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Transportation accessibility as a factor of negative demographic processes: a case study of the Podgorje region (an Adriatic region of Croatia)

Podgorje is in the zone of the overlapping nodal-functional regions of Rijeka and Zadar. Despite its central position in the geographical context of Adriatic Croatia, the Podgorje region is suffering very negative demographic processes and trends because it is an area of poor transportation accessibility.

The aim of this research paper is to analyze the interdependency of transport accessibility of Podgorje and the neighboring leading regional centers, as well as the negative demographic processes and trends that have destabilized this region and converted it into a rural periphery of Adriatic Croatia. The processes of littoralization and industrialization of the coast of Podgorje failed, when they should have created the prerequisites for the development of a functional network of settlements, which would have in turn created and kept necessary functions and retained the population. The absence of these processes has led to the demographic decline of the area.

Key words: depopulation, rural area, transportation accessibility, Podgorje (Velebit)

Podgorje se nalazi u zoni preklapanja nodalno-funkcionalnih regija Rijeke i Zadra. Unatoč središnjem položaju u geografskom kontekstu Jadranske Hrvatske Podgorje trpi vrlo negativne demografske procese i trendove jer je to područje slabe prometne dostupnosti.

Cilj je ovoga istraživačkog rada analizirati međuovisnost prometne dostupnosti Podgorja i susjednih glavnih regionalnih centara te negativne demografske procese i trendove koji su destabilizirali ovu regiju i pretvorili je u ruralnu periferiju Jadranske Hrvatske. Procesi litoralizacije i industrijalizacije obale Podgorja nisu uspjeli stvoriti preduvjete za razvoj funkcionalne mreže naselja, koja bi zauzvrat stvorila i zadržala potrebne funkcije te zadržala stanovništvo. Nepostojanje tih procesa dovelo je do demografskoga pada.

Introduction

Transportation accessibility has a significant impact on demographic conditions. This is particularly pronounced in rural areas which, in principle, have fewer central functions than urban centers. Rural areas, which are more accessible than urban centers in terms of transportation, are clearly in a better position in this regard. This is primarily manifested in the accessibility of central functions that contribute to the improvement of quality of life in rural areas. This, of course, also has positive demographic implications. Without accessibility to certain central functions, the modern way of life is simply unimaginable. The accessibility of healthcare services can be given as an example. The *golden hour* is a well-known term in providing emergency medical services. If emergency medical care is not provided to a person who needs it within an hour after authorities have been contacted, the chance for a positive outcome in the person's treatment is significantly reduced, which in certain situations can even result in the patient's death. This is especially pronounced in elderly people who need healthcare services more often than younger people.

Veljko Rogić (1952) was among the first people who wrote about transportation accessibility in the Podgorje region. He, among others, pointed out that Senj and Podgorje have always been on the outskirts of main transportation routes along the eastern Adriatic coast. D. Husanović-Pejnović (2010) stated that Podgorje is the most pronounced example of a rural periphery, and also the most pronounced example of a developmentally problematic area on the Croatian coast. She also claimed that the unfavorable demographic and economic features of the Podgorje region were determined by its distance from the developed focal points of social and economic development, and by the functional and demographic underdevelopment of its few central settlements. Peripheral areas are marked by the processes of late modernization which additionally intensify negative demographic processes (Štambuk, 1998). The general perception of periphery is associated with the demographic recession of an area intensified by migration due to urbanization, i.e. deruralization related to these processes (De Souza, 2017).

Podgorje is a coastal region in the northern Adriatic (the northern Croatian Littoral), located between the foot of Velebit Mountain and the sea (Magaš, 2015). As with most other Croatian regions, its borders, especially natural-geographic, are not strictly defined, so there are multiple understandings of its territorial composition (Poljanec-Borić et al., 2017). Podgorje can also be understood as a vernacular region, with borders that have shifted over the centuries, based on a cognitive mental map and an awareness of regional belonging (Vukosav and Fuerst-Bjeliš, 2015). The complexity of regional allocation arises from a broad and multilateral understanding of a region in the modern science of geography (Agnew, 2013). This paper, therefore, applies an administrative approach to the determination of the territorial extent of the Podgorje region (Fig. 1). This means that the analysis encompasses only those settlements which are a part of the administrative Town of Senj and the municipalities of Karlobag and Starigrad. Podgorje defined this way by Turk (2006) and Turk et al. (2017). Podgorje, in its aforementioned form, administratively belongs to two Croatian counties: Lička-Senj County (to which the Town of Senj and the Karlobag Municipality belong) and Zadar County (to which the Starigrad Municipality belongs). Podgorje, thus defined, encompasses 24 settlements with a total area of 728 km², which amounts to 1.3% of the mainland territory of Croatia.

Podgorje differs from the rest of Adriatic Croatia because of its natural features, which have unfavorably influenced the population. The most important in this context is the climate, which is strongly influenced by Velebit Mountain, i.e. by the frequent occurrence of the bora wind which is characterized by powerful gusts that can reach/exceed hurricane strength (Rogić, 1957; Šegota and Filipčić, 1996). During strong instances of bora, transportation circulation through Podgorje is more difficult, and it can become completely impossible (especially in winter), which is a strong determinant for the poor transportation accessibility for Podgorje's settlements. Climate features have also negatively influenced economic activities, especially tourism development, which is an unfavorable factor for economic and demographic development. The entirety of Podgorje is a karstic relief area, which also negatively influences the potential for agricultural development

and related activities of the primary and secondary sector. Due to these features, Podgorje is less attractive for investment in comparison to the other parts of the Croatian coast. This has long-term unfavorable implications for natural change and development of the population as a whole (Šimunić, 2017).

Podgorje is primarily a rural area, and Senj is the area's only urban settlement. The Town of Senj, based on population, belongs to the category of small cities¹, and therefore does not have enough central functions to support the entire area of Podgorje. Podgorje's settlements, therefore, strongly gravitate toward larger urban centers which are spatially and temporally (in the Croatian context) quite distant. In addition to the aforementioned problems, another important issue is that Podgorje does not belong to a single unit of the regional self-government, rather it is divided between two administrative units: Lika-Senj County and Zadar County. The bulk of Podgorje is in Lika-Senj County, which is the largest county in Croatia in terms of area (5,353 km², i.e. 9.5 % of the mainland area of the Republic of Croatia), but also has the smallest population (50,927 inhabitants according to the 2011 census, i.e. 44,068 according to the official assessments of the CBS²). The population density of Lika-Senj County (only 9.5 inhabitants per km²) is convincingly the lowest in Croatia and it points to problematic features. Also, Gospić (the administrative seat of the Lika-Senj County) is the smallest county seat in Croatia in terms of population (6,575 inhabitants according to the 2011 census). As a consequence, it has relatively limited centrality due to its limited number of central functions (Lukić, 2012). To make the situation more unfavorable still, in order to go from Podgorje to Gospić by the shortest road, Velebit Mountain must be crossed, which has an elevation of almost 1,000 m a.s.l.³ Transportation over mountainous areas generally prolongs travel time, and in winter conditions, due to the snow and bora wind⁴, transportation can become completely impossible. Due to the aforementioned reasons, only a small part of Podgorje (around Karlobag) gravitates to Gospić, while most of the observed area gravitates to the more spatially distant centers of neighboring counties: Rijeka (Primorje-Gorski Kotar County) and Zadar (Zadar County) (Rogić, 1958; 1975; Magaš, 2015).

Accessibility can be defined as the ability to access specific goods, services, activities and destinations (Witherick et al., 2001), and it is frequently analyzed in terms of material cost, temporal duration, or physical distance (Ingram, 1971; Baxter and Lenzi, 1975).

Rodrigue (2020) defined accessibility as the measure of the capacity of a location to be reached from, or to reach, different locations. This means that the capacity and the arrangement of transport infrastructure are key elements in the determination of accessibility (Rodrigue 2020). Freiria et al. (2022) confirmed that transport accessibility has the potential to impact economic performance in certain European regions, although they also found that the relationship between transport infrastructure and economic variables (productivity or growth) isn't always positively correlated. Silva and Alteri (2022) considered accessibility to be the ease with which one can reach certain activities or take advantage of desired opportunities, but that ease is dependent on the spatial distribution of people and activities (Geurs and Eck, 2001; Levine and Grab, 2002). Rodrigue (2017) suggested that space be regarded as being able to both support and constrain mobility, which can lead to socio-economic and demographic shrinking in spatially peripheral areas. On the other hand, accessibility can be understood as the potential of opportunities for interaction (Hansen, 1959), the inherent characteristic (or advantage) of a place with respect to overcoming some form of spatially operating source of friction (Ingram 1971), and even as the ease with which any land-use activity can be reached from a location using a particular transport system (Dalvi and Martin, 1976). However, Neutens (2017) maintained

1 According to the 2011 census, 7,182 inhabitants lived in the Town of Senj, which is an administrative unit of the Lika-Senj County, while the settlement Senj itself had 4,810 inhabitants.

