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ISSUES OF PROVIDING TRANSPORT SERVICES TO SPARSELY POPULATED AREAS: A CASE STUDY OF THE TERRITORY OF THE NATIONAL PARK ŠUMAVA IN THE CZECH REPUBLIC

Summary. This paper deals with public transport services in sparsely populated areas. The definition of the term *transport services* and possible approaches to its provision is given in the introduction. The term *sparsely populated area* is subsequently defined. The problems that arise during the organization of transport services in these areas are further defined. These problems lie primarily in the variations in the number of people in the thousands in the area in the off-tourist season and in the summer tourist season. This affects the organization of transport and the organization of transport services. This paper proposes the technological procedure and measures for improving transport services in sparsely populated areas outside and during the summer tourist season. The proposals are applied in a selected sparsely populated area in the territory of the National Park Šumava and the Šumava Protected Landscape Area in the Czech Republic.

1. INTRODUCTION

The term *transport service* means the provision of transport on all days of the week, especially to schools and educational establishments, to work, to public authorities, to health care facilities providing basic health care, and to meet cultural, recreational, and social needs, including transport back. Transport services contribute to the sustainable development of the territory. Providing transport services is the basic task of public transport [1]. It is a prerequisite for regional development and contributes to eliminating the negative effects of private car transport on the environment. This is particularly important in sparsely populated areas, which are often located in protected areas and “unspoiled nature.” Therefore, the organization of public transport is influenced by the European Union and individual countries through legislation and subsidies from the state and municipalities. Interconnection of public transport service and tourism is discussed by [2]; issues of touristically crowded localities by [3] and transport in national parks by [4].

For example, the Ministry of Transport of the Czech Republic issued a certified methodology, namely the “methodology for ensuring the operation and development of public passenger transport systems supporting supraregional integration.” The specificity of the Czech Republic is that the methodology of the Ministry of Transport provides principles and rules for the operation and planning of the development of regional passenger transport and the interconnection of regional systems. The methodology sets out the principles and rules for the operation and planning of public passenger transport systems. Applying these rules will enable conflict-free intermingling of the area’s existing

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regional systems. Local conditions must always be considered when using the methodology, the attractiveness of tourist destinations, and the location of accommodation facilities for tourists [5]. In addition to legislation, transport services are supported by the state, regions, and municipalities through the provision of compensation to carriers.

Compensations make carriers economically willing to provide public transport, even in areas of weak transport demand. During the tourist season, many people are in the area, which creates high transport demand. Compensation to carriers is still provided during this period. This is done to make public transport attractive in terms of fares (and possibly free transport) and the number of connections offered as well as to limit the undesirably increased intensity of private car transport. During the tourist season, public transport lines are also run to areas where private car transport is prohibited (e.g., line No. 979 Železná Ruda – Prášily – Modrava – Kvilda).

Individual regions in the Czech Republic must (and do) have their own transport service plans. These plans address the concept of transport services in the region's territory by rail transport, public line transport, and the necessary transport infrastructure. The National Plan addresses passenger train services. Regional plans focus on bus services and interchanges. None of the plans specifically mention transport services to sparsely populated areas. A sparsely populated area is an area with a low population density (rural areas are settlements with a population density of fewer than 150 inhabitants/km² [6]). These are usually small municipalities in the periphery of a region, agricultural areas, and border areas. This is a problem because these areas have very limited public transport provision. In the Czech Republic, population density (density per km²) is lowest in the South Bohemia Region, at 63.3 people/km².

This paper presents the situation of passenger transport in a part of the Šumava National Park and Protected Landscape Area Šumava in the Czech Republic. This area is in the South Bohemia Region in the Prachatice district, which has a population density of 36.5 people/km², and in the Český Krumlov district, which has a population density of 37.2 people/km² [7]. It is an area with mountainous terrain and mostly contains small villages. The county town is approximately 70 km away, and the district town is approximately 40 km away. The study area is shown in Fig. 1.

