VISUAL EXPOSURE OF MONUMENTS ON CYCLE ROUTES IN THE NITRA SELF-GOVERNING REGION

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Abstract
The promotion of cycling transportation (CT) and cycling tourism is pivotal for societal advancement, owing to their progressive, eco-friendly, and health-promoting attributes. This study delineates the multifaceted benefits of CT and cycling tourism, encompassing economic, ecological, health, and social dimensions. Emphasizing the importance of robust cycling infrastructure, the research aims to bolster cycling tourism, particularly in rural areas, through the establishment of functional cycling routes. Focusing on the Nitra Self-Governing Region, this work evaluates the proximity of historical landmarks to cycling routes, envisioning their integration into cultural, educational, and sightseeing excursions. Through comprehensive analysis, including the identification and characterization of historical sites and the delineation of buffer zones along cycling routes, the study reveals the potential for enriching cycling tourism experiences. The findings provide valuable insights into the spatial distribution of historical attractions, facilitating informed decision-making for the sustainable development of cycling tourism in the region.

Keywords: viewshed, monuments, tourism, cycle paths

Introduction

As Slovakia (SK) has experienced notable advancements in living standards in recent decades, there has been a corresponding rise in individual motorization, overshadowing alternative modes of transportation. This shift has been accompanied by a decline in physical activity, including pedestrian and cycling endeavours. Recognizing the detrimental effects of this trend, developed countries have increasingly advocated for eco-friendly transportation alternatives, particularly cycling, as a means to mitigate environmental impact and promote public health (www.nsrv.sk/index.php?pl=18&article=615, 2024). The development of cycling and cycle tourism is highly desirable for society. Transport by bicycle not only has no negative impact on the environment but also contributes to improving the health of the population (www.cyklotrasytsk.sk/buxus/docs/cyklostrategia_v2.pdf, 2024). Cycling is a non-motorized mode of transportation powered by human effort and utilizing bicycle infrastructure. Cycle tourism is a form of tourism where bicycles are used for transportation. A cycling route is a path suitable for use by cyclists. It can be located on all categories of roads. The term "cycle route" is a general term for all types of routes built or designated for cyclists (www.dedinka.sk/evt_file.php?file=5586, 2024). International and national experiences successfully demonstrate that areas that decide to promote cycling have experienced a significant increase in tourists (Pavione, E., et al., 2018).
In the conditions of SK, cultural heritage can represent one of the key developmental factors. Natural and cultural heritage constitutes the primary offering of cultural tourism and is a source of attractiveness for specific locations. In the conditions of SK, a negative effect is more likely due to insufficient, disproportionately distributed, or improperly set cultural tourism offerings (Dubská, M., 2010).
The aim of the article is to evaluate the distance and accessibility of historical objects and monuments from cycling routes in the Nitra Self-Governing Region (NSK).

Area of interest

Cycling tourism is becoming increasingly popular and beloved in Slovakia (SK) (www.slovakia.travel/co-vidiet-a-robit/sport-a-aktivny-oddych/cykloturistika, 2024). Every region in SK offers countless cycling routes of various difficulty levels. The Nitra Self-Governing Region (NSK) is a place rich in history, culture, and natural attractions. Its cultural-historical foundations date back to the times of early settlement, the first state entity, the Principality of Nitra, Great Moravia, the Middle Ages, and into modern times (Kompasová, K., 2023). The strategic vision for the development of cultural tourism in NSK is founded on the region´s inherent strengths and potential. This position it to emerge as a nationwide centre for cultural tourism with a special emphasis on cultural exploration and utilization of cycling (Kramáreková, et al., 2006). NSK covers an area of 6343.7 km2, accounting for

12.9% of the territory of SK. It is in the southwest part of SK, bordered by the Hungarian Republic to the south, Banská Bystrica Region to the east, Trenčín Region to the north, and Trnava Region to the west. NSK is divided into 7 districts: Komárno, Levice, Nitra, Nové Zámky, Šaľa, Topoľčany, and Zlaté Moravce (https://slovak.statistics.sk/wps/portal/, 2024). In NSK, there are cycling routes in lengths of 1669.85 km. The routes include red trails covering 454.3 km, blue trails covering 581.6 km, green trails covering 395 km, and yellow trails covering 238.95 km (Tab. 1). In terms of the length of cycling routes, NSK ranks 6th in SK, following Banská Bystrica (3623.27 km), Žilina (3080,74 km), Prešov (2815.5 km), Košice (1803.2 km), and Trenčín (1759.2 km) Regions.