2 Source: CBS, 2020: *Population estimate of Republic of Croatia, 2020, First Release number 7. 1. 3*. Available at www.dzs.hr (15. 10. 2021.).

3 The Baške Oštarije Pass on the Karlobag-Gospić road is located at the 927 m above sea level.

4 The bora wind in Podgorje often reaches hurricane strength (1 minute sustained wind of ≥ 119 km/h). The greatest speed of the bora wind ever documented was in December 2003 on the A1 motorway between junctions Sv. Rok and Posedarje. The wind speed then reached 304 km/h. For comparison, according to the Saffir-Simpson Scale, the strongest hurricane (category 5) is defined as 1 minute sustained wind of ≥ 252 km/h.

that accessibility is connected with the ability to access spatially dispersed activities, which is connected to lack of said ability in isolated areas (like Podgorje) and leads to increased depopulation and population aging. Turk et al. (2016) confirmed the negative impact of inadequate transportation accessibility on basic demographic features in the Žumberak area.

The concept of accessibility involves networking and quality of interactions between local developmental factors and transportation, i.e. logistical support (Cascetta, 2009; Freiria et al., 2015; Schwanen, 2016; Cascetta et al., 2016). Therefore, this concept is vital in transportation geography (Van Wee, 2016), and especially in strategic planning (Kozina, 2009). The correlation between increases in transportation accessibility and improvement of socio-economic indicators have been confirmed by multiple studies (Keeble et al., 1982; Njegač, 1993; Ilić, 1995; Murayama, 1994).

Methodological notes

This paper explores the temporal accessibility of the Podgorje region by road transport in relation to the three closest county centers: Gospić (the county seat of Lika-Senj County, which is the administrative center for the bulk of Podgorje), Zadar (the seat of Zadar County that is the main center for the southern part of Podgorje) and Rijeka (the seat of Primorje-Gorski Kotar County and also the main macroregional center of the northern Croatian Littoral, to which Podgorje belongs in the sense of geographical regionalization).

The travel times listed relate to travel by car, and the travel times from all Podgorje settlements to the three observed cities were determined using GIS. Travel duration is defined using the HAK interactive map⁵. The acquired data were entered into the GIS spatial database and analyzed, and isochrone maps were made by applying the IDW (Inverse Distance Weighting) method of spatial interpolation.⁶ In this way, accessibility zones were determined in relation to the three aforementioned regional urban centers (with different levels of centrality), which are bordered by the 15-minute isochrones. By applying this methodological procedure, eight accessibility zones were defined (Tab. 1).

Next, the settlements belonging to a given accessibility zone were determined and, on that basis, an index value of intercensal population change in the period from 1971 to 2011 was calculated for each individual zone. In the case of territorial distribution of a single settlement among two or more accessibility zones, the entire population was lumped into the accessibility zone which contained the largest share of its administrative territory. The acquired values of the index of the intercensal population change (2011/1971) are car-

Tab. 1 The accessibility zones of Podgorje settlements according to 15-minute isochrones

Accessibility zones	Travel time (minutes)
1	≤60
2	61–75
3	76–90
4	91–105
5	106–120
6	121–135
7	136–150
8	≥151

Source: authors

⁵ Source: *Croatian Autoclub (HAK) Interactive Map*, 2021. Available at: map.hak.hr (25. 10. 2021.).

⁶ The analysis is performed in the ArcGIS Pro 2.8 tool. On possibilities of applying the GIS tool in the transportation accessibility analysis see: Birkin et al., 2004; Kozina (2010a; 2010b).



tographically presented (with a previous GIS analysis) for each accessibility zone, in order to find out if the intensity of the total depopulation was stronger, equal, or weaker in zones with worse transportation accessibility in the observed period.⁷ If zones with weaker transportation accessibility really had more pronounced depopulation, it would be a clear confirmation of the assumption that the transportation accessibility of Podgorje is one of significant factors that has influenced the intensity of depopulation; this would mean that it has unfavorably influenced all demographical processes in that area. As the temporal accessibility zones of Podgorje settlements were determined to three different cities, it should be pointed out that there is some amount of overlap between them (Fig. 1).

Only car traffic was analyzed because it is the only functional form of transportation in Podgorje. There is no railway and no regular ferry lines, with the exception of ferry lines to the islands of Rab and Pag that do

⁷ When analyzing index values of intercensal population change, it should be kept in mind that Podgorje's settlements have a small number of inhabitants. This presents a problem because small (*insignificant*) absolute population change can look significant when it is represented by a relative indicator such as a change index value. Despite this deficiency, the authors believe that the analysis of population change index values according to the determined accessibility zones is indicative, and that it provides the insight into features of demographic processes.

not affect the transportation accessibility of Podgorje to the selected centers. Air transport is not a factor in this area. Public bus transportation is scarce, inefficient, and unreliable. Motorways bypass Podgorje due to its unfavorable relief and frequent strong winds (bora). Therefore, the Croatian motorway network also has little effect on the transportation accessibility of Podgorje.

Results

Basic demographic features of Podgorje

The most significant dynamic demographic feature of Podgorje is pronounced total depopulation, i.e. demographic *extinction* as a type of intercensal change intensity (Pejnović and Husanović-Pejnović, 2008; Husanović-Pejnović, 2010). The intensity and long duration of the total depopulation are exactly what makes Podgorje different than the rest of the Croatian Adriatic coast. The trend of the almost continual intercensal (numerical) decrease in population, both in Podgorje as a whole and in all of its territorial units, is being caused by destabilizing determinants of population dynamics and development, one of which is poor transport accessibility. Such problems have persisted in this area for more than a century (Fig. 2).

Namely, from the beginning of the 20th century to present day, the maximal population in Podgorje, as well as in Senj and Karlobag, was registered in 1910. At that time, 16,782 people lived in Podgorje. At the

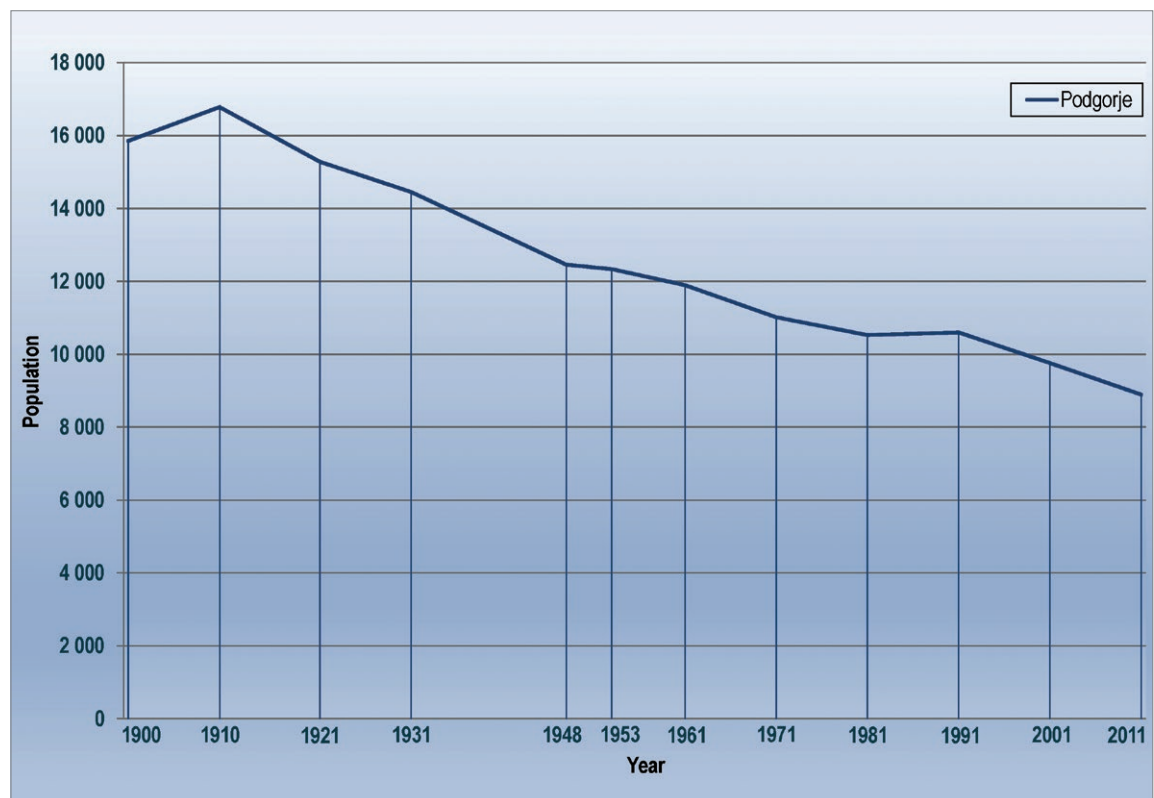


Fig. 2 Population change in Podgorje

Sources: Croatian Bureau of Statistics (2005; 2011)