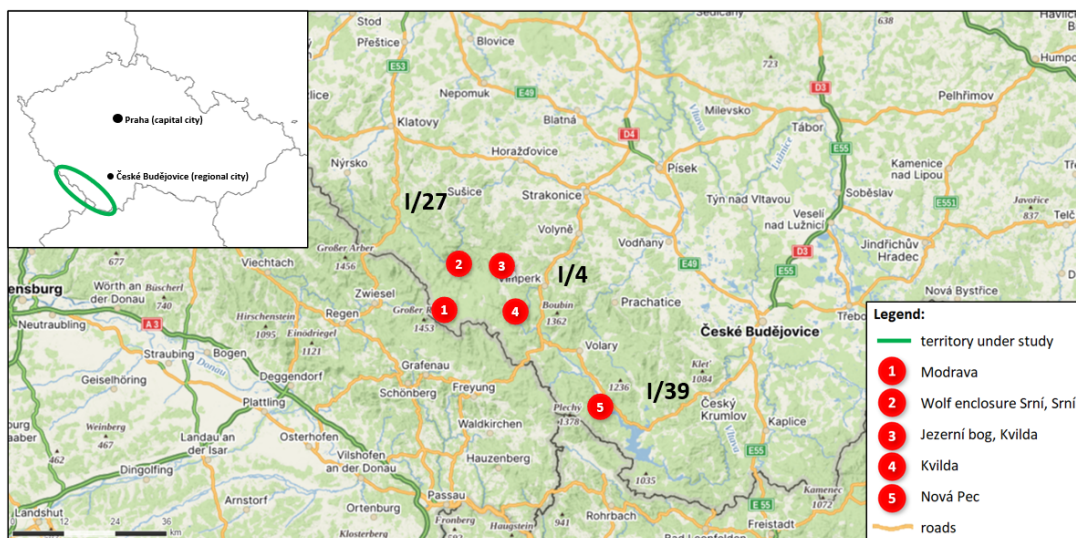


Fig. 1. Map of the study area (Source: server mapy.cz, 2024, edited by authors)

2. ISSUES OF PASSENGER TRANSPORT IN SPARSELY POPULATED AREAS AND APPROACHES TO SOLVING THEM

There is growing research interest in innovation, sustainable transport, and sustainable mobility [8-10]. However, most studies focus on urban areas (e.g., intelligent transport systems used in cities) [11].

Transport policy is mainly adapted to urban and developed areas [12]. Remote and rural areas receive much less attention [13-16]. An alternative transport solution using carsharing is addressed in a paper [17]. Although carsharing has proven to be a successful alternative to private cars in large cities, the different nature of areas with lower population densities must be considered. Research that has only marginally addressed this topic has pointed out that carsharing in lower-density areas is likely to face more significant challenges than in large cities, mainly because the lower demand makes a profit-oriented carsharing offer impossible.

Authors Klementschtz and Roider [18] argued for the importance of marketing as a support for the use of public transport in rural areas. The aim is to provide information and motivate the population to use public transport in the region. They argued that marketing tools and minor adjustments in transport services planning can help change residents' perceptions of public transport, even in rural areas. For example, there is a scientific contribution to transport and mobility issues in the Baltic Sea region [19].

Authors from the Czech Republic and abroad have dealt with transport services in areas with different population densities. For example, [20] pointed to differences in transport services in different parts of the Czech Republic and compared the availability of transport services with private cars in individual households. The authors also described the so-called vicious circle of public transport and stated that the profitability of connections decreases with population decline. A correlation (correlation coefficient) established the relationship between transport services and regional population density.

In sparsely populated areas, residents face several major obstacles to fulfilling livelihood opportunities [21]. Sparsely populated areas face many challenges, including limited education and career development, lower wages, a high cost of living, a lack of full-time employment opportunities, and the seasonality of some jobs such as tourism and agricultural-sector jobs (OECD 2021). These socioeconomic factors are often influenced by the availability of transport services [22]. Geographical isolation, a lack of public transport lines and connections, and poor transport infrastructure are the main problems of transport accessibility in sparsely populated areas. [6,20-21]. Peripheral (predominantly rural) areas are characterized by specific features affecting transport needs. These specific features include low population density, unfavorable demographic structure (as young people leave because of the difficulty of accessing educational centers and workplaces [23-24]), distance from urban centers, and an underdeveloped public transport network (or the absence of public transport) [25].

In sparsely populated areas, low transport accessibility appears to be a major problem. The term *accessibility* has several definitions. *Accessibility* can be defined as proximity or facilities for spatial interaction. In a transport context, *accessibility* can be defined as the facilities or opportunities by which basic services can be reached from a given location using a particular transport system [26].

Transport infrastructure is another problem for public transport in sparsely populated areas. It is mainly related to the poor technical condition of roads. Bus and rail stops are also problematic because of:

- their inappropriate location on the road and rail network,
- long walking distances,
- difficult access due to the rugged terrain in mountainous areas,
- accessibility and safe access to bus stops,
- the technical condition and appearance of stops,
- the amenities of the stops.

Many sparsely populated areas have limited or no connections to public transport and, thus, their populations predominantly use private cars for transportation. The lack of accessibility and connectivity in remote areas strongly affects people with limited access to private car transport, such as children, the elderly, people with disabilities, and people with reduced mobility [27]. Most people in rural areas face high transport costs and complex (and often seasonal) transport links (OECD, 2021).

Some areas with a low population density have specific features (e.g., locations in a protected area, high tourist attractiveness, and significant demand for transport during the summer holidays, usually from mid-June to mid-September). These topics are addressed in the publications *Rural Tourism* [28], *Tourism of Czech Republic* [29], and *Strategic Planning of Tourism Development* [30]. Planning public passenger transport is challenging in areas with variable demand for transport services, with peaks in the tourist seasons and low demand in the rest of the year, where the region's residents mainly use

transport services. A sparsely populated area requires specific transport services solutions (e.g., on-demand or at least demand-calculated services) to avoid the high costs of providing services to few or no passengers. Such a problem is mainly addressed in areas with low population density, where the concept of mobility as a service tailored to the needs of residents improves accessibility to and the liveability of the area [31].

Considering the characteristics of sparsely populated areas (e.g., the location of important tourist destinations), traffic problems can be divided into issues outside the tourist season and problems during the summer season. During the tourist season, there is an increase in car traffic and high occupancy rates; outside the tourist season, there are low occupancy rates and a reduction in the range of services. Examples of these problems are given in Sections 2.1 and 2.2.

2.1. Examples of Problems Outside the Tourist Season

Private car transport is the basic transport system by which public transport cannot provide sufficient quality standards. This is particularly the case for regular bus services in sparsely populated areas. Inadequate transport services impact disadvantaged groups, children, the elderly, and persons with reduced mobility, who do not usually own a car and are dependent on public transport [32]. The concept of timetables, the differences in transport time and speed, and the extensive use of private car transport are the main public transport problems in sparsely populated areas.

The timetable structure in peripheral areas is a reason for not using public transport. The first connection starts and the last connection ends in cities or large villages, and connections are not made in the periphery. An example of rail transport is the timetable of line No. 194 České Budějovice – Černý Kříž. The last connection from České Budějovice (departure at 20:11) goes only to Český Krumlov (arrival at 20:57), and the area towards the state border (65 km away from Český Krumlov) is not accessible by passenger rail transport after 18:00 [33]. An example of public line transport is the line Český Krumlov – Nová Pec. The last connection ends at Horní Planá at 20:32. The remaining part of the route (9 km) must be covered on foot or by private car transport [34].

Differences in transport times and journey speeds are problematic. The peripheries are generally served by regional passenger trains with low journey speeds (approximately 38 km/h according to the train schedule in the Czech Republic 2022/2023). The main lines and corridors are served by express trains (according to the Czech Republic 2022/2023 train schedule with a travel speed of about 2.5 times higher, approximately 96 km/h). It follows that a shorter distance traveled by a passenger train takes the same or longer than the same or longer distance traveled by an express train. An example is the route from Nové Údolí (state border with Germany) via České Budějovice (regional city of the South Bohemian Region) to Prague (capital city of the Czech Republic). The journey time by train from Nové Údolí to České Budějovice (96 km) is 2 hours 29 minutes. The journey time by train from České Budějovice to Prague (164 km) is 1 hour 42 minutes. The comparison of distance, transport times, and journey speeds in individual sections by rail and car is in the graph in Fig. 2.

The entire route from Nové Údolí to Prague by car is 237 km, and the transport time is 3 hours 15 minutes [35]. The resulting journey speed, calculated as the ratio of the distance and the transport time, is 75 km/h. This may be one of the reasons why passengers choose private car transport instead of public transport.

Even a routine journey to work for a shift or shopping can be problematic in peripheral areas. For example, a comparison can be made between the travel time by public transport and private car transport when traveling to a health facility or shopping from a small village in a peripheral area to a district city 37 km away [35]. According to the timetable [36], the time of transport by bus is one hour. The transport time by car is 40 minutes [35]. After considering the transport time, the time needed to deal with the matter in the city, and the waiting time for the return journey, the total time for using the bus is 5 hours 20 minutes. If a car is used, the time required is 3 hours 20 minutes. The difference is two hours in favor of private car transport. Commuting to work from the periphery to the city presents a similar case. In particular, waiting for return public transport connections increases the time needed to complete the journey.

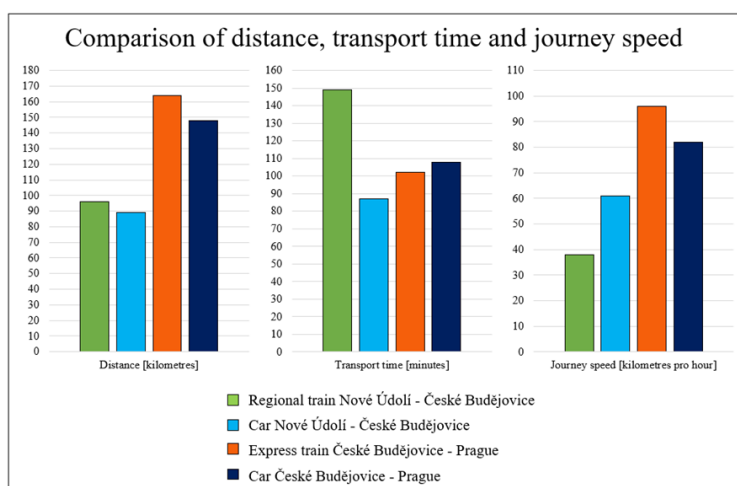


Fig. 2. Comparison of distance, transport time, and journey speed (Source: authors)

The poor accessibility of public transport and the lack of interconnectedness of transport lines ultimately contribute to the outflow of population from peripheral areas to larger agglomerations and significantly negatively impact the demographic development in these areas. This is evident from the Statistical Yearbook of the Czech Republic, which shows a trend of decline in the number of inhabitants in villages in this area. [32]

2.2. Examples of Problems During the Summer Tourist Season

A specific approach is required to address transport services in so-called sensitive areas. The authors define *sensitive areas* as those with a lower population density and a high ecological value; they also act as core areas in terms of the ecological stability of the territory. At the same time, these areas are very attractive to tourists, meaning they sometimes generate high traffic volumes, especially for private car traffic. This is a threat to the ecological and landscape value of these areas. This is particularly the case for specially protected areas such as national parks, segments of zones 1 and 2 of protected areas, as well as national nature reserves. The aim is to find alternative solutions for recreational transport in ecologically sensitive areas [32].