Tab. 1: Extract from the National Register of Cycling Routes

Self-Governing Region	Color of the cycling routes				Total
	Red	Blue	Green	Yellow	
Bratislava	314.4	421.1	216.3	243.3	1195.1
Trnava	384.8	356.5	313.5	257.2	1312
Trenčín	481.7	598.1	413.5	265.9	1759.2
Nitra	454.3	581.6	395	238.95	1669.85
Žilina	781	1028.5	885.708	385.532	3080.74
Banská Bystrica	743.8	1008.6	1194.55	676.32	3623.27
Prešov	711.9	645.4	935.25	522.95	2815.5
Košice	516.8	572	485.3	229.1	1803.2
Total	4388.7	5211.8	4839.108	2819.252	17258.86

Source:https://www.cykloklub.sk/vypis-z-narodneho-registra-cykloturistickych-tras/, 2024

Methods

The research methodology consisted of creating cycling routes from current geodata on cycling routes in the area, extracting these routes, and then making all monuments using vector layers (Tab. 3) using the QGIS from a web source (https://geoportal.gov.sk/gallery/datasets?q=pamiatky) on the raster layer of the digital terrain model from a web source (http://www.geoportal.sk/sk/zbgis/udaje-zbgis/aktualizacia-dmr-3-5.html).

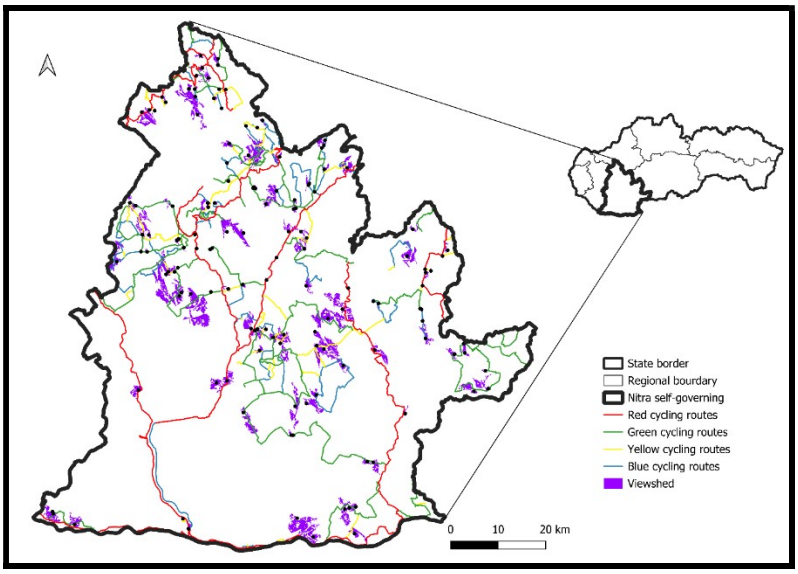
In each territory, there are areas that are highly visually exposed and, conversely, those that are hidden from the visitors' view. The most exposed places are concentrated around roads, viewpoints, hiking trails, and cycling routes (Kubinský, D., 2024). Petluš et al. 2018 use GIS software to determine the visual exposure of the area. The software offers the Visibility or Viewshed function, which can identify cells in the input raster visible from one or more observation points. By using the analytical function Visibility in GRASS GIS and with the support of programming capabilities, a tool was created. The tool, developed for creating a map of potential visual exposure with a spatial resolution of 50 m, a raster cell size of 50x50 m, observer height of 1.75 m, and a visibility limit of 50 km. The authors' methods were modified and adapted to the NSK territory focusing on the exposure of monuments to cycling routes. The observer height was standardized to 1.75 m, and the visibility was set to 2.5 km. We utilized the OpenRouteService (ORS) plugin. ORS provides access to openrouteservice.org functions based on OpenStreetMap. This toolset encompasses mapping functions with extensive attributes such as duration, length, start and end locations, configurable for output files (www.plugins.qgis.org/plugins/ORStools/#plugin-about, 2024). Taking into account bicycle accessibility, the toolset calculates the nearest routes available. Routes within a range of 5, 10, 15, 20, 25 minutes and distances of 1, 5, 10, 15 km from the cycling route were considered. We also identified cadastral territories of municipalities where the construction of cycling routes could be beneficial for complete connectivity of cycling routes within a 25-minute distance.

The methodology of creating cycling routes consists of several phases. The first phase is reconnaissance of the cycling route, the second phase is pre-negotiation. This involves consultation and subsequent approval of the proposal with relevant entities. The next step is register the route and its integration into the nationwide cycling network (Žebenský, M., 2010). Cycling routes are marked in the field according to the technical standard STN 01 8028. Routes are divided by color, type, purpose, difficulty, or surface. Red denotes EuroVelo routes and long-distance routes. Blue indicates parallel routes to EuroVelo routes, longer or more challenging regional cycling routes. It represents moderately challenging routes. Yellow signifies easy cycling routes and connections between routes (www.cykloportal.sk/legenda, 2024), short detours to various natural, historical, cultural, and technical points of interest (www.visitnitra.eu/wp-content/uploads/2021/01/Strategia-rozvoja-cyklotras-v-NSK-na-roky-2021-2027.pdf, 2024).