same time, 10,234 people lived in and around Senj, and 3,383 people lived in and around Karlobag. The maximum population in the Starigrad area was also registered long ago, in 1921, when 3,475 people lived there. The smallest number of inhabitants in Podgorje and in all of its units was registered in the 2011 census⁸. In 2011, 8,894 people lived in Podgorje, and the index value of the intercensal change in comparison to the maximal population from 1910 was 53.0, meaning that the number of inhabitants was almost halved. There were 6,160 people in the Senj area in 2011, giving an intercensal change index value in comparison to 1910 of 60.2. In the Karlobag area there were only 858 people in 2011, giving an intercensal change index value in comparison to the maximum population from 1910 of only 25.4. In the Starigrad area, there were 1,876 people in 2011, and the intercensal change index value in comparison to the maximum population from 1921 was 53.9.

The aforementioned dynamic indicators clearly show that the intercensal (numerical) population change of Podgorje as a whole, and of its allocated units, has a considerably negative direction, which indicates a strong, long-term, and steady demographic recession. Still, there is a certain spatial differentiation in the total depopulation intensity. Namely, population change is the least unfavorable in the Senj part of Podgorje, which is understandable because Senj is the largest urban settlement and the only one in Podgorje which has a certain level of centrality and economic activity, so this relatively positively influences intercensal population change. The most unfavorable situation was registered in the Karlobag (central) area, which is the most distant from larger urban centers (Rijeka and Zadar). This clearly indicates the influence of poor transportation accessibility and related temporal accessibility.

For a more thorough insight into the researched issues, intercensal (numerical) population change was taken into consideration in the period from 1971 to 2011 (Fig. 3). Namely, in the former Yugoslavia, at the beginning of 1970s, the process of automobilization intensified, and also tourism development along the Adriatic coast strengthened (even in the area of Podgorje). Unfortunately, the development of tourism in Podgorje did not follow the dynamics of the rest of the Croatian coast, which has had a negative impact on local demographic trends.

From 1971 to the last population census in 2011, it was observed that Podgorje, as a whole, had a decrease in the number of inhabitants from 11,018 to 8,894, giving an intercensal change index value of 80.7. All three allocated parts of Podgorje also registered total depopulation. In the Senj area, the number of inhabitants shrank from 7,367 to 6,160, giving an intercensal change index value of 83.6, in the Karlobag area it shrank from 1,290 to 858, giving an intercensal change index value of 66.5, and in the Starigrad area it shrank from 2,361 to 1,876, giving an intercensal change index value of 79.5. In the period from 1971 to 2011, only two Podgorje settlements achieved a demographic increase, while the population of all other settlements shrank with varying intensity. Besides the aforementioned, it should be noted that, in the three observed intercensal periods, the Konjsko settlement (which is a part of the Karlobag Municipality) became demographically extinct, because it did not have any permanent inhabitants according to the census from 2011.). An increase in the number of inhabitants was registered only in the settlements of Vrataruša⁹ (part the Town of Senj) and Vidovac Cesarički (in the Karlobag Municipality). Although the index values of intercensal population change in Vrataruša (216.2) and Vidovec Cesarički (133.3) seemingly indicate a significant demographic expansion, this is not the reality because the population of the Vrataruša settlement grew from 173 to 374 people, and the population of the Vidovec Cesarički settlement grew from 42 to 56 people. Therefore, in total, the absolute demographic increase was only 215 inhabitants. It is well known that relative indicators can inaccurately indicate a significant change of population when dealing with small populations, so this increase in the population of these settlements is insignificant in the Podgorje context.

⁸ The paper was written and submitted for review before the publication of the results of Croatia's 2021 census.

⁹ Before the 2011 census, the Bunica, Pijavica and Sveta Jelena settlements were separate from the Vrataruša settlement. In order to compare the number of inhabitants from 1971 with the number in 2011 (at the settlement level), the aforementioned allocated settlements are considered to be part of the Vrataruša settlement in this paper.

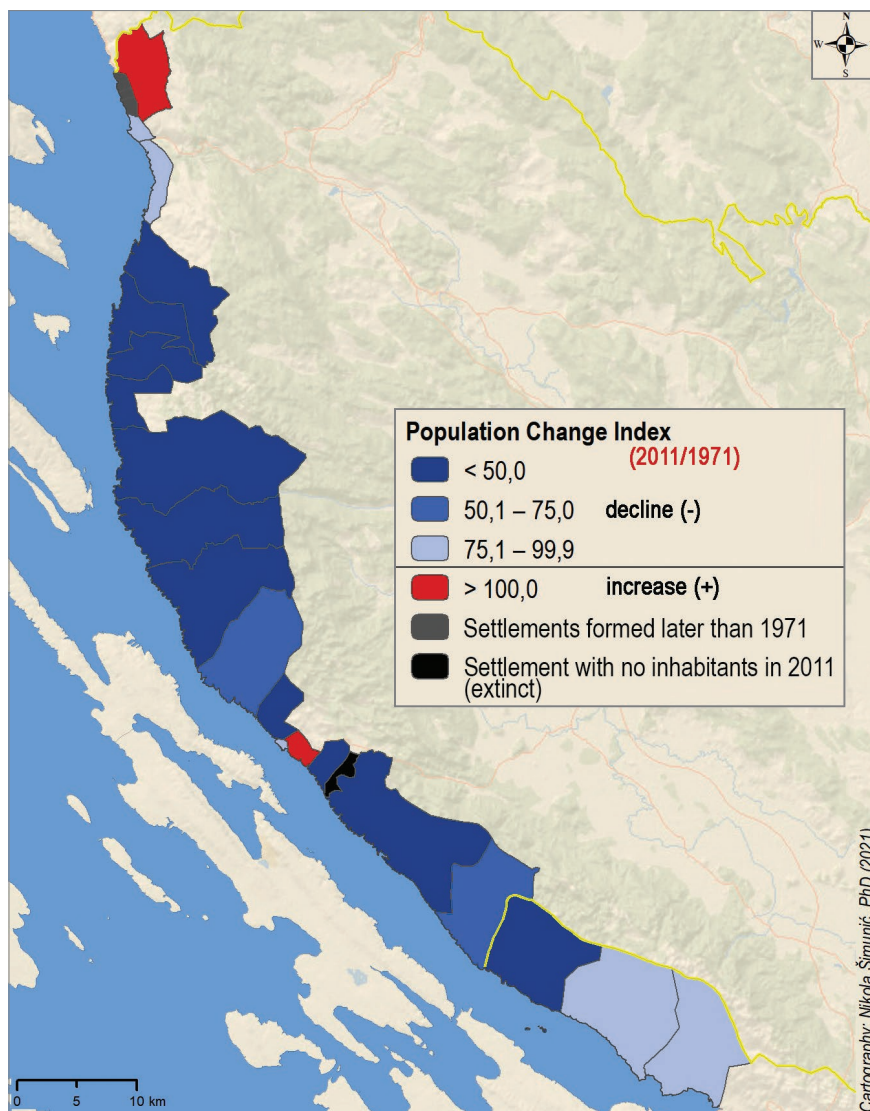


Fig. 3 Population Change Index values in Podgorje settlements (1971–2011)

Sources: Croatian Bureau of Statistics (2005; 2011); State Geodetic Administration (2021)

Central parts of Podgorje, except for the immediate area around Karlobag, registered the most intense decrease in the number of inhabitants, which indicates the unfavorable influence of poor transportation accessibility on demographic conditions. These issues are more thoroughly analyzed, described, and interpreted later in the paper.

