

Spatial Analysis of Changes in the Demographic Characteristics of the Cres-Lošinj Area Using the GIS Model

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Abstract. The paper aims to carry out a spatial analysis of the changes in selected demographic characteristics of the Cres-Lošinj area using the GIS model. For this purpose, data from all censuses carried out so far (1857–2021) were used, which were primarily analyzed cartographically by using Mean Center and the Standard Deviational Ellipse (Directional Distribution) spatial analysis methods, which are an integral part of the basic software package ArcGIS Desktop version 10.0 produced by ESRI. Tabular and graphical appendices were used to additionally complement the analyses. The analyses were carried out on three levels: the level of the Cres-Lošinj area as a whole, the individual level of the Town of Cres and the Town of Mali Lošinj, and the level of settlements. For the area of Cres-Lošinj as a whole, the results showed a tendency of the mean center of the population moving towards the north in the 1857–1948 period, then towards the southwest in the 1948–1991 period, while in subsequent censuses the tendency was again towards the north. Among the local self-government units, a common feature of the movement of the mean center of the population is that in the observed period (1857–2021), and particularly the last observed year (2021), the mean centers of the population are very close to the center of the town/municipality. Using the standard deviational ellipse (directional distribution) method, it was determined that larger settlements (Mali Lošinj, Cres and Veli Lošinj) have an increasing influence on the population direction, and it was determined that the population is concentrated closer to the larger settlements, i.e. to the centers of local self-government, while at the same time the influence on the directional distribution of the population of a large number of small settlements in the northern part of the research area decreased due to an increasing reduction in the number of inhabitants. The GIS model used in this study is suitable for researching the complexity of the demographic dynamics of the so-called of small populations because it enables an analysis at multiple spatial levels and contains methods of spatial analysis that use absolute numbers.

Keywords: GIS model, demo(geo)graphy, spatial analysis methods, small populations, Island of Cres, Island of Lošinj

1 Introduction

Each area has its own peculiarities when it comes to its demographic development, which is the result of a complex combination of socio-economic, political and many other factors in the past and today. This means that the demographic situation at the moment of observation is actually a function of a combination of earlier events (Novosel-Žic 1976). In addition to the above, the islands can be said to have specific conditions, whereby changes in demographic characteristics are largely dependent on the method of connection to the mainland

(e.g. by a bridge¹) as well as distance from the mainland². More distant islands have a lower chance of interacting with the mainland, which will ultimately result in their

¹ Currently, five larger Croatian islands are connected to the mainland by bridges: Krk, Pag, Vir, Murter and Čiovo.

² Based on their distance from the mainland, inhabited Croatian islands are divided into *inner (coastal)* and *outer islands*. The internal (coastal) islands include: Krk, Rab, Pag, Vir, Ugljan, Pašman, Vrgada, Murter, Prvić (kod Šibenika), Zlarić, Krapanj, Drvenik Mali, Drvenik Veli, Čiovo, Šolta, Brač, Šipan, Koločep i Lopud. The outer islands include other inhabited Croatian islands (Nejašmić 1992).

Prostorna analiza promjena demografskih obilježja cresko-lošinjskog područja primjenom GIS modela

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Sažetak. Cilj je ovog rada prostorno analizirati promjene odabranih demografskih obilježja cresko-lošinjskog područja primjenom GIS modela. U tu su svrhu korišteni podatci svih do sada provedenih popisa stanovništva (1857–2021) koji su prvenstveno analizirani kartografski, pri čemu su korištene metode prostorne analize težišta (Mean Center) i elipsa standardnih devijacija (distribucije smjerova) (Standard Deviational Ellipse (Directional Distribution)) koje su sastavni dio osnovnog softverskog paketa ArcGIS Desktop verzije 10.0 proizvođača ESRI. Tablični su i grafički prilozi dodatno nadopunili analize. Analize su provedene na trima razinama: razini cresko-lošinjskog područja u cjelini, razini pojedinačno Grad Cres i Grad Mali Lošinj te razini naselja. Za cresko-lošinjsko područje u cjelini rezultati su pokazali tendenciju pomicanja težišta naseljenosti prema sjeveru u razdoblju 1857–1948, zatim prema jugozapadu u razdoblju 1948–1991, dok je u narednim popisima tendencija opet bila prema sjeveru. Među jedinicama lokalne samouprave zajedničko je obilježje kretanja težišta naseljenosti to da su u promatranom razdoblju (1857–2021), a pogotovo posljednje promatrane godine (2021), težišta naseljenosti vrlo blizu sjedišta grada/općine. Metodom elipse standardnih devijacija (distribucija smjerova) utvrđeno je da veća naselja (Mali Lošinj, Cres i Veli Lošinj) imaju sve veći utjecaj na usmjerenost naseljenosti te je utvrđeno koncentriranje stanovništva bliže navedenim većim naseljima, odnosno sjedištima lokalne samouprave, uz istovremeno smanjivanje utjecaja na usmjerenost naseljenosti velikog broja malih naselja na sjevernom dijelu područja istraživanja zbog sve snažnijeg smanjivanja broja stanovnika. U ovom je istraživanju korišten GIS model pogodan za istraživanja složenosti demografske dinamike tzv. malih populacija jer omogućava provođenje analize na više prostornih razina te sadrži metode prostorne analize koje koriste apsolutne brojeve.

Ključne riječi: GIS model, demo(geo)grafija, metode prostorne analize, male populacije, otok Cres, otok Lošinj

1. Uvod

Svaki prostor ima svoje osobitosti u demografskom razvitku, što je posljedica čitavog kompleksa društveno-gospodarskih, političkih i mnogih drugih čimbenika u prošlosti i danas. Time se može reći da je demografska situacija u trenutku promatranja zapravo funkcija spleta ranijih zbivanja (Novosel-Žic 1976). Uz navedeno, za otoke se može reći da imