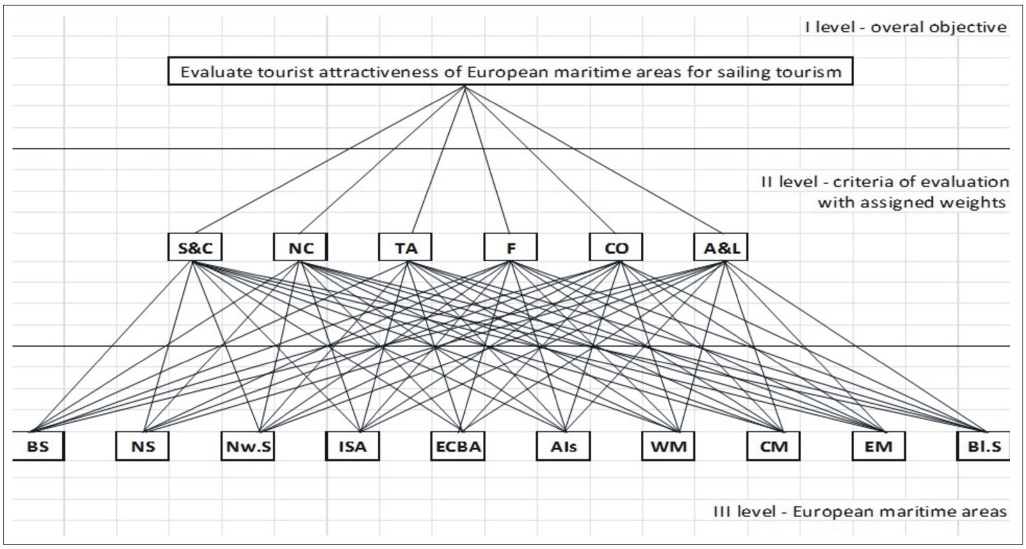

Fig. 2: The attractiveness of European coastal and offshore areas for sailing tourism: The hierarchical tree and pair-wise comparisons
Source: author's conceptualisation
(Notes: Level 11: S&C – Safety and Comfort of navigation; NC – Nautical Conditions; TA – Tourist Attractiveness of destinations; F – Formalities; CO – Commercial Offer; A&L – Accessibility and Location of destinations; Level 111: BS – The Baltic Sea; NS – The North Sea; Nw.S – The Norwegian Sea; ISA – The Irish Sea and Atlantic; ECBA – The English Channel, Bay of Biscay, Atlantic; AIs – Atlantic Islands; WM – Western Mediterranean; CM – Central Mediterranean; EM – Eastern Mediterranean; Bl.S – The Black Sea)

Group of sailors	Number of participants	Criteria						Ratio of consistency**
		S&C	NC	TA	F	CO	(A&L)	
Experienced sailors	7	0.33	0.22	0.09	0.22	0.07	0.07	6.7%
Medium-experienced sailors	7	0.29	0.19	0.17	0.07	0.13	0.14	7.5%
Less-experienced sailors	10	0.44	0.14	0.23	0.04	0.08	0.07	6.4%
Total	24	0.35	0.18	0.17	0.10	0.10	0.10	6.9%

*Tab. 3: Weights assigned to the criteria of evaluation (Notes: *For the description of specific criteria see Tab. 1; **The Ratio of consistency should not exceed 10%)*
Source: author's survey

In the next stage, according to PROMETHEE principles, a 'usual' function was chosen as a function of preference – applied particularly in qualitative assessments. Then, the ten selected European coastal and offshore areas were evaluated by 10 'experts' (this time only by experienced skippers and sailing tourism organisers, and all of them must have had knowledge of all areas in question) using a 5-level qualitative scale (1 – very bad; 2 – bad; 3 – average; 4 – good; 5 – very good) against to each criterion. The interviews were conducted between April and June, 2016.

The idea of joining both the AHP and PROMETHEE methods together resulted from the fact that, in the PROMETHEE procedure, weights assigned for each criterion are determined in a quite subjective way only by a researcher. This can cause the situation that the obtained results will be encumbered with subjectivity. To avoid this danger, in the first step of the whole procedure, the AHP technique was applied. Based on its principles, the weights were determined by pair-wise comparison of six criteria carried out by sailors from various groups. This has reduced the subjectivity of the researcher, replacing it with more objective opinions of many groups of sailors. In such a way the relative values of weights for each criterion were computed. The remaining part of the research was carried out according to the PROMETHEE methodology.

5. Results

According to the applied procedure, the criteria selected for the evaluation of the attractiveness of the chosen European coastal and offshore areas were weighted using the AHP methodology (in practice all calculations were made using the AHP calculator: for academic purposes, it is accessible at: emic/ahp_calc.php). The values of weights assigned to each criterion are presented in Table 3. Additionally, apart from the final weights, certain differences which occurred among experienced, medium-experienced and less-experienced sailors have also been shown. They point out the different importance of particular criteria among these sub-groups of sailors.

The next step of the analysis was to evaluate (and rank) the European coastal and offshore areas by experts using the PROMETHEE method. The data have been processed by means of the PROMETHEE-GAIA plane – a special software for computing and the graphical presentation of the results – for this purpose a version for all non-profit academic research and teaching was used (http://www.promethee-gaia.net/software.html).

The complete ranking of the evaluated areas is presented in Table 4. It also contains the values of the preference flows which are computed to consolidate the results of the pair-wise comparisons of the areas and to rank them from the most preferred to the least preferred. There are three types of preference flows (PROMETHEE methods. Visual PROMETHEE 1.4 Manual (2014, pp. 149–150):

1. Phi+ (Ø+) positive (leaving) flow:

$$\emptyset^{+}(a) = \frac{1}{n-1}\sum_{b \neq a} \pi(b,a)$$

where a and b are compared areas; it measures how much given area a is preferred to the other $n - 1$ ones. It is a global measurement of the strengths of area a. The larger Ø+ (a) the more preferred area;

2. Phi− (Ø−) negative (entering) flow:

$$\emptyset^{-}(a) = \frac{1}{n-1}\sum_{b \neq a} \pi(b,a)$$

it measures how much the other $n - 1$ areas are preferred to area a. It is a global measurement of the weaknesses of area a. The smaller Ø− (a) the more preferred area;

3. Phi (Ø) net flow:

$$\emptyset(a) = \emptyset^{+}(a) - \emptyset^{-}(a)$$

the net preference flow shows the balance between the positive and negative preference flows. It thus takes into account and aggregates both the strengths and the weaknesses of the area into a single score. Ø (a) can be positive or negative. The larger Ø (a) the more preferred area.

In the complete ranking all the areas are compared (it includes no incomparabilities even when comparison is difficult). The resulting ranking can thus be more disputable, especially in the presence of strongly conflicting criteria. The ranking is based on the net preference flow. It combines the two other preference flows in a single summary score. So area a is preferred to area b if and only if it is preferred to b according to the net preference flow:

$$aPb \text{ if and only if } \emptyset(a) > \emptyset(b)$$

The obtained results clearly show that the highest ranks (positive net flows) are occupied by the southernmost European coasts with two exceptions – the Baltic and the Black Sea area, which can be caused by the fact that all maritime areas were assessed from the perspective of Polish participants. All northernmost seas characterised by negative net flows. The Black Sea was assessed as the least attractive in comparison with other areas by a large degree.

The PROMETHEE-GAIA tool also allows the presentation of a disaggregated view of the complete ranking (Fig. 3). For each evaluated area a bar is drawn with as many bands as the number of criteria. Each band corresponds to the contribution of the criterion to the Phi net flow score of the area taking into account the weight of the criterion. This way the sum of the positive bands minus the sum of the negative ones is equal to the Phi net flow score of the area.

On the graph (Fig. 3) it is clearly shown that in the Central Mediterranean area almost all criteria positively contributed to the net flow score. In contrast the Black Sea characterised by negative contribution of all criteria to the final net flow score.

The PROMETHEE-GAIA software also makes possible the computing of the partial ranking. This means that all the evaluated areas are not necessarily compared (because of conflicting criteria) and that the ranking can include incomparabilities. The partial ranking is based on the preference flows. As the two preference flows consolidate the pairwise comparisons of the areas according to opposite points of view, they usually induce two different rankings on the set of areas. The partial ranking is the intersection of these two rankings. So area a is preferred to area b in the partial ranking if and only if it is preferred to b according to both preference flows:

$$aPb \text{ if and only if } \emptyset^{+}(a) \geq \emptyset^{+}(b) \text{ and } \emptyset^{-}(a) \leq \emptyset^{-}(b)$$

Whenever the two preference flows give opposite rankings of the areas, the areas become incomparable.

In Figure 4 the partial ranking was presented in a way such that all areas are represented by nodes and arrows are drawn to indicate preferences. Incomparabilities are thus very easy to detect. Taking into account the condition that area a is preferred to area b if and only if it is preferred to b according to both preference flows, one can see that not all areas are comparable. This feature concerns the following areas: Western Mediterranean – WM (Phi+: 0.34, Phi−: 0.10); the Baltic Sea – BS (Phi+: 0.36, Phi−: 0.13); Eastern Mediterranean – EM (Phi+: 0.41, Phi−: 0.22); The North Sea – NS (Phi+: 0.09, Phi−: 0.30); and The Norwegian Sea – Nw.S (Phi+: 0.13, Phi−: 0.33).

Apart from the complete and partial rankings, a more detailed qualitative analysis was conducted. It was carried out by means of the special GAIA plane tool (Fig. 5) which contains three types of information:

Rank	Maritime areas	Phi	Phi+	Phi−
1	Central Mediterranean	0.6211	0.6767	0.0556
2	West Mediterranean	0.2378	0.3367	0.0989
3	The Baltic Sea	0.2267	0.3589	0.1322
4	East Mediterranean	0.1933	0.4100	0.2167
5	Atlantic Islands	0.0600	0.2700	0.2100
6	The Irish Sea & Atlantic	− 0.1122	0.1422	0.2544
6	English Chanel & Biscay	− 0.1122	0.1422	0.2544
8	The North Sea	− 0.2011	0.0978	0.2989
8	The Norwegian Sea	− 0.2011	0.1311	0.3322
10	The Black Sea	− 0.7122	0.0000	0.7122

Tab. 4: The complete ranking of the European coastal and offshore areas
Source: author's calculations

1. actions (maritime areas) – represented by small squares;
2. criteria – represented by axes; and
3. the weighting of the criteria and the complete ranking – represented by the decision axis (a thicker line).

Using this tool, one can represent in a very synthetic form interrelations which occur within and between particular areas and criteria. One should remember, however, that applying the GAIA plane tool in order to obtain such different types of comprehensive information in a relatively simple pattern, we have to accept the loss of accuracy and quality of information.

The positions of all areas represented graphically in Figure 5 as squares are related to their evaluations on the set of criteria in such a way that areas with similar profiles are closer to each other. In this case, one can distinguish three groups of areas with similar profiles:

1. the Norwegian Sea (Nw.S), the English Channel, Bay of Biscay and Atlantic area (ECBA), the Irish Sea with coastal Atlantic – ISA (ECBA and ISA overlap each other and thus they occupy the same location in this diagram), as well as the North Sea (NS);
2. the Western Mediterranean (WM) area and the Baltic Sea (BS);
3. Atlantic Islands (AIs) and the Eastern (EM) and Central Mediterranean (CM). The Black Sea (Bl.S) area is characterised by a completely different profile.