Along with intercensal population change, an important indicator and factor of demographic recession of Podgorje is natural population change. Natural population change, which is an extremely important factor of demographic dynamics in Podgorje, has also had very unfavorable features for a number of years. This paper explores natural population change based on the data regarding vital statistics of the Croatian Bureau of Statistics of the Republic of Croatia, from the period from 1971 to 2019¹⁰ (encompassing the period of 49 years) (Fig. 4). The occurrence of natural decrease in the population (natural depopulation) was

¹⁰ Since the scope of the Podgorje region in this paper is defined by the settlement borders, natural population change is shown at the settlement level. Given that the operation of vital statistics at this level has been systematically performed since 1964, the most logical option was to start with the period following the first census (1971) and go to the last year for which the vital statistics at the settlement level that was available at the time of writing (2019).

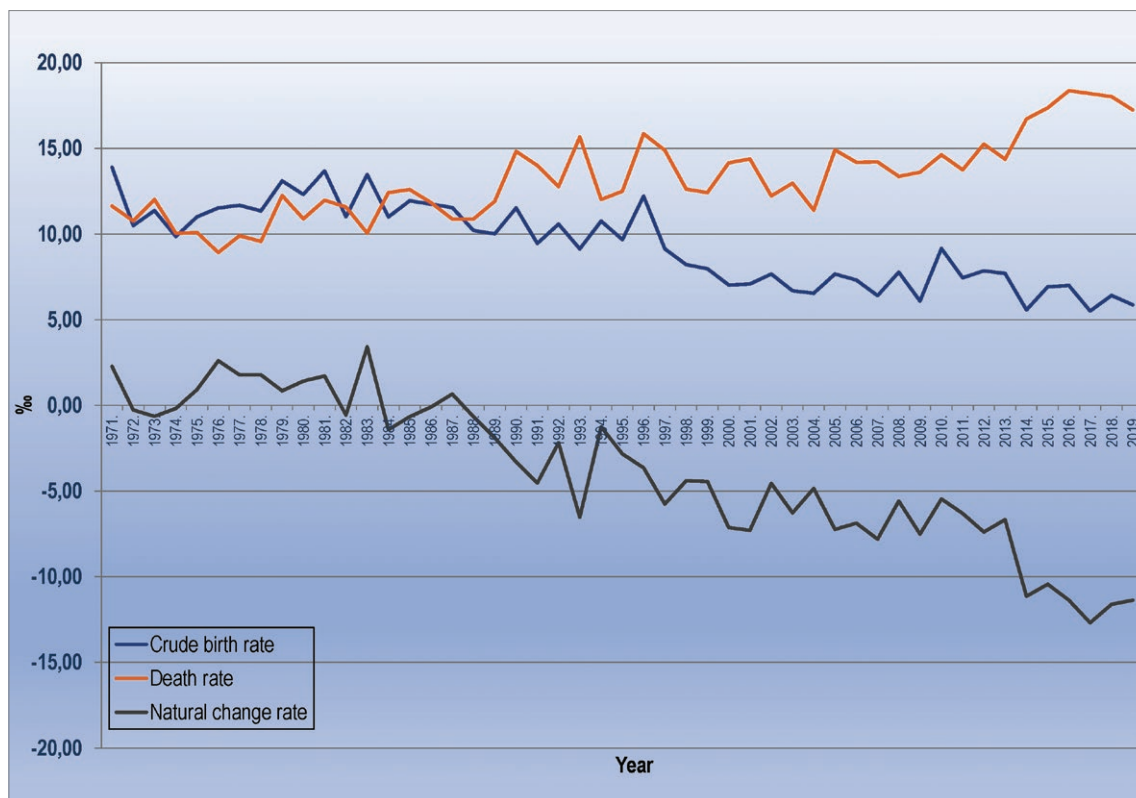


Fig. 4 Natural population change rates in Podgorje

Source: Croatian Bureau of Statistics (2020)

registered for the first time in Podgorje in 1972, and the aforementioned process has continued steadily since 1988.¹¹ In total, from 1971 to 2019, 4,636 live births occurred in Podgorje, which is 94.6 children on average per year, and 6,335 people died, which is 129.3 deaths on average per year, giving a natural decrease of -1,699 inhabitants, which resulted in the average annual natural decrease of -34.7 inhabitants in the observed period. From 1971 to 1987, natural change was oscillatory, because years with a natural increase alternated with years of natural decrease. Therefore, in the period from 1971 to 1980, natural change was positive (1,257 live births; 1,144 deaths, i.e. +113 people), giving an arithmetic mean of the vitality index of 110.5. In the next intercensal period (1981–1990), natural change was slightly negative (1,226 live births; 1,256 deaths; i.e. -30 people), with an arithmetic mean of the vitality index of 98.8, which indicates decreasing bio-reproduction among the population.

Recently, the trend of the intensity of natural population decrease has accelerated (Wertheimer-Baletić, 2017; Weeks, 2020), as a result of a strong reduction in the birth rate, while the death rate has relatively been steady with a slight increase, i.e. a decrease in the absolute values. Therefore, in the 1991–2000 period there were 962 live births, in the 2001–2010 period there were 676 live births, and in the 2011–2019 period there were 515 live births. At the same time, 1,396 people died in the 1991–2000 period, 1,269 people died in the 2001–2010 period, and 1,270 people died in the 2011–2019 period. This means that the natural decrease of -434 people in the period from 1991 to 2000 increased to -593 people in the period from 2001 to 2010, and to -755 people in the period from 2011 to 2019. The acceleration of the decreasing bio-reproduction is

¹¹ In Croatia, observed as a whole, natural decrease in population has been continuous since 1991 (Nejašmić, 2008). For more, see: Nejašmić, (1999); Wertheimer-Baletić, (1999); Gelo et al., (2005).

clearly illustrated by the decrease of the arithmetic mean of the vitality index – from 68.9 (1991–2000.) to 41.2 (2011–2019).

If the number of years during which the natural decrease in the number of inhabitants was present is taken into consideration, an even clearer insight into the extent of the demographic crisis of Podgorje emerges. Natural decrease in the population was registered in the Podgorje region as a whole during a 39-year period. In the Starigrad area, the situation was the best (but still bad), as a natural decrease in the population was registered in 30 of 49 years. In the Senj area, natural decrease was registered during 36 years, and the most unfavorable situation was in the Karlobag area, where the same process was registered during all 49 years of the observed period.

The previous analytical insight clearly shows that the features of demographic dynamics are very unfavorable in Podgorje. This has, expectedly, had a strong negative influence on the structural population features, and especially on the composition of population according to age and sex, which shows the dominant features of the acceleration of the population aging process.

If the age-sex pyramids for Podgorje are compared according to the census results from 1971 and 2011 (Fig. 5), it is noticeable that the pyramid for 2011 looks like an inverted version of the 1971 pyramid. This fact clearly shows the intensity of demographic aging which was present in Podgorje during the observed period. This undoubtedly indicates a considerably regressive composition and advanced inversion of the age structure. According to the census from 1971, the most represented age groups in Podgorje were those aged 15 to 19 years, while in 2011 the most represented groups were those aged 50 to 54 years. The scarcity of