The next step is the processing of simplified documentation. The documents consist of a map and a textual part. The subsequent step is the legalization of the cycling route (territorial decision). The final step is recording cycling routes into maps (Žebenský, M., 2010).

Results

In map number 1, we can observe the potential exposure of objects relative to cycling routes within a visibility range of 2.5 km. There are a total of 198 visible objects from the cycling routes, with a standardized observer height of 1.75 m, covering a total length of 1669.85 km, which matches the total length of cycling routes in NSK.



Map number 1: Exposure of monuments in NSK relative to cycling routes
Source: https://nr.cykloportal.sk/, 2024; processed using QGIS 3.34.0-Prizren

Within a 5-minute accessibility range, we observe the highest number of monuments on the green route, with 41 and the lowest on the red route, with 24 (Tab. 2). When considering accessibility to all monuments regardless of exposure, we observe the highest number on the yellow route, with 308 and the lowest on the red route, with 128. In terms of distance (km), we observe the highest number of monuments within approximately 1 km on the green route, with 53, and the lowest on the red route, with 26. Within a 15 km distance, regardless of exposure, we observe the highest number of monuments on the green route, with 335, and the lowest on the blue route, with 316.

Tab. 2: Number of objects in buffer zones

Cycling routes	Availability in min					All available	Availability in km				All availability
	5	10	15	20	25	To 25 min	1	5	10	15	To 15 km
Green	41	50	55	58	60	190	53	69	71	71	335
Yellow	34	37	41	42	43	308	32	45	46	46	319
Red	24	26	26	28	29	128	26	33	34	35	324
Blue	32	36	37	38	40	170	35	45	46	46	316

Source: https://nr.cykloportal.sk/, https://plugins.qgis.org/plugins/QuickOSM/, 2024; processed using QGIS 3.34.0-Prizren

Of the total 198 object, the majority, comprising 87 (43.93%), are monuments of religious architecture, historical sites and art. Monuments of fortification architecture and archaeology constitute 58 (29.30%) of the total, while monuments of secular architecture, castles, and historic greenery make up 21 (10.60%). Monuments of folk architecture and technical structures amount to 20 (10.10%). The categories of monument conservation fund represent 6 (3.03%), settlements with historical monuments and technical monuments each account for 3 (1.52%).

Conclusion

One of the characteristic features of the present time is the effort to promote the principles of sustainable development, balancing economic, social, and environmental development (Oremusová, D., et al., 2021). Similarly, the Cycling Route Development Strategy in NSK for the years 2021 – 2027 speaks of connecting cycle routes with historically significant areas. The main goal is to establish a functional, hierarchically organized continuous system of cycling routes, connecting locations with recreational or cultural-historical potential (www.visitnitra.eu/wp-content/uploads/2021/01/Strategia-rozvoja-cyklotras-v-NSK-na-roky-2021-2027.pdf, 2024).

The aim was to analyse the accessibility of historical sites in relation to cycling routes in NSK. The best accessibility of objects in minutes and km was found on the green route. The lowest number of objects is accessible from the red route. The best accessibility from the green and red routes is to landmarks of sacred architecture, history, and fine arts. From the green route, there are 29 such landmarks, and from the red route, there are 15. The yellow route offers the best accessibility to landmarks of fortification architecture and archaeology. From the blue route, the most accessible landmarks are those of secular architecture and castles.

In the comprehensive assessment of object accessibility from cycling routes, we find that object within a 25-minutes and 15-kilometer radius are highly accessible. Out of the total 354 municipalities surveyed, only 41 were found to be inaccessible within these distance. Looking ahead, a potential improvement could involve establishing the proposed cycling route. This route would connect 14 monuments and traverse 23 municipalities. However within the specified distance, accessibility to monuments was found to be lacking in 12 of these municipalities.

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Souhrn

Rozvoj cykloturistiky a cyklistické dopravy je pro společnost velmi žádoucí. Doprava na kole nejenže negativně neovlivňuje životní prostředí, ale také přispívá ke zlepšení zdravotního stavu obyvatel a podporuje kvalitu jejich života. Ve srovnání s ostatními zeměmi v rámci Evropské unie patří Slovensko mezi ty, které nedostatečně reagují na trend intenzivního zavádění této problematiky. CD je velmi citlivá na image země a velmi účinně a efektivně ji podporuje. Přírodní a kulturní dědictví představuje hlavní nabídku CD a je zdrojem atraktivity konkrétních lokalit.

Dostupnost objektů a plánování nových cyklistických tras v blízkosti historických památek může zvýšit atraktivitu a rekreační potenciál daného území. Cílem bylo zjistit dostupnost historických objektů v různých vzdálenostech od cyklostezek v Národním parku Slovenský kras (NSK). Zjistili jsme, že nejlepší dostupnost památek je zelenou cyklostezkou, a to v době 5 minut až 41 objektů, nejhorší dostupnost je na červené trase, kde je pouze 24 objektů.

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