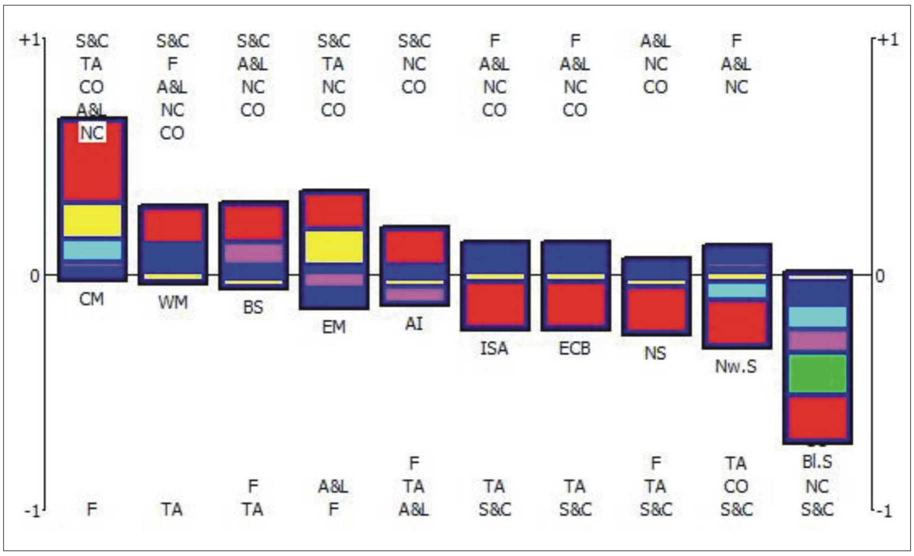

Fig. 3: The complete ranking of the European coastal and offshore areas using the PROMETHEE rainbow tool (Note: S&C – Safety and Comfort of Navigation [red], NC – Nautical Conditions [lime], TA – Tourist Attractiveness of destinations [yellow], F – Formalities [blue], CO – Commercial Offer [aqua], A&L – Accessibility and Location of destinations [violet]; BS – The Baltic Sea, NS – The North Sea, Nw.S – The Norwegian Sea, ISA – The Irish Sea and Atlantic, ECB – The English Channel, Bay of Biscay, Atlantic, AIs – Atlantic Islands, WM – Western Mediterranean, CM – Central Mediterranean, EM – Eastern Mediterranean, Bl.S – The Black Sea)
Source: author's elaboration

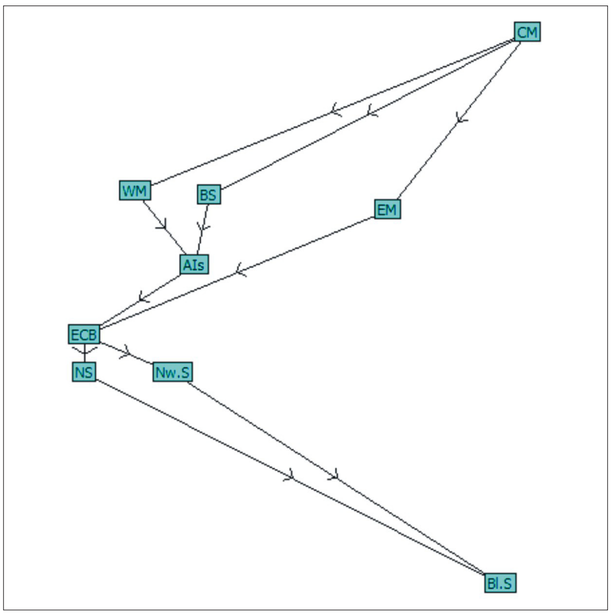

Fig. 4: The partial ranking of the European coastal and offshore areas (Note: for legend, see Fig. 3)
Source: author's elaboration

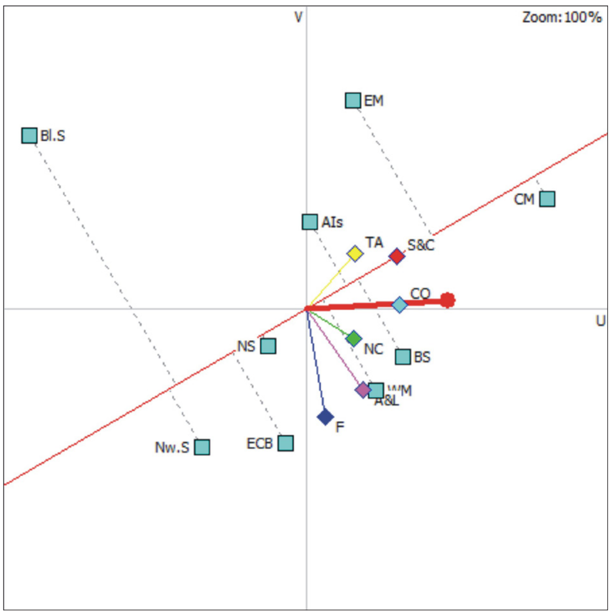

Fig. 5: The GAIA plane as a tool for qualitative evaluation of the European maritime areas (Note: for legend, see Fig. 3). Source: author's elaboration

To better understand the differences between distinguished groups of areas one may analyse the criteria. Each criterion is represented by an axis drawn from the centre of the plane. The orientation of these axes indicates how closely the criteria are related to each other (criteria expressing similar preferences have axes that are close to each other; conflicting criteria have axes that are pointing in opposite directions). Based on this assumption, one can state that all six criteria (chosen for the evaluation in this project) are not very conflicting, but they are not very similar either, wherein can be found the relatively most conflicting criteria, Formalities (F) in relation to Tourist Attractiveness (TA), which are placed in two extreme positions.

The relative positions of areas and criteria axes in the diagram are also interesting to analyse. They indicate which is the best area in relation to a given criterion. In Fig. 5, one can observe the general ranking of areas in terms of safety and comfort of navigation (S&C). It is shown by the orthogonal projection of all areas on the direction of the axis S&C. The highest positions are occupied by the Central and Eastern Mediterranean areas, while the lowest ranks are assigned to the Norwegian and Black Seas. In the same way, one may rank each area against each separate criterion.

Finally, the decision axis (the thickest line in Fig. 5) represents the weights of the criteria. Its orientation indicates which criteria are in agreement with the PROMETHEE rankings and which are not. In Figure 5 one may note that such criteria as Commercial Offer (CO), Nautical Conditions (NC), Safety and Comfort of Navigation (S&C), as well as Tourist Attractiveness (TA), were mostly taken into account in the overall rankings.

The results of this type of research can also be used for more practical purposes: not only do they determine the competitive position of a given maritime area, but they also point out its strengths and weaknesses in relation to others. This can be particularly interesting and helpful for smaller areas, which compete with each other in terms of different criteria. An example of such an analysis are relative rankings of the areas in relation to particular criteria (Tab. 5). The results show the competitive advantage of particular areas in terms of particular criteria.

Another type of information which can be interesting for practical purposes is the relative assessment of a given area in terms of particular criteria. As an example, one can represent the evaluations of the Central Mediterranean area (the 1st position in the complete ranking) and the Black Sea (the last position in the complete ranking) – in a graphical form see Figures 6 and 7.

Analysing Figure 6, one can see (much more clearly than in the synthetic Fig. 4) that the Central Mediterranean area is characterised by a positive net flow for all criteria except Formalities. Moreover, one may notice that the relative position of this area (in relation to other areas) is very strong in terms of safety and comfort of navigation, commercial offer and tourist attractiveness. Only in terms of formalities does this area show a minimal negative flow.

On the other hand, the area of the Black Sea (Fig. 7) is characterised by negative flows in all criteria. A detailed analysis of these types of information can be helpful for decision makers in showing them in which fields their areas are strong or weak (in relation to potential competitors).

6. Conclusions and implications

Multi-criteria decision-making methods started to develop in the 1970s in an intensive fashion. They were mainly directed towards the support of decision-making processes and constituted the output of researchers in management science (although many of them were elaborated by mathematicians). Due to their usefulness, popularity and low cost, they were often adopted by other disciplines in various fields of study. Tourism, because of its complexity and heterogeneity, was one of these domains where frequent multi-criteria tools appeared to be rather attractive. As mentioned in section 3, they were mostly applied to different types of tourism evaluation research. Unfortunately, the use of multi-criteria methods of assessment in nautical tourism and particularly for the evaluation of coastal areas, has been relatively rare. In this situation, an assessment of the attractiveness of European coastal and offshore areas for sailing tourism using the combined AHP and PROMETHEE methodology, seemed to offer some interesting perspectives as the approach integrates these two multi-criteria techniques in order to benefit from their assets and avoid their weaknesses. AHP has been applied to minimise the

Criteria	**S&C**		**NC**		**TA**		**F**		**CO**		**A&L**	
Areas	Rank	Phi net	Rank	Phi net	Rank	Phi net	Rank	Phi net	Rank	Phi net	Rank	Phi net
Baltic Sea	2	0.44	1	0.11	3	– 0.22	5	– 0.22	2	0.11	1	1.00
North Sea	6	– 0.56	1	0.11	3	– 0.22	5	– 0.22	2	0.11	2	0.22
Norwegian Sea	6	– 0.56	1	0.11	3	– 0.22	1	0.67	9	– 0.78	2	0.22
Irish Sea, Atlantic	6	– 0.56	1	0.11	3	– 0.22	1	0.67	2	0.11	2	0.22
Eng. Channel, Biscay, Atlantic	6	– 0.56	1	0.11	3	– 0.22	1	0.67	2	0.11	2	0.22
Atlantic Islands	2	0.44	1	0.11	3	– 0.22	5	– 0.22	2	0.11	8	– 0.67
Western Mediterranean	2	0.44	1	0.11	3	– 0.22	1	0.67	2	0.11	2	0.22
Central Mediterranean	1	1.00	1	0.11	1	0.89	5	– 0.22	1	1.00	2	0.22
Eastern Mediterranean	2	0.44	1	0.11	1	0.89	9	– 0.78	2	0.11	8	– 0.67
Black Sea	6	– 0.56	10	– 1.00	3	– 0.22	10	– 1.00	10	– 1.00	10	– 1.00

Tab. 5: Complete rankings of coastal and offshore areas in relation to particular criteria
Source: author

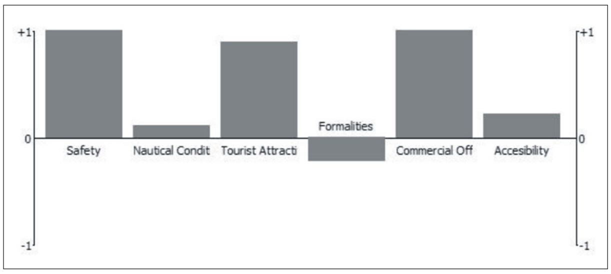

Fig. 6: The assessment of the Central Mediterranean area in terms of particular criteria

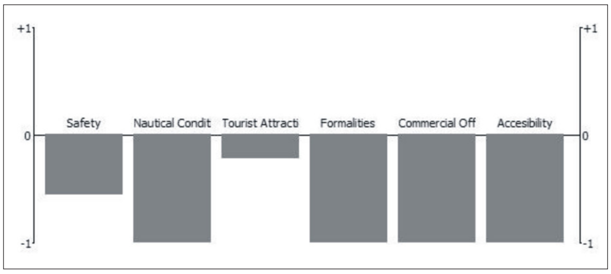

Fig. 7: The assessment of the Black Sea in terms of particular criteria

subjectivity of the researcher at the stage of determination of the weights of the criteria. The PROMETHEE methodology, on the other hand, has been used to conduct the whole evaluation process. The latter has also made it possible to carry out detailed analyses and obtain relevant results, including their graphical presentation.

This research project, likely the first of its type, should contribute to knowledge of the attractiveness of European maritime areas in the context of sailing tourism. Secondly, this approach should also improve the methodological bases of nautical tourism research, including coastal tourism and sailing tourism research. In this context, the current paper focused on two goals. The first concerned the methodological aspects of such research, as the researcher wanted to show, in a detailed way, how both methods in question could be used for the evaluation of given areas (and, by implication, not only for tourism purposes). From this perspective, the empirical research only provided background information, where the proposed combined methodology was tested. The second goal was related to the relative lack of academic knowledge on sailing tourism: to realise this task and increase such knowledge, the author's personal interests and experience in sailing appeared to be an additional asset. The latter factors contributed to the choice of such a subject area as an empirical testing site (not only in the spatial context) for the research. Taking into account these aspects, it is hoped that the paper constitutes a relevant contribution to research on tourism (from both methodological and empirical perspectives).

As in most projects with relatively few antecedents, the limited character of the current work also indicates directions for further investigation. It seems that comparative analyses should be carried out among experts from various European countries, as this could allow the comparison of preferences expressed by different groups of sailors. Additionally, research with a similar methodology could be conducted for at least two other reasons:

1. the assessment of smaller sub-areas (located in a larger geographical territory) in order to determine their competitive positions, e.g. selected coastal areas within the Baltic Sea or the North Sea (this approach could also be applied to other non-European areas); and
2. the evaluation of areas taking into account particular criteria and their weights in relation to various groups of sailors, such as potential visitors (i.e. their assessment in terms of navigation safety, commercial offer, accessibility and location, etc.).

Finally, it is important to emphasise that the results of research of this type can be used for more practical purposes. Such results can not only determine the competitive positions of given (not only maritime) tourism regions, but also point out their relative strengths and weaknesses in relation to particular criteria. This can be particularly interesting and helpful for smaller areas which compete with each other in terms of the various factors. Using knowledge about their (and their competitors') strengths and weaknesses, they could develop specialisations related to their competitive advantages.

Taking into consideration all of the aforementioned advantages of multi-criteria methods, it must be remembered that (despite attempts of their formalisation) they are burdened with a certain degree of subjectivity: experts carry out their assessments in subjective ways; criteria are selected and weighted by them subjectively, etc. Due to this effect, in order to receive a possibly complete and relatively objective picture of a real situation, traditional quantitative analyses are also recommended. Their results should complete more subjective evaluations conducted using multi-criteria methods. In relation to the assessment of European maritime areas, such analyses could concern primarily supply aspects: i.e. factors such as the shoreline development ratio; climate and weather data; locations of destinations (in terms of both time and distance accessibility measures); prices; the number of marinas and yachts, and many other factors.

References:

ADAMCZYK, T., NOWACKI M. (2014): Ocena atrakcyjności krajoznawczej destynacji żeglarskich z wykorzystaniem metody AHP. Turystyka kulturowa, 8: 51–68.

AKKAYA, G. C., UZAR, C. (2013): The usage of multiple-criteria decision making techniques on profitability and efficiency: an application of PROMETHEE. International journal of economics and finance studies, 5(1): 149–156.

ANHOLT, S. (2010): Places: Identity, image and reputation. Basingstoke, Palgrave Macmillan.

ATLANTIC SPAIN AND PORTUGAL (2006): RCC Pilotage Foundation. Cambridgeshire, Imray.

BALAGUER, P., DIEDRICH, A., SARDÁ, R., FUSTER, M., CAÑELLAS, B., TINTORÉ J. (2011): Spatial analysis of recreational boating as a first key step for marine spatial planning in Mallorca (Balearic Islands, Spain). Ocean & Coastal Management, 54(3): 241–249.

BARTKOWSKI, T. (1971): O metodyce oceny środowiska geograficznego, Przegląd Geograficzny, 53(3): 263–281.

BLANCAS, J., GUERRERO, F. M., LOZANO, M. (2009): La localización espacial en la planificación del turismo rural en Andalucía: un enfoque multicriterio. Revista de estudios regionals, 84: 83–113.

BRANDON, R., MARCHMENT, J. (2007): Corsica and North Sardinia. Cambridgeshire, Imray.

BRANDIS, D., MARTÍN, F., CALLE, M., RÍO, M. I., TROITIÑO, M. A., GUTIÉRREZ, J., LOBO, P. (1998): Toledo: problemática e implicaciones urbanas del turismo. Ería, Revista cuatrimestral de geografía. 47: 299–325.

BRANS, J. P., MARESCHAL, B., VINCKE, P. H. (1984): PROMETHEE: a new family of outranking methods in multicriteria analysis. In: Brans, J. P. [ed.]: Operational Research'84 (pp. 477–490), North-Holland.

BRANS, J. P., VINCKE, P. H. (1985): A preference ranking organization method, the PROMETHEE method. Management Science, 31: 647–656.

BUCHANAN, G. (2009): Shetland Islands Pilot. Imray, Cambridgeshire.

BUTOWSKI, L. (2010): Morska turystyka żeglarska w Europie – podstawy metodologiczne analizy jakościowej wybranych elementów popytu i podaży. Folia Turistica, 23: 95–114.

BUTOWSKI, L. (2014): Maritime Tourism Space. Turyzm, 24(1): 57–64.

BUTTRES, R., DU PORT, A. (2009): Reeds Nautical Almanac 2010. Atlantic Europe from the tip of Denmark to Gibraltar. Adlard Coles Nautical.

CABAŁA, P., ONDERKA, Z. (2015): Przegląd metod wielokryterialnego wspomagania decyzji. In: Stabryła, A. [ed.]: Praktyka projektowania systemów organizacyjnych przedsiębiorstwa (pp. 191–199). Kraków, Mfiles.pl.

CHARLIER, R. H., DE MEYER, C. P. (1992): Tourism and the coastal zone: The case of Belgium. Ocean & Coastal Management, 18(2–4): 231–240.

CHEN, C. F. (2006): Applying the Analytical Hierarchy Process (AHP) Approach to Convention Site Selection. Journal of Travel Research, 45(2): 167–174.

CHO, V. (2008): Linking location attractiveness and tourist intention. Tourism and Hospitality Research, 8(3): 220–224.

CHOU, T. Y., HSU, C. L., CHEN, M. C. (2008): A fuzzy multi-criteria decision model for international tourist hotels location selection. International Journal of Hospitality Management, 27(2): 293–301.

COHEN, E. (1972 Spring). Toward a Sociology of International Tourism. Social Research, 39(1): 164–182.

CORNELL, J. (2008): World Crusing Routes. Adlard Coles Nautical, 6th edition.

CRACOLICI, M. F., NIJKAMP, P. (2009): The attractiveness and competitiveness of tourist destinations: A study of Southern Italian regions. Tourism Management, 30: 336–344.

CROUCH, J. (2007): Modelling destination competitiveness: A survey and analysis of the impact of competitiveness attributes. CRC for Sustainable Tourism Pty Ltd., Queensland.

DAGDEVIREN, M. (2008): Decision making in equipment selection: an integrated approach with AHP and PROMETHEE. Journal of Intelligent Manufacturing. 19: 397–406.

DALTON, T., THOMPSON, R. (2013): Recreational boaters' perceptions of scenic value in Rhode Island coastal waters. Ocean & Coastal Management, 71: 99–107.

DAVENPORT, J., DAVENPORT, J. (2006): The impact of tourism and personal leisure transport on coastal environments: A review. Estuarine, Coastal and Shelf Science, 67(1–2): 280–292.

DE BRUCKER, K., VERBEKE, A., MACHARIS, C. (2004): The applicability of multicriteria-analysis to the evaluation of intelligent transport systems (ITS). Research in Transportation Economics, 8: 151–179.

DEJA, W. (2001): Przydatność rekreacyjna strefy brzegowej jezior Polski. Poznań, Bogucki Wydawnictwo Naukowe.

DENG, J., KING, B., BAUER, T. (2002): Evaluating natural attraction for Tourism. Annals of Tourism Research, 29(2): 422–438.

DIAKOMIHALIS, M. N., LAGOS, D. G. (2008): Estimation of the economic impacts of yachting in Greece via the tourism satellite account. Tourism Economics, 14(4): 871–887.

DUBEL, K. (2000): Uwarunkowania przyrodnicze w planowaniu przestrzennym. Białystok, Wydawnictwo Ekonomia i Środowisko.

FILIPOWIĆ, M. (2007): The analytic hierarchy process as a support for decision-making. Spatium, 15–16: 44–59.

FORMICA, S., UYSAL, M. (2006): Destination attractiveness based on supply and demand evaluations: An analytical framework. Journal of Travel Research, 44: 418–430.

FRANCO, S., OSORIO, M., NAVA, G., REGIL, H. H. (2009): Evaluación multicriterio de los recursos turísticos. Parque Nacional Nevado de Toluca – México. Estudios y perspectivas en turismo, 18(2): 208–226.

GARTNER, W. (1989). Tourism image: Attribute measurement of state tourism products using multidimensional scaling techniques. Journal of Travel Research, 28(2): 16–20.

GENÇ, A. N. (2015): A Model to Simulate Yacht Movements in Enclosed Bays. Journal of Coastal Research, 31(2): 364–370.

GÖKSU, A., KAYA S. E. (2014): Ranking of tourist destinations with multi-criteria decision making methods in Bosnia and Herzegovina. Economic Review – Journal of Economics and Business, XII(2): 91–103.

GOŁEMBSKI, G. [ed.] (2002): Kompendium wiedzy o turystyce. Warszawa / Poznań, WN PWN.

GOUMANS, M., LYGEROU, V. (2000): An extension of the PROMETHEE method for decision making in fuzzy environment: Ranking of alternative energy exploitation projects. European Journal of Operational Research, 123(3): 606–613.

HALL, C. M. (2001): Trends in ocean and coastal tourism: the end of the last frontier? Ocean & Coastal Management, 44(9–10): 601–618.

HEATH, N. (2006): The Channel Islands. Cambridgeshire, Imray.

HEIKELL, R. (1998): Mediterranean Cruising Handbook. Cambridgeshire, Imray.

HEIKELL, R. (2006): Italian Waters Pilot. Cambridgeshire, Imray.

HEIKEL, R. (2007): Greek Waters Pilot. Cambridgeshire, Imray.

HUANG, Y., BIAN, L. (2009): A Bayesian network and analytic hierarchy process based personalized recommendations for tourist attractions over the Internet. Expert Systems with Applications, 36(1): 933–943.

HUSBANDS, W. C. (1983): Tourists space and tourist attraction, an analysis of the destination choices of European travelers. Leisure Sciences, 5(4): 289–307.

HSU, T. K., TSAI, Y. F., WU, H. H. (2009): The preference analysis for tourist choice of destination: A case study of Taiwan. Tourism management, 30(2): 288–297.

IAŢU, C., BULAI, M. (2010): A critical analysis on the evaluation of tourism attractiveness in Romania. Case study: the region of Moldavia. Proceedings of the 5th WSEAS International Conference on Economy and Management Transformation (Volume I, pp. 145–150). Timisoara, West University of Timisoara.

ISHIZAKA, A., NEMERY, P., LIDOUH, K. (2013): Location selection for the construction of a casino in the Greater London region: A triple multi-criteria approach. Tourism Management, 34: 211–220.

JOE, Y. A., KIM, S. (2011): An Application of SWOT – AHP to develop planning for a tourist destination. Texas: Nutrition, Hospitality, and Retailing Department, Texas Tech University, Tourism Education.

KIM, D., PERDUE, R. R. (2011): The influence of image on destination attractiveness. Journal of Travel & Tourism Marketing, 28: 225–239.

KIM, S. S., AGRUSA, J. (2005): The positioning of overseas honeymoon destinations. Annals of Tourism Research, 32(4): 887–904.

KOVAČIČ, M. (2010): Selecting the location of a nautical tourism port by applying PROMETHEE and GAIA methods. Case study – Croatian Northern Adriatic. Promet – Traffic & Transportation, 22(5): 341–351.

KOŻUCHOWSKI, K. (2005): Walory przyrodnicze w turystyce i rekreacji. Poznań, Wydawnictwo Kurpisz.

KREŠIĆ, D. (2007): Faktori atraktivnosti turističkih destinacija u funkciji konkurentnosti / Tourism Destination Attractiveness Factors in the Funcion of competitiveness. Acta Turistica, 19(1): 45–82.

KREKRE, D., PREBE, E. D. (2011): Index of destination attractiveness as a tool for destination attractiveness assessment. Tourism, 59(4): 497–517.

KRUCZEK, Z. (2011): Atrakcje turystyczne. Fenomen, typologia, metody badań. Kraków, Proksenia.

LAI, W. H., VINH, N. Q. (2013): An Application of AHP Approach to investigate tourism promotional effectiveness. Tourism and Hospitality Management, 19(1): 1–22.

LAWRENCE, M. (2002): The Yachtsmans Pilot to North and East Scotland. Cambridgeshire, Imray.

LEASK, A. (2010). Progress in visitor attraction research: Towards more effective management. Tourism Management, 31: 155–166.

LEE, H. C. (2001): Determinants of recreational boater expenditures on trips. Tourism Management, 22(6): 659–667.

LEW, A. A. (1987): A Framework of tourist attraction research. Annals of Tourism Research, 14(4): 553–575.

LLORET, J., ZARAGOZA, N., CABALLERO, D., RIERA, V. (2008): Impacts of recreational boating on the marine environment of Cap de Creus (Mediterranean Sea). Ocean & Coastal Management, 51(11): 749–754.

LUKOVIC, T. (2012): Nautical Tourism and its Functions in the Economic Development in Europe. In: Kasimoglu, M. [ed.]: Visions for Global Tourism Industry – Creating and Sustaining Competitive Strategies (pp. 399–430). Rijeka, In Tech.

LUKOVIC, T. (2013): Nautical Tourism. CABI.

LÜCK, M. [ed.] (2007): Nautical tourism. Concepts and issues. Cognizant Communication Corporation.

LÜCK, M. [ed.] (2008): The Encyclopedia of Tourism and Recreation in Marine Environments, CABI.

MACHARIS, C., VERBEKE, A., DE BRUCKER, K. (2004): The strategic evaluation of new technologies through multicriteria analysis: the Advisors case. Research in Transportation Economics, 8: 443–462.

MARUŠIĆ, Z., HORAK, S., TOMLJENOVIĆ, R. (2008): The socioeconomic impacts of cruise tourism: A case study of Croatian destinations. Tourism in Marine Environments, 5(2): 131–144.

MARROU, L. (2011): Nautical Frequentation and Marina Management. Journal of Coastal Research (Special Issue), 61: 126–132.

MAYO, E. J., JARVIS, L. P. (1981): Psychology of leisure travel. Boston, CABI Publishing.

MIKULIĆ, J., KREŠIĆ, D., KOŽIĆ, I. (2015): Critical factors of the maritime yachting tourism experience: an impact-asymmetry analysis of principal components. Journal of Travel & Tourism Marketing, 32: 30–41.

MIOSSEC, J. M. (1977: Un modčle de l'espace touristique. L'Espace Géographique. 6(1): 41–48.

MIOSSEC, A. (1988): The physical consequences of touristic development on the coastal zone as exemplified by the Atlantic coast of France between Gironde and Finistčre. Ocean and Shoreline Management, 11(4–5): 303–318.

MONDÉJAR-JIMÉNEZ, J. A., GARCÍA-CENTENO, M. C., MÍNGUEZ-SALIDO, R., MONDÉJAR-JIMÉNEZ, J., CORDENTE-RODRÍGUEZ, M. (2010): Cultural Tourism, Using a Multicriteria Analysis: Spanish World Heritage Cities. International Journal of Management & Information Systems, 14(4): 35–43.

MONTIS, A., NIJKAMP, P. (2006): Tourism development and collaborative evaluation: a multicriteria web based planning support system. International Journal of Environmental Technology and Management, 6(1–2): 40–64.

MUSZYŃSKA-KURNIK, M. (2010): Atrakcyjność turystyczna Tatrzańskiego Parku Narodowego. Paper published in the IV Conference: The Nature of Tatra National Park and a Man, 3: 69–73.

MOUTINHO, L., RITA, P., CURRY, B. (1996): Expert Systems in Tourism Marketing. London, Routledge.

NAVIN, B. (2004): Cruising Guide to the Netherlands. Cambridgeshire, Imray.

NAVIN, B. (2006): Cruising Guide to Germany and Denmark. Cambridgeshire, Imray.

NAVIN, B. (2003): North Sea Passage Pilot. Cambridgeshire, Imray.

NICKEL, P., HARRIES J. (2009): Norwegian Cruising Guide 2009, Norway, Swalbard, and the West Coast of Sweden. Hamilton, Bermuda, Atteinable Adventure Cruising Ltd.

NEKOOEE, Z., KARAMI, M., FAKHARI, I. (2011): Assessment and Prioritization of Urban Tourist Attractions Based on Analytical Hierarchy Process (AHP): A Case Study of Birjand, Iran. Iran Journal of Applied Business and Economics, 12(4): 122–134.

OCEAN PASSAGES FOR THE WORLD (2004): NP 136, Fifth Edition, United Kingdom Hydrographic Office.

OMERZEL GOMZELJ, D., MIHALI, T. (2008): Destination competitiveness—Applying different models, the case of Slovenia. Tourism Management, 29(2): 294–307.

ORAMS, M. B. (2007): The impact of hosting a major marine sports tourism event: The America's cup in Auckland, New Zealand. In: Luck, M. [ed.]: Nautical tourism: Concept and issues (pp. 97–105). New York, Cognizant Communication Corporation.

OTAMENDI, F. J., GONZÁLEZ DE VEGA J. R. (2014): Recreational boating incidents based on marine surveyors reports: Economic, safety and prevention issues across Spain. Ocean & Coastal Management, Vol. 102, Part A: 65–71.

PAPATHANASSIS, A., ROSS, A. K. [eds.] (2015): Tourism in Marine Environments. Special issue Cruise Tourism. Cognizant Communication Corporation.

PAPIĆ-BLAGOJEVIĆ, N., GAJIĆ, T., DJOKIĆ, N. (2012): Using Bayesian network and AHP method as a marketing approach tools in defining tourists' preferences. Turizam, 16(1): 8–19.

PAPRZYCKA, A. (2005): Kryteria typologii i oceny krajobrazu kulturowego. In: Szponar, A., Horska-Schwarz, S. [eds.]: Struktura funkcjonalno-przestrzenna krajobrazu (pp. 78–83). Wrocław, Uniwersytet Wrocławski.

PARRAIN, C. (2011): Sailing Routes and Stopovers: Spatial Disparities Across the Atlantic. In: Micallef, A. [ed.]: Journal of Coastal Research (Special Issue), 61: 140–149.

PÉREZ, V., CAMARGO, I., CABALLERO, R., GONZÁLEZ, M. (2008): Selección multicriterio de nuevos productos turísticos en Pinar del Río, Cuba. Revista Investigación Operacional, 2(2): 98–107.

PIKKEMAAT, B. (2004). The measurement of destination image: The Case of Austria. The Poznan University of Economics Review, 4(1): 87–102.

PROMETHEE methods. Visual PROMETHEE 1.4 Manual, 2014. VP Solutions [online] [cit. 01.05.2016]. Available at: http://www.promethee-gaia.net/software.html

QANIR, A. (1989): Planning of marina developments along the Moroccan coastline. Ocean and Shoreline Management, 12(5–6): 561–570.

RAYMOND, C. M., BROWN, G. (2006): A method for assessing protected area allocations using typology of landscapes values. Journal Environmental Planning Management, 49(6): 797–812.

RANJAN, R., CHATTERJEE, P., CHAKRABORTY, S. (2016): Performance evaluation of Indian states in tourism using an integrated PROMETHEE-GAIA approach. Opsearch, 53(1): 63–84.

RETIERE, D. (2002): Pratiques plaisancičres: évolution et spatialisation dans le Soient (Grande- Bretagne) et la baie de Quiberon (France). In: Guillaume, P. [ed.]: Les activités littorals (pp. 147–168). Paris, CTHS.

RITCHIE, B. J., CROUCH, G. I. (2005): The Competitive Destination: A Sustainable Tourism Perspective. Wallingford, CABI Publishing.

ROGALEWSKI, O. (1974): Zagospodarowanie turystyczne. Warszawa, WSiP.

ROZMAN, C., POTOCNIK, M., PAZEK, K., BOREC, A., MAJKOVIC, D., BOHANEC, M. (2009): A multi-criteria assessment of tourist farm service quality. Tourism Management, 30(5): 629–637.

SAATY, T. L. (1980): The analytic hierarchy process. New York, McGraw.

SAATY, T. L. (1982): Decision making for leaders. Lifetime learning publications. Belmont, Wadsworth.

SAATY, T. L. (1987): The analytic hierarchy process - what it is and how it is used. Mathematical Modelling, 9(3–5): 161–176.

SAATY, T. L. (1995): Decision making for leaders. The analytical hierarchy process for decisions in a complex world. Pittsburgh, RWS publications.