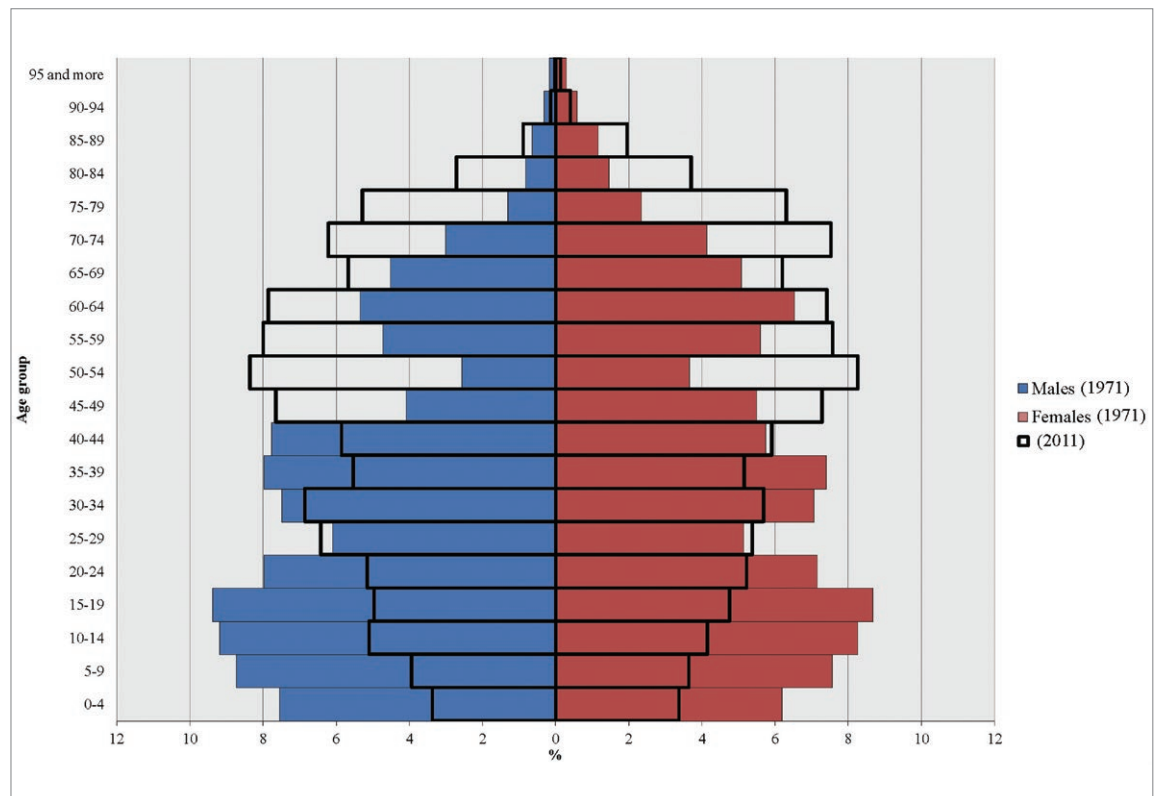


Fig. 5 Sex and age structure of the Podgorje population in 1971 and 2011
Sources: Federal Bureau of Statistics (1972); Croatian Bureau of Statistics (2011)

the youngest age groups is especially concerning in the age-sex pyramid from 2011. At the moment, these groups are not sufficiently large to ensure future demographic capacities for reproduction and economic activity. Such a state indicates the certain continuation of unfavorable demographic processes into the future, with a likely worsening trend.

The aging index¹² represents the simplest indicator of the age level of the population (Wertheimer-Balatić, 1999; Nejašmić, 2005, Weeks, 2020). This is the ratio of old (≥ 60 years) and young population (≤ 19 years). Its value in 1971 in Podgorje was 58.0, meaning that even then the population had begun to age. The value of the same indicator, for 2011, was 187.8, which shows a very advanced process of population aging, whereby the contingent of the elderly population was almost twice the size of the contingent of the young. This process is much more unfavorable than the Croatian average (115.0 for 2011). If the population age level is typified according to Nejašmić (2005), it can be seen that the population of Podgorje registered as type 3 in 1971 (numerical indicator 83.5), which is categorized as *old age*; in 2011, type 5 was registered (with a numerical indicator 55.5) which is categorized as *very old age*. The lowest level of population age was registered in 2011 in the Starigrad area (type 5 – *very old age*, with a numerical indicator of 56.0), while the Karlobag area registered the least favorable situation (type 6 – *extremely old age*, with a numerical indicator of only 44.0). It is clear that population aging in Podgorje is a very important indicator of the considerably unfavorable general demographic situation. In order for this to improve, comprehensive and long-term measures of demographic revitalization should be developed and implemented, by both national and regional authorities.

DISCUSSION

Analysis of temporal transportation accessibility between Podgorje and Rijeka

As mentioned earlier, Rijeka is the main macroregional center of the northern Croatian Littoral and Primorje-Gorski Kotar County, which neighbors Podgorje, so it significantly gravitationally influences Podgorje. Before Croatian independence and the establishment of the current county structure (in 1993), the Senj area was also administratively oriented toward Rijeka, which makes this step particularly relevant

Population, households and dwellings census in 1971: Data on Localities and Communes, Federal Bureau of Statistics, Beograd, 1972; Census of population, households and dwellings in 2011: Population by sex and age, by settlements, www.dzs.hr (10. 1. 2022.).

Regarding the map (Fig. 6), it can be seen that Podgorje, in the context of temporal transportation accessibility to Rijeka (by car), is divided into 7 accessibility zones. Regarding accessibility zones (tab. 1), only zone 1 has been excluded (≤ 60 minutes of traveling).¹³ This is expected because Rijeka is spatially the most distant from Podgorje, among the cities in the analysis, so there are no settlements that would require less than an hour of travel to Rijeka by car. It can be seen that the accessibility zones are evenly distributed (Fig. 6), meaning that temporal accessibility is proportional to the spatial distance of settlements from Rijeka. In other words, the settlements in northern Podgorje, which are the most accessible to Rijeka, are also spatially closest to Rijeka, while the settlements that are temporally the least accessible to Rijeka are the settlements in southern Podgorje that are also the most distant from Rijeka. Such a state is to be expected and it can be concluded that this is conditioned by the relief, because the relief determined the distribution of the road

¹² The population enters the aging process when the value of the aging index surpasses 40.

¹³ Since there are no settlements that require ≤ 60 minutes (zone 1) of travel time to Rijeka, zone 2 is the most accessible zone, which is then defined by a travel time of ≤ 75 minutes to Rijeka.

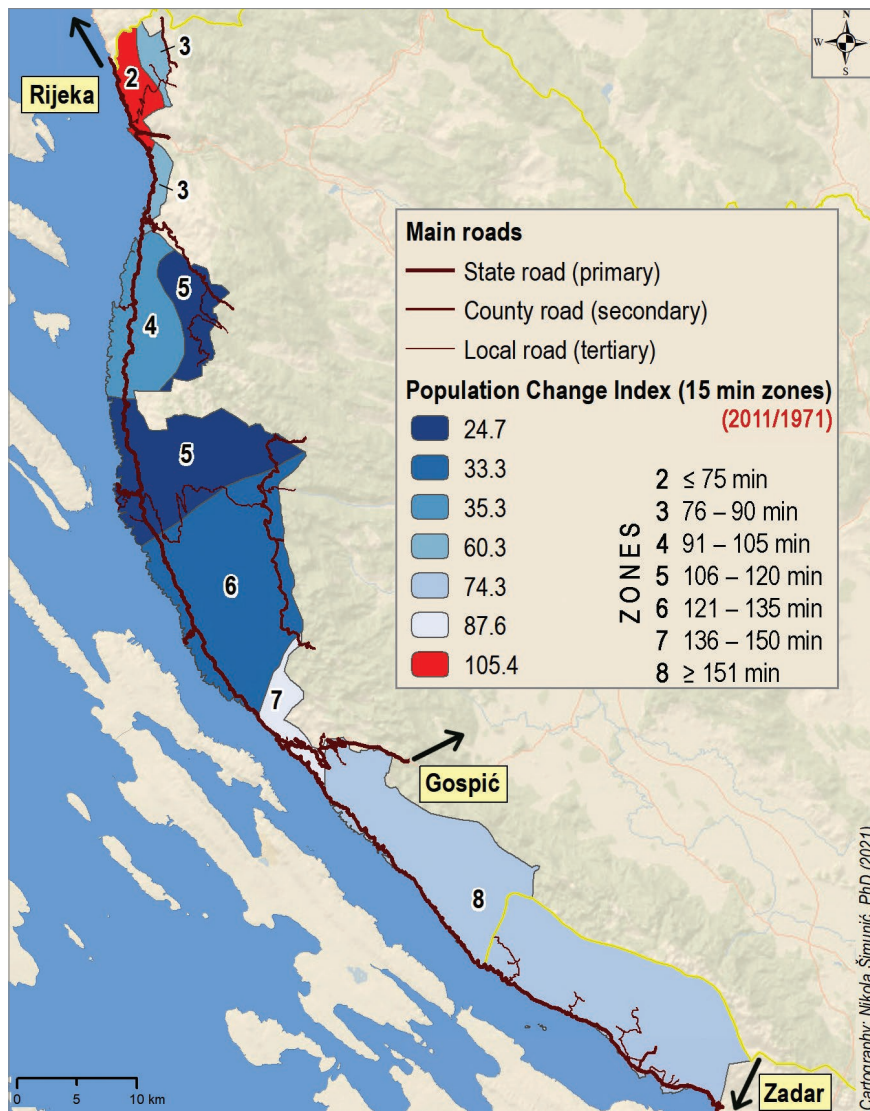


Fig. 6 Temporal transportation accessibility of Podgorje to Rijeka by car

Sources: Federal Bureau of Statistics (1972); Croatian Bureau of Statistics (2011); CAC/HAK (2021); State Geodetic Administration (2021)

transport network. The shortest and fastest way from Podgorje to Rijeka is by the D8 state road (*Jadranska magistrala*—the main coastal highway), which stretches along the Adriatic coast, so there are no discrepancies between temporal accessibility and spatial distance.

By examining the index values of intercensal population change according to accessibility zones, it is clear that the temporally most accessible zone to Rijeka is zone 2, from which it takes ≤ 75 minutes to drive to Rijeka. Also, it is evident that this zone registered an intercensal increase in population in the observed period from 1971 to 2011 (the index value of intercensal population change was 105.4). This is a relatively slight increase, but it is still significant in relation to the demographic dynamics of Podgorje. In zone 2 we find the largest settlement in Podgorje: Senj, which has surely contributed to the more positive dynamic population trends in relation to those registered in other parts of Podgorje.

All other accessibility zones in the observed period (1971–2011) registered an intercensal decrease in the population. Zone 3, from which it takes 76–90 minutes to drive to Rijeka, registered an index value for intercensal population change of 60.3, which shows a very pronounced demographic decrease. This indicates

that a strong demographic regression area begins near Senj. The next is zone 4, from which it takes 91–105 minutes to drive to Rijeka, which has an intercensal population change index value of 35.3. This is a very large decrease in population, which means that this zone has experienced a demographic collapse. The most unfavorable situation was registered in zone 5, from which it takes 106–120 minutes to drive to Rijeka. This zone registered an intercensal population change index value of only 24.7. This is the area between Senj and Karlobag, which is actually the most transportationally isolated area from all of the three cities according to the analysis. Zone 6 (121–135 minutes of driving time to Rijeka) registered an intercensal population change index value of 33.3, which is slightly better than the situation in zone 4, but this is also an area where the demographic recession is very intense. The differences among index values among zones 4, 5 and 6 are actually insignificant, meaning this is a continual transportationally isolated area that has unfavorable demographic features. Unlike this area, zone 7 (136–150 minutes of driven time to Rijeka) registered a noticeably more favorable situation; the intercensal population change index value was 87.6. Zone 7, of course, is also an area of the demographic regression, but this regression is less pronounced than in zones 4, 5 and 6. The primary reason for this is that the municipal center Karlobag is located in this zone. Its centrality, although small in scope, positively influences the demographic conditions in the nearby surroundings to a certain extent, which has also somewhat mitigated the negative influence of the significant transportation distance and poor transportation accessibility of this area in relation to Rijeka. Also, Karlobag is relatively well-connected to Gospić via a road over Velebit Mountain, which also positively influences demographic changes. Zone 8, the most distant zone from Rijeka (≥ 151 minutes of travel time) registered an intercensal change index value of 74.3, which again shows a significant decrease in the population number, but less pronounced than in the area between Senj and Karlobag. The reason for this is that the southern part of Podgorje gravitates toward Zadar, the centrality of which positively influences demographic conditions. Also, Paklenica National Park is located in this accessibility zone, which generates significant income from tourism, and has a positive effect on the issues taken into consideration.

Analysis of temporal transportation accessibility of Podgorje to Gospić

Although Gospić is the least populous of the three gravitation centers that were researched but, as the county center of the bulk of Podgorje, it is very important. Unlike Rijeka and Zadar, which are located on the coast, Gospić is located inland, and this is also one of the reasons why its influence on Podgorje is somewhat weaker. Furthermore, the relief barrier of the Velebit Mountain ridge represents the largest obstacle to stronger influence and gravitation of Podgorje toward Gospić, and also disrupts the logical spatial complementarity of the islands, coast, and hinterland.

Population, households and dwellings census in 1971: Data on Localities and Communes, Federal Bureau of Statistics, Beograd, 1972; Census of population, households and dwellings in 2011: Population by sex and age, by settlements, www.dzs.hr (10. 1. 2022.).

By analyzing the transportation accessibility of Podgorje settlements with Gospić, only the first five accessibility zones were relevant (Fig. 7; tab. 1). Namely, as Gospić is spatially close to Podgorje, there are no settlements which are farther than 120 minutes from Gospić by car.¹⁴ If the intercensal population change index values from 1971 to 2011 are analyzed according to the accessibility zones in relation to Gospić, it can be seen that all zones registered a decrease in population. This is the consequence of various settlements being in the same accessibility zone as settlements that gravitate towards centers other than Gospić.

It has already been mentioned that the shortest way from Gospić to Podgorje is via the Gospić–Baške Oštarije–Karlobag road which crosses over Velebit Mountain. But one can get from Gospić to

¹⁴ Therefore the least accessible zone (5) has an average travel time to Gospić of ≥ 106 minutes.

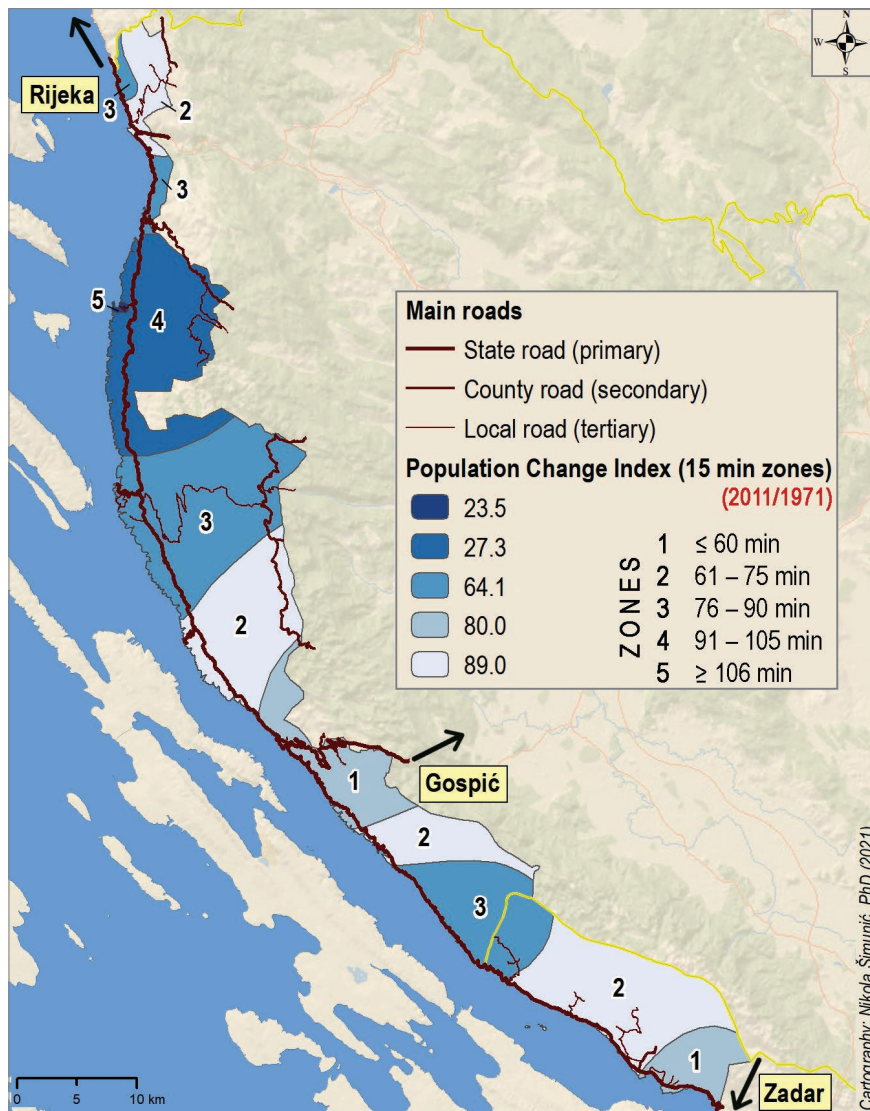


Fig. 7 Temporal transportation accessibility of Podgorje to Gospić by car

Sources: Federal Bureau of Statistics (1972); Croatian Bureau of Statistics (2011); CAC/HAK (2021); State Geodetic Administration (2021)

Podgorje just as “fast” on the longer A1 highway (by exiting the highway at the Maslenica exit). This means that accessibility zone 1 (≤ 60 minutes of traveling to Gospić) is divided into two mutually-unrelated parts. One part encompasses Karlobag and its surroundings, while the other part is at the very southern end of Podgorje (which is the closest to the Maslenica exit). Accessibility zone 1 registered a significant decrease in population, with an intercensal population change index value of 80.0; but it is paradoxical that, for Podgorje, this demographic decrease can be provisionally considered slight (although it, of course, is not slight). Accessibility zone 2 (61–75 minutes of travel time to Gospić) is also divided, like zone 1, into 4 mutually-related parts. Two parts of zone 2 are located northwest and southeast of zone 1 around Karlobag. These parts are connected by the Gospić–Karlobag road. One part is located northwest of zone 1 in the farthest southern part of Podgorje and it is connected to the A1 highway (Maslenica exit), while the other part is located in the farthest northern part of Podgorje. This part is also connected with the A1 highway but, unlike the southern part, it is close to the Žuta Lokva exit, which is the closest exit to Senj. Zone 2 registered the least unfavorable intercensal population change index value: 89.0. The reason for this is that this zone encompasses the largest settlement in

Podgorje: Senj, which has less-pronounced unfavorable demographic features. Zone 3 (76–90 minutes of travel time to Gospić) is also divided into 4 unrelated parts. Two parts are located north and south of zone 2, which encompasses Senj, while the remaining two parts are located northwest and southeast of zone 2, which are connected to the Gospić–Karlobag road. Zone 3 registered a noticeably unfavorable intercensal population change index value: 64.1. Zone 4 (91–105 minutes of travel time to Gospić) stretches from the Lukovo settlement in the north to Starigrad (which belongs to the Town of Senj administratively) in the south. This area registered a very unfavorable intercensal population change value: 27.3. Zone 5 (≥ 106 minutes of travel time to Gospić) is the smallest in terms of area and it has the most unfavorable intercensal population change value: 23.5. Zone 5 encompasses only the Lukovo settlement. For zones 4 and 5 it can be claimed that, in the observed period (1971–2011), they experienced a considerably strong demographic recession. The analysis of temporal transportation accessibility to Gospić confirmed that the zones with the worst accessibility also had the most unfavorable values and features of numerical (censal) population dynamics.

The analysis of temporal transportation accessibility of Podgorje to Zadar

The final center which was analyzed regarding transportation accessibility of Podgorje settlements was Zadar (Fig. 8). Zadar is a logical gravitational center for the area, as Podgorje's southeastern part (the Starigrad Municipality) is in Zadar County. Moreover, Zadar is the main regional center of northern Dalmatia and has significant centrality.

Population, households and dwellings census in 1971: Data on Localities and Communes, Federal Bureau of Statistics, Beograd, 1972; Census of population, households and dwellings in 2011: Population by sex and age, by settlements, www.dzs.hr (10. 1. 2022.).

The analysis of transportation accessibility of Podgorje settlements to Zadar determined the relevance of all listed accessibility zones, apart from the zone 4 to which none of the settlements belong (tab. 1). All accessibility zones in the observed period (1971–2011) registered a demographic decrease. Zone 1 (≤ 60 minutes of travel time to Zadar) lies in the farthest southeastern part of Podgorje, which is logical since this part is spatially the closest to Zadar. This zone registered, for Podgorje, a relatively small decrease in population, with an intercensal population change value of 92.8. Zone 2 (61–75 minutes of travel time to Zadar) continues up the coast from zone 1 towards the northwest and it registered a noticeably more unfavorable intercensal population change value: 49.3. Zone 3 (76–90 minutes of travel time to Zadar) continues up the coast to the northeast of zone 2. This zone registered the least favorable intercensal population change index value: 37.0. It is interesting that no settlements belong to zone 4 (91–105 minutes of travel time to Zadar), rather accessibility zone 5 follows zone 3. It takes 106–120 minutes to go from zone 5 to Zadar. This accessibility zone registered an intercensal population change index value of 74.4. Zone 6 stretches to the northwest of zone 5 (106–120 minutes of traveling to Zadar). It registered the least unfavorable intercensal population change index value: 95.2. This zone encompasses Karlobag, which is the center of the municipality of the same name and has central function for the surrounding area. Zone 7 (136–150 minutes of travel time to Zadar) mostly stretches to the northwest of zone 6, however it is not unified and it comprises three unconnected parts. The accessibility zones extend along the D8 state road (*Jadranska magistrala*), which is the fastest and shortest way to Zadar from the southern part of Podgorje. The bulk of zone 7 can also reach Zadar by the D8 state road.¹⁵ The exception to this is the northernmost part, which encompasses the Senj settlement. The fastest way from this area to Zadar is by the A1 highway. This zone registered a very unfavorable intercensal population change index value: 38.3. The least accessible zone is zone 8 (≥ 151 minutes

¹⁵ This also encompasses a very small part of this zone that contains the Sušanj Cesarički settlement. The settlement itself is not located on the Adriatic coast, but its administrative territory stretches to the coast.

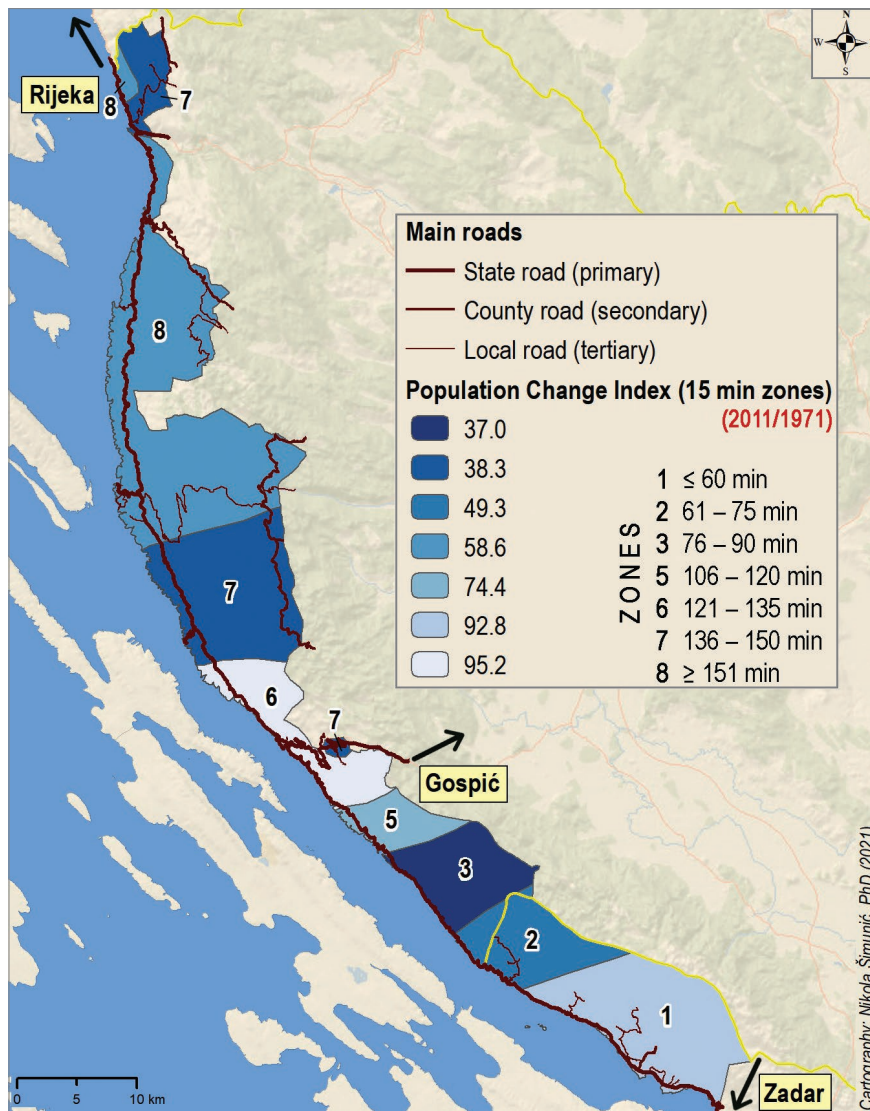


Fig. 8 Temporal transportation accessibility of Podgorje to Zadar by car

Sources: Federal Bureau of Statistics (1972); Croatian Bureau of Statistics (2011); CAC/HAK (2021); State Geodetic Administration (2021)

of travel time to Zadar), which encompasses the bulk of Podgorje around the (administrative) Town of Senj, with the exception of the immediate area around Senj itself, which belongs to zone 7 due to its vicinity to the Žuta Lokva exit of the A1 highway. Zone 8 registered an intercensal population change index value of 58.6, confirming the unfavorable features of local demographic dynamics.