The increase in demand for transport during the summer tourist season (mid-June to mid-September) is faced, for example, in the Šumava National Park and Protected Landscape Area Šumava in the Czech Republic. The tourist attractiveness of the region lies mainly in its valuable landscape potential, which is affected little by civilization. The area also has a rich offer of cultural and historical attractions. The possibility of water areas and streams suitable for recreation and water sports is also significant. Among the most visited places are Kvilda, the Srní Wolf Enclosure, Modrava, Jezerní Bog, and Nová Pec. Table 1 shows the five most visited places in Šumava and the number of visitors from mid-June to mid-September 2022 compared to the permanent population of the municipalities concerned. These locations are also shown in Fig. 1.

Table 1
The most visited tourist areas in Šumava (Source: The Czech Statistical Office, 2023)

Placing	Name of tourist destination	Number of inhabitants	Number of visitors from June–September 2022
1	Modrava	78	57 120
2	Wolf Enclosure Srní, Srní	217	52 430
3	Jezerní Bog, Kvilda	125	30 527
4	Kvilda	125	29 016
5	Nová Pec	436	26 115

Table 1 shows a high increase in the number of tourists in the area during the summer tourist season. Public transport in the region is not sufficiently prepared for the increased seasonal demand. Therefore, visitors mainly use private car transport. As a result, there is a shortage of parking spaces. The negative impacts of private car traffic (especially emissions and noise) have a major impact on residents' fauna, flora, and lives.

Tourism management is a measure that can and should be applied during the tourist season, not to concentrate only on the main tourist destinations but to offer other lesser-known yet interesting tourist destinations to potential visitors. This is one of the main challenges for developing remote areas and can help ensure sustainable mobility. Sustainable mobility requires changes to the entire mobility management system [37]. The aim of the proposal is to relieve tourist congestion and bring tourists and associated services and jobs to other parts of the region.

3. METHODOLOGY FOR SOLVING TRANSPORT SERVICES IN SPARSELY POPULATED AREAS

When proposing solutions for transport services in sparsely populated areas, it is necessary to consider several factors that affect the area. These include:

- the location of the area and the distribution of major settlements,
- the location of important institutions (schools, major businesses, health centers, government institutions, etc.)
- the composition and age of the population,
- the location of railway stops and stations,
- the location of bus stations and bus stops,
- the technical condition of roads and railways,
- the management of public transport lines,
- the management of railway lines,
- the location and attractiveness of tourist destinations.

When planning transport services in sparsely populated areas, it is very important to know the local conditions and circumstances (e.g., the most important employers, the habits of the local population, and the state of transport and its problems during the tourist season and beyond). The following methodology is proposed in this paper to address transport services in sparsely populated areas:

- (1) defining the geographical location of the area under consideration,
- (2) identifying the structure of the area, the location of important settlements and institutions such as schools, businesses, health care facilities, shops, large recreational centers, tourist destinations, and their attendance during the tourist season,
- (3) collecting demographic data, for example, using data from the Czech Statistical Office,
- (4) analyzing and collecting data on the accessibility of the territory by rail and public transport using timetables and transport surveys,
- (5) analyzing and collecting data on the accessibility of the territory by private car transport using traffic surveys or data from parking meters,
- (6) examining the peripheral conditions affecting transport services (e.g., off-season tourist destinations, ski resorts, and accommodation facilities)
- (7) evaluating and drawing conclusions from the analysis based on the collected data,
- (8) identifying priorities to be addressed, including tourism management,
- (9) preparing proposals for the modification of transport services in the defined area,
- (10) applying the proposals and pilot project,
- (11) making adjustments according to the results of the pilot project,
- (12) implementing the proposals.

Points 1 to 6 refer to the analytical part, which is one of the key parts for the subsequent proposal of transport services in the selected area. A priori and posterior demand data collection methods can be applied to determine transport demand. Household and business surveys can determine a priori demand regardless of the range of services offered. For example, the number of inhabitants and household

structure, the number of cars in the household, the number of employees of the enterprise, and the beginning and end of working hours can be examined. A posteriori demand (i.e., the demand linked to a specific service) can be determined by surveys on board vehicles, at bus stops, or from the number of tickets sold. The difficulty in determining the a posteriori demand lies in including passengers who are unsatisfied with the service offered but use it because they have no other transport option (e.g., children who use it to get to school). This phenomenon is common in sparsely populated areas.

In assessing transport accessibility under point 3, which relates to public transport, it is necessary to ascertain:

- the number and management of lines,
- the number of connections,
- the continuity of public transport connections at interchanges,
- the number and locations of stops,
- the locations of stops in relation to the location of schools, businesses, health facilities, etc.,
- amenities and accessibility of stops.

In the assessment under point 4, which concerns the accessibility of the area by private car transport, it is necessary to find out data on:

- the road network,
- the technical condition of roads and winter maintenance,
- restrictions to and prohibitions of access (e.g., because a location is in a strictly protected area),
- the number of parking areas and parking spaces,
- the method of charging for parking spaces.

Marginal conditions affecting the transport services of the selected area need further consideration. These include the locations of major tourist destinations, the routing of walking and cycling routes, and the locations of major accommodation facilities. Based on the collected data and after setting priorities for solutions, it is possible to propose changes in the organization of transport services in the selected area.

When setting priorities for solutions and proposing changes in transport services, it is necessary to consider the investment and operating costs and the duration of the proposal's implementation. According to the time requirements, the proposals can be divided into:

- (1) short time (e.g., changing the route or time position of a connection),
- (2) medium time (e.g., change of line routing),
- (3) long time (e.g., construction of infrastructure).

The sources of funding for the proposed measures need further consideration. Funding could be received from:

- European Union funds,
- Euroregion funds,
- the state budget,
- the regional budget,
- city budget or the budgets of individual towns and municipalities,
- investment by a private investor,
- a combination of the previous methods.

It is also necessary to evaluate the expected benefits of the chosen solution in terms of regional development, sustainable mobility, and the elimination of negative environmental impacts from transport.

Graph theory can be used to propose changes in the organization of transport services. A graph represents the transport network. The vertices of the graph represent individual stops. The edges of the graph represent road sections. Using Kruskal's algorithm, a minimum skeleton graph defines the line route to connect all considered municipalities. The backbone route is then determined according to the knowledge of the demand and the main traffic flows. Other municipalities lying outside this route are served only by on-call connections. In the event of low demand for transport on a given line, the entire connection may be on call. The advantage is the saving of kilometers, the saving of operating costs (especially fuel and vehicle wear and tear), and the mitigation of negative environmental impacts.

Potential disadvantages of this system are the ignorance of passengers (mainly tourists and foreigners but also locals, such as elderly residents and children) and the need for high driver reliability.

Introducing tourist bus lines is another suitable solution, especially during the tourist season. The use of environmentally friendly vehicles (e.g., electric buses) should be preferred on selected routes serving the main tourist destinations in the area. In the summer tourist season, there are usually cyclo buses. In both cases, the authors recommend setting a clear and simple fare tariff and benefits for using public transport. For example, a ticket to a local tourist destination could also serve as a ticket to a selected public transport connection. Tourists would find it useful to be able to purchase such tickets online in advance and submit them electronically using QR codes.

4. EXAMPLE OF A TRANSPORT SERVICES SOLUTION IN THE SELECTED AREA

The area selected for the application of the proposed transport service solution is located in the Šumava National Park and Protected Landscape Area Šumava in the Czech Republic. It is a peripheral area in the southeastern part of Šumava. The defined area lies between the towns of Volary and Český Krumlov. These two towns have important institutions such as schools, companies, healthcare facilities, and shops. There are large recreation centers and important tourist destinations near the Lipno Dam. The defined area, including the main tourist destinations, is depicted in Fig. 3.

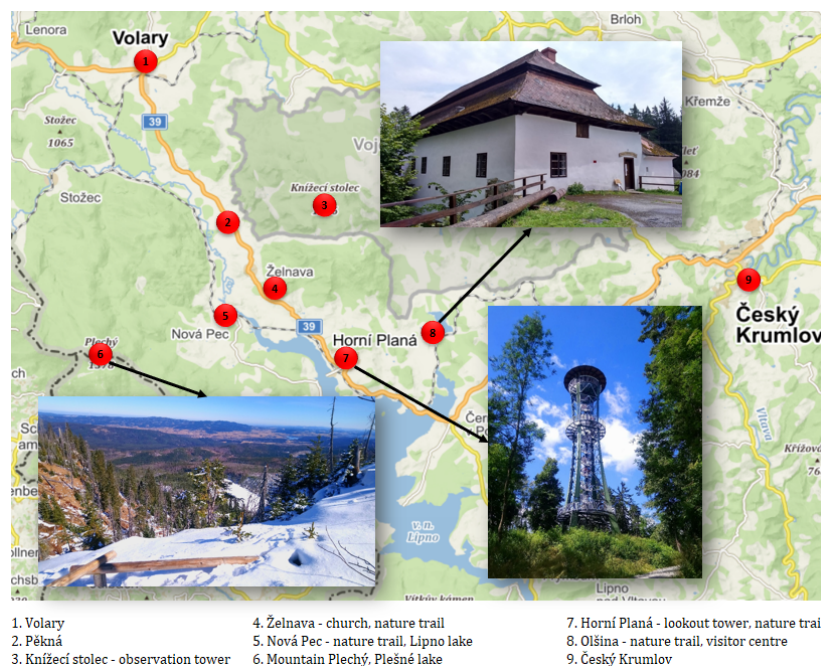


Fig. 3. The defined area, including the main tourist destinations (Source: server mapy.cz, 2023, photo: authors)

The most visited tourist destinations include the village of Nová Pec, the top of Mount Plechý and Plešné Lake, the town of Horní Planá, and the Olšina Nature Trail. The numbers of visitors to selected tourist destinations in 2022 are listed in Table 2.

Table 2 shows the high attractiveness of tourist destinations in the vicinity of Nová Pec, Horní Planá, and Olšina. During the year, most visits occur during July and August. During the week, the most common days on which visits occur are Saturdays, Sundays, and public holidays. The proportion of visits increases from 8:00 onwards. From 20:00, the area of Šumava is hardly used for tourist transport [38]. From a demographic point of view, Šumava is characterized by a low average population density (about 20 inhabitants/km²). More inhabitants live in small settlements. Settlements with up to 10 or 20 permanent inhabitants are common (19% of the population lives in villages with up to 100 inhabitants).

Table 2

Numbers of visitors to selected tourist destinations
(Source: Czech Statistical Office 2023)

Tourist destination	Number of visitors per year
Nová Pec	58 350
Horní Planá	36 200
Olšina	26 064
Plešné Lake	25 000

The area is served by rail and bus transport. Three regional railway lines run through the southeastern part of Šumava. These are line No. 194 České Budějovice – Černý Kříž, line No. 197 Čičenice – Nové Údolí, and line No. 198 Strakonice – Volary. Train connections on these lines run at two-hour intervals [33]. Public line transport is also operated in the defined area. There are three lines with a small number of connections (usually only three pairs of connections per working day outside the tourist season) [34].

Road transport is the most significant type of transport in the Šumava region (Fig. 1). Thanks to road transport, settlements are connected to roads of regional and international importance. Important class I roads that pass through the area are:

- I/39 from České Budějovice via Český Krumlov, Černá v Pošumaví, Volary to Nová Houžná,
- I/4 from Prague via Strakonice, Vimperk, Strážný to the state border with Germany,
- I/27 from Plzeň via Klatovy, Železná Ruda to Germany.

The road network also consists of Class II and III roads, local roads, publicly accessible special-purpose roads, and publicly inaccessible special-purpose roads. Examples of publicly inaccessible special-purpose roads are those in the Šumava National Park in the Czech Republic. These special-purpose roads are mainly used to operate vehicles and mechanization equipment for forestry work. Alternatively, they serve as access roads to recreational facilities. The entry of vehicles is possible only with a permit issued by the Šumava National Park Administration.

During the summer tourist season, the traffic volume increases significantly. The reason for this is the high attractiveness of Šumava as a tourist area and the increasing use of private car transport. Outside the main tourist season, the traffic intensity is low.

The analysis of the transport services of the peripheral area in the southeastern part of Šumava was carried out by the co-author of this paper in 2022, and the research of the Šumava National Park [39] shows that the area is not sufficiently served by public transport. For example, residents have to use private car transport for their daily commutes to work. Due to the tourist attractiveness of the area, the demand for transport increases in the summer tourist season. Public transport is not sufficiently prepared for this demand. Therefore, visitors make extensive use of private car transport. The consequence of this is congestion and a lack of parking spaces in tourist-exposed locations. Tourists also park their cars inappropriately or in prohibited places.

This paper proposes two measures to eliminate the identified public transport problems in the selected area. The first measure, on-call connections, will be applied outside the main summer tourist season (from mid-June to mid-September). The second measure, the introduction of tourist bus lines, will be applied during the main summer tourist season (mid-June to mid-September).

4.1. Measures Outside the Summer Tourist Season

The proposal to introduce a bus line with on-call connections is applied on one of the main routes connecting the town of Český Krumlov with the sparsely populated area around the Lipno dam. This line is used by residents (e.g., from Nová Pec) to commute to work and school in Horní Planá or Český Krumlov. The route of the line is shown in Fig. 4. The blue line shows the route of the line. The red dots represent important villages or towns along the line's route.

As the area is served by rail transport at regular two-hour intervals, bus transport is generally used only in the morning (from 6:00–7:00) and then in the afternoon (16:00–17:00). To save operating costs, it is possible to use on-call connections for part of the route. Therefore, the authors propose the operation of the connections between Český Krumlov and Horní Planá without reservation. This line section connects two larger towns with more significant transport demand. In the following area between Horní Planá and Nová Pec, the demand for transport is minimal or irregular. Therefore, the authors propose operating services in this section only by prior order. This can be done by phone, online, or in person with the driver. The deadline for ordering the connection is at least 30 minutes before the departure of the connection from the departure stop. The 30 minutes allows the connection to leave the departure stop. In the case of early booking, the waiting time is acceptable for the ordering passenger.

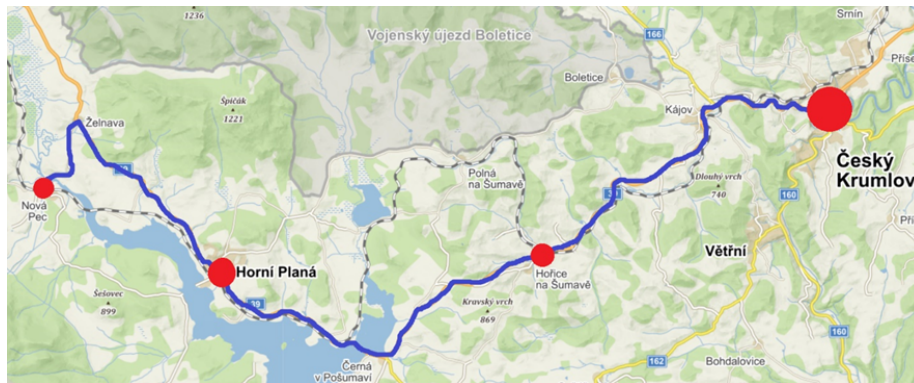


Fig. 4. The route of the bus line Český Krumlov – Nová Pec (Source: server mapy.cz, 2023)

4.2. Measures During the Summer Tourist Season

The selected area is a very attractive tourist location, especially in the summer tourist season (from mid-June to mid-September). Tourists mainly use private car transport, which has several negative impacts. Therefore, the authors propose the introduction of a tourist bus line from Český Krumlov via Horní Planá, Nová Pec, and Pěkná to Volary to connect the main tourist destinations. The route of the bus line and the locations of the stops to be served are shown in Fig. 5.

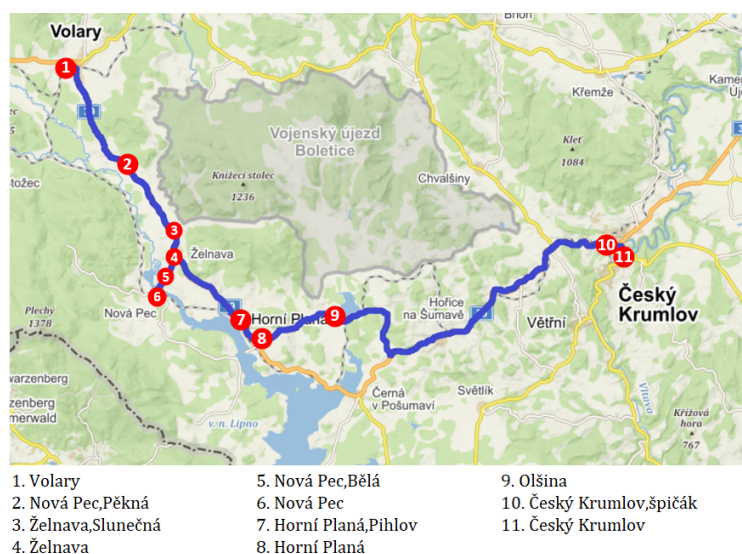


Fig. 5. Route of the proposed tourist bus line and locations of stops – main destinations (Source: server mapy.cz, 2023)

Providing transport services to important tourist destinations in the sparsely populated area of south-eastern Šumava is the main objective of introducing the bus line Český Krumlov – Volary. It will also connect the selected area with the town of Český Krumlov. This connection can be used by visitors staying in accommodations and recreational facilities in Nová Pec, Želnavá, and Horní Planá, for example, for a day trip to Český Krumlov.

The length of the Český Krumlov – Volary line is 59 km. A total of 11 stops are proposed to be served on the line. The departure stop (Volary) is 20 m from the railway station, making it possible to arrange a transfer between railway and bus transport. The individual stops are conveniently located near tourist destinations and accommodation facilities. The final stop is Český Krumlov, a bus station where passengers can transfer to other public transport lines.

Based on the determined journey times between stopping points, dwell times at individual stops, and drivers' work schedules, a timetable for the proposed line was drawn up. When proposing the timing of the connections, the possibilities of changing the railway connections in Volary and the bus connections in Český Krumlov were considered. The opening times of tourist destinations (e.g., visitor center opening times) were also considered. The proposed timetable for the tourist bus line from Český Krumlov to Volary is shown in Fig. 6.

Bus line Český Krumlov - Volary																			
Bus 1		Bus 3		Bus 5		Bus 7		Bus 9		Bus 2		Bus 4		Bus 6		Bus 8		Bus 10	
arrival	departure	arrival	departure	arrival	departure	arrival	departure	arrival	departure	arrival	departure	arrival	departure	arrival	departure	arrival	departure	arrival	departure
	7:30		9:30		12:30		14:30		16:15		10:45		12:45		14:35		16:35		19:30
	7:42		9:42		12:42		14:42		16:27		10:33		12:33		14:23		16:23		19:18
	7:47		9:47		12:47		14:47		16:32		10:28		12:28		14:18		16:18		19:13
	7:49		9:49		12:49		14:49		16:34		10:26		12:26		14:16		16:16		19:11
	7:52		9:52		12:52		14:52		16:37		10:23		12:23		14:13		16:13		19:08
7:54	7:56	9:54	9:56	12:54	12:56	14:54	14:56	16:39	16:41	10:19	10:21	12:19	12:21	14:09	14:11	16:09	16:11	19:04	19:06
	7:58		9:58		12:58		14:58		16:43		10:17		12:17		14:07		16:07		19:02
	8:01		10:01		13:01		15:01		16:46		10:14		12:14		14:04		16:04		18:59
	8:08		10:08		13:08		15:08		16:53		10:07		12:07		13:57		15:57		18:52
8:12	8:14	10:12	10:14	13:12	13:14	15:12	15:14	16:57	16:59	10:01	10:03	12:01	12:03	13:51	13:53	15:51	15:53	18:46	18:48
8:25	8:27	10:25	10:27	13:25		15:25		17:10	17:12	9:48	9:50	11:48	11:50	13:40		15:40		18:33	18:35
8:57	8:58	10:57	10:58					17:42	17:43	9:17	9:18	11:17	11:18					18:02	18:03
	9:00		11:00					17:45	17:45		9:15		11:15						18:00
										Bus stop Volary Nová Pec,Pěkná Želnavá,Slunečná Želnavá Nová Pec,Bělá Nová Pec Nová Pec,Bělá Želnavá Horní Planá,Pihlov Horní Planá Olšina Český Krumlov,Špičák Český Krumlov									

Fig. 6. The proposed timetable for the tourist bus line from Český Krumlov to Volary (Source: authors)

The first connection from Volary departs at 7:30. Connection No. 1 arrives at Olšina at the visitor center, open from 8:30 to 20:25. The arrival of the first connection to Český Krumlov is set for 9:00, when most of the sights in the town open. Connections No. 5 to 8 run only between the stops in Volary and Olšina. The last connection from Český Krumlov to Volary leaves at 18:00. It is proposed to operate from mid-June to mid-September. The timing of the connections and the chosen period of operation of the line correspond to the nature and needs of tourist transport in the defined area.

Tourism management is another measure that can be applied during the summer tourist season. This makes it possible to dilute the frequency of visitors at a certain place and time, thus reducing the devastation of the landscape and the environment. Tourism management seeks to ensure that visitors visit not only the main tourist destinations in the area but also lesser-known destinations. The benefit of this would be a reduction in the concentration of traffic (especially of private cars) in tourist-exposed locations, alleviating the traffic and transport problems. The marketing and promotion of lesser-known tourist destinations is an important part of this, and increasing these destinations' accessibility by public transport would contribute to their development. Destination management organizations are being set up in the Czech Republic. In the case of Šumava, these are Šumavsko and the Šumava Regional Development Agency.

5. DISCUSSION

The issue of transport services in sparsely populated areas has been examined from various perspectives. The provision of transport services by alternative modes of transport (e.g., demand-responsive transport or shared transport), is currently being addressed. However, public transport as such is still of great importance in the transport service in sparsely populated areas [40-43].

The main factors in providing transport services are the area of the territory, the number of inhabitants, socioeconomic factors, and the attractiveness of the territory in terms of tourism. According to research [44], the population was found to be the most important spatial characteristic in predicting the demand for demand-responsive transport services. An increase in population increases the number of potential users, which underlines the principle of the "rural mobility problem" caused by low population size and density [45].

The authors of this paper examined the transport serviceability of sparsely populated areas from the perspective of different numbers of inhabitants in such an area during different times of the year and defined its main problems. Based on the research in a selected sparsely populated area of the Czech Republic, the authors recommend dividing the transport service solution into two areas:

- transport services outside the tourist season,
- transport services during the tourist season.

According to this division, the authors recommend applying the measures proposed in this paper (on-call connections and tourist bus lines). The authors also recommend considering the local conditions in the area (number of people, tourist seasons, number and attractiveness of tourist destinations, etc.). In their future research, the authors will focus in detail on investigating the impact of applied measures on the transport service and development of the sparsely populated area, possibly extending the research to other areas in the Czech Republic and Europe.

6. CONCLUSIONS

The provision of transport services is particularly problematic in sparsely populated areas. These areas can be divided into two groups. The first group comprises areas where population density is low all year round. The second group comprises areas where the population density is low only during part of the year and then increases greatly during the tourist season. In areas with sparse populations, the problem lies in the small number of connections in the public transport timetable, which leads to the low use of public transport and low vehicle occupancy. During the tourist season, there is a substantial increase in the number of inhabitants in the area and, thus, in the demand for transport. This paper outlined the main problems with providing transport services in sparsely populated areas. Subsequently, specific examples of issues in the off-tourist season and during the tourist season were given. Measures and a technological solution procedure were proposed to provide and improve transport services in sparsely populated areas in the off-tourist and tourist seasons. The aim of this paper was to propose a methodology for organizing public passenger transport in sparsely populated areas, where there is usually a lack of funds for improving this kind of transport. The paper suggests ways to change the concepts of and approaches to transport in such areas. The proposal is intended to be used by public administration bodies responsible for public passenger transport. A possible application is presented by the case of the sparsely populated but tourist attraction area of the Šumava National Park in the Czech Republic.

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