SAATY, T. L. (2008): Decision making with the analytic hierarchy process. International Journal of Services Sciences, 1(1): 83–98.

SALMONA, P., VERARDI, D. (2001): The marine protected area of Portofino, Italy: A difficult balance. Ocean & Coastal Management, 44: 39–60.

SILVEIRA, L., SANTOS, N. (2012): The marina of Horta (Azores Island) – Impacts on the local population and in the tourism development. Proceeding of the 7th International Coastal & Marine Tourism Congress (pp. 117–129). Breda, NHTV Breda University of Applied Science.

SILVEIRA, L., SANTOS, N. (2013): Marina Impacts on the Local Population and on Tourism Development in Horta (Azores Islands), Portugal. Tourism in Marine Environments, 9(1–2): 193–202.

SOŁOWIEJ, D. (1992): Podstawy metodyki oceny środowiska przyrodniczego człowieka. Poznań, Wyd. Nauk. UAM.

SOUTH AND WEST COASTS OF IRELAND (2006): Sailing Directions of Irish Cruising Club.

THOMPSON, T., THOMPSON, D. (2008): Adriatic Pilot. Cambridgeshire, Imray.

TURCKSIN, L., BERNARDINI, A., MACHARIS, C. (2011): A combined AHP-PROMETHEE approach for selecting the most appropriate policy scenario to stimulate a clean vehicle fleet. Procedia Social and Behavioral Sciences, 20: 954–965.

UYGURTÜRK, H., KORKMAZ, T. (2015): The Determination of Preference Ranking of a Group Travel Agencies in Turkey with PROMETHEE Method. Business and Economics Research Journal, 6(2): 141–155.

WANG, J. J., YANG, D. L. (2007): Using a hybrid multi-criteria decision aid method for information systems outsourcing. Computers and Operation Research, 34: 3691–3700.

WORM, K. (1997): Coastal zone planning in Denmark. Ocean & Coastal Management, 37(2): 253–268.

YOON, Y., UYSAL, M. (2005): An examination of the effects of motivation and satisfaction on destination loyalty: a structural model. Tourism Management, 26(1): 45–56.

ZAJADACZ, A., ŚMIAŁEK, J. 2009): Ocena potencjału turystycznego. In: Młynarczyk, Z., Zajadacz, A. [eds.]: Tourist development: determinants and plans. Volume 3 – The tourist values and attractions. Touristic potential. Plans of the development of tourism (pp. 35–61). Poznań, Adam Mickiewicz University Press.

ZHOU, Y., MAUMBE, K., DENG, J., SELIN, S. W. (2015): Resource-based destination competitiveness evaluation using a hybrid analytic hierarchy process (AHP): The case study of West Virginia. Tourism Management Perspectives, 15: 72–80.

ZIOŁKOWSKI, R. (2006): Praktyczne aspekty rozwoju turystyki i rekreacji na obszarach przyrodniczo cennych. Białystok, Wydawnictwo Politechniki Białostockiej.

ŻEMŁA, M. (2014): Autentyczność obiektywistyczna wybranych typów atrakcji w oczach turysty w kształtowaniu doświadczenia turystów. Zeszyty Naukowe Uniwersytetu Szczecińskiego, 1(25): 385–404.

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MORAVIAN GEOGRAPHICAL REPORTS

Aims and scope

Moravian Geographical Reports [MGR] is an international, fully peer-reviewed journal, which has been published in English continuously since 1993 by the The Czech Academy of Sciences, Institute of Geonics through its Department of Environmental Geography. The journal followed the traditions of the Reports of the Institute of Geography of the Czechoslovak Academy of Sciences, which was published from 1963 to 1992.

The MGR journal has been indexed in the SCOPUS database since 1993. In 2012, MGR was selected for coverage in the WEB OF SCIENCE (Thomson Reuters/Clarivate Analytics) products and customs information services. Beginning with Volume 19 (2011), this publication is being indexed and abstracted in the Social Science Citation Index ®, Current Contents Connect ®, Journal Citation Reports / Social Science Edition ®.

As a general purpose journal, it receives and evaluates articles contributed by both Human and Physical Geographers, as well as by other researchers who specialize in related disciplines, including the geosciences and geo-ecology, and the human sciences (sociology, urban studies, etc.). The journal has a distinct regional orientation, broadly for countries in Europe. The title of the journal celebrates its origins in the historic lands of Moravia in the eastern half of the Czech Republic.

The Moravian Geographical Reports aims at presenting original and relevant research on topics responding to the role of 'regions' and 'localities' in a globalized society, given the geographic and temporal scales at which they are evaluated.

Several inter-related questions are stressed:

- the problems of regional economies and societies, especially over time;
- societies and societal change in urban or rural contexts;
- regional perspectives on the influence of human activities on landscapes and environments;
- the relationships between localities and macro-economic structures in rapidly changing socio-political and environmental conditions;
- environmental impacts of technical processes on bio-physical landscapes; and
- physical-geographic processes in landscape evolution, including the evaluation of hazards such as floods, landslides, etc.

Theoretical questions in the broad discipline of Geography are also addressed, especially the relations between Physical and Human Geography in their regional and temporal dimensions.

Types of papers

The journal, Moravian Geographical Reports, publishes the following types of papers:

(1) Original scientific paper: the backbone of individual journal issues. These contributions from geography and regionally-oriented results of empirical research in various disciplines, normally have theoretical and methodological sections and must be anchored in the international literature. We recommend following the classical structure of a research paper: introduction, including objectives; theoretical and methodological bases for the work; empirical elaboration of the project; evaluation of results and discussion; conclusions and references. With the exception of purely theoretical papers, each contribution should contain colour graphic enclosures such as maps, charts, diagrams, photographs, etc. Some of the photographs may be placed on the second, third or fourth cover pages of the journal. For papers on regional issues, a simple map indicating the geographical location of the study region should be provided. Any grant(s) received to support the research work should be acknowledged. Major scientific papers include an Abstract (up to 200 words) and 3 to 6 keywords. The length of the text should be in the range of 6,000 – 8,000 words (the word count does not include the abstract, tables, figures, and references), plus a maximum of 3 pages of enclosures (tables, figures). The number of graphic enclosures can be increased by one page provided the text is shortened by 500 words below the maximum allowable length (per graphic page). All scientific papers are subject to the peer-review process by at least two independent reviewers appointed by the Editorial Board.

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