Population, households and dwellings census in 1971: Data on Localities and Communes, Federal Bureau of Statistics, Beograd, 1972; Census of population, households and dwellings in 2011: Population by sex and age, by settlements, www.dzs.hr (10. 1. 2022.).

The analysis of the interrelationship between contemporary population change in Podgorje and transportation accessibility confirmed the partial conditionality of negative dynamic demographic features and transportation accessibility, in such a way that the more inaccessible parts of Podgorje can be singled out, in which a higher intensity of negative population change was confirmed, while in the more accessible parts of Podgorje there are somewhat more favorable features of demographic dynamics (Fig. 9).

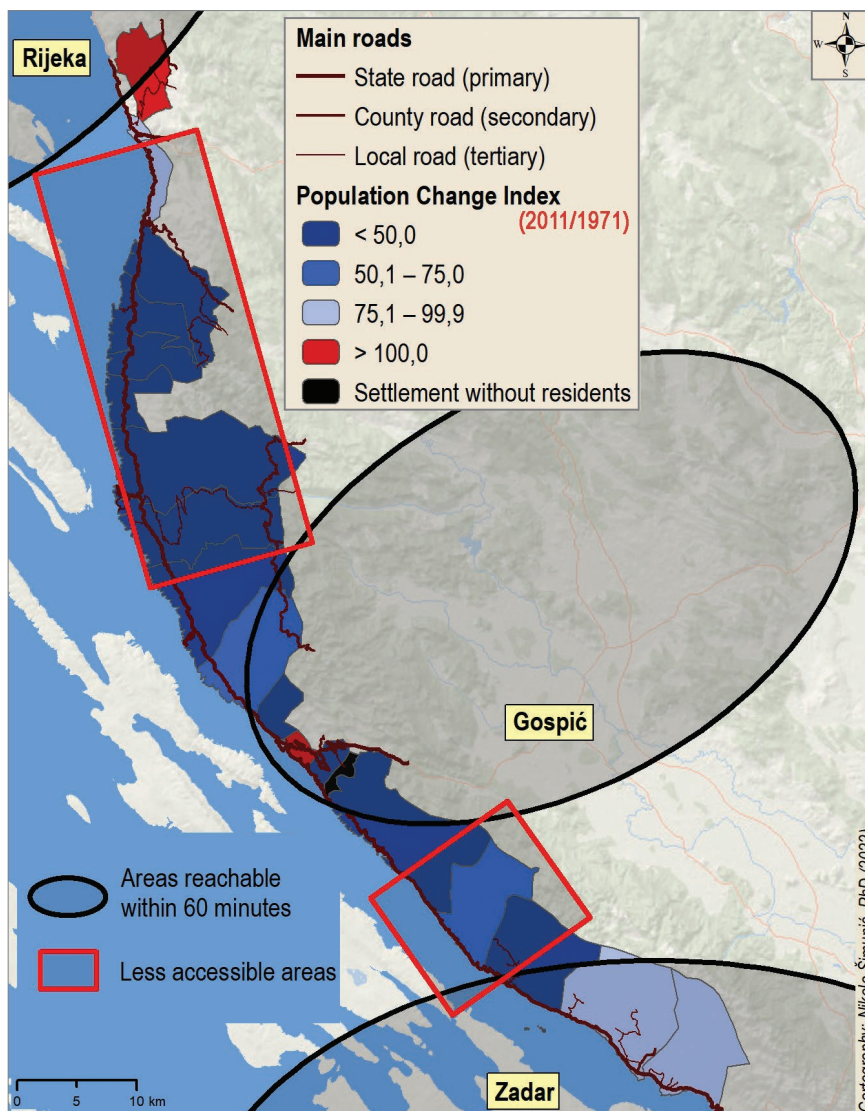


Fig. 9 Conditionality of negative demographic features by adverse transportation accessibility

Sources: Federal Bureau of Statistics (1972); Croatian Bureau of Statistics (2011); CAC/HAK (2021); State Geodetic Administration (2021)

CONCLUSION

On the basis of the analyzed data, it is clear that Podgorje is among the Croatian regions with the most unfavorable demographic indicators. Depopulation processes have been present for many years, and it is clear that poor transport connectivity, i.e. poor transportation accessibility, is one of most significant factors influencing this situation. It is also clear that there are other factors in play. Some of these factors are physical-geographical (geomorphological and climatological features), but insufficient economic development certainly represents an important disruptive factor which contributes to the current state of the area.

It is not possible to categorically state that this analysis has provided unequivocal results, but certain trends are clearly evident. With certain exceptions, it can be concluded that poor transportation accessibility influenced the intensity of depopulation in the period from 1971 to 2011. Small peripheral settlements belonging to central cities/municipalities had the least favorable intercensal population change index values in the observed period. In contrast, town/municipality centers have noticeably more favorable intercensal

population change index values, e.g. this value for Senj and Starigrad (Paklenica) is 98.0, while for Karlobag it is 92.1. The largest problem lies in the fact that, generally speaking, Podgorje has poor accessibility to the observed cities, so the results of the analysis of transportation accessibility should also be considered in this light.

It is clear that the gravitational zones of Rijeka, Gospić and Zadar in Podgorje overlap, which has undoubtedly influenced demographic conditions. Still, it should be kept in mind that the gravitational pull of Gospić cannot be compared to the gravitational pull of noticeably larger cities such as Rijeka and Zadar. Podgorje has a similar problem to Lika, which manifests itself in the lack of a more significant local central settlement, which causes the entire area to gravitate to more distant centers.¹⁶ This results in the need for more frequent travel to satisfy basic needs (commuting to work, shopping, going to the doctor, attending cultural events, etc.). The need for frequent longer travel negatively influences quality of life and living expenses. For these reasons, such areas are not attractive places to live, or for immigration. On the other hand, in these areas the *push* factor influence of emigration is much stronger. In order to improve demographic, economic, and social conditions, a strong, continual state-level intervention is necessary; in the form of incentivized development measures that must also include achieving prerequisites for the immigration of younger (possibly educated) population of reproductive age, which would mitigate the very negative current demographic situation in Podgorje in the long term.

In Croatia, there has long been a need for decentralization, and there has been much discussion and little action taken on the subject. However, since this process encompasses the transfer of central functions from established centers to the periphery, a question arises of whether the centers in Podgorje have enough functional capacity for this transfer to work. It is the opinion of the authors that these centers do not have enough central functions or capacity for them and that a prerequisite would be to strengthen the existing central functions and capacities of these settlements. Therefore, the process of deperipherisation is put forward as a possible solution, which implies the generation of new central functions in peripheral areas with the purpose of reducing existing peripheral characteristics. Deperipherisation is also a good concept for application in Croatia as a whole, if the fact that Croatia is decidedly peripheral in the context of the European Union is taken into consideration. In the case of Podgorje, endogenous development of the region based on its own potential could also contribute to the improvement of current situation.

The implementation of the deperipherisation process is not simple and it cannot be conducted in a short period of time. Still, it is not impossible, and support for the generation of new central functions should come both from state authorities and from the European Union. Podgorje has great potential for tourism development, which is definitively positive but, on the other hand, it is not good to depend only on one branch of economy—especially not one which generates profit only 3 to 4 months a year, and which is also extremely susceptible to global factors such as economic crises, the COVID-19 pandemic, etc. In other words, tourism certainly helps economic prosperity, but there should also be more stable solutions which should form the basis of the economy. Such an economic structure would contribute to the improvement of the demographic situation in this region and, by extension, positively influence general demographic characteristics. It is important that plans for economic restructuring take local specificities into consideration and that they be based on the advantages of these specificities.

16 D. Pejnović's analysis (2014) confirmed that peripheral location is a developmental handicap, which spurs emigration and the associated negative demographic processes. He stated that, with 8.4 persons/km², Lika had the lowest population density of any Croatian region, nine times lower than the national average (78.5 persons/km² in 2001), and besides its geographic 'marginality', a periphery is characterized by explicit economic dependence on developed urban centers as nodes of more complex development (Pejnović, 2014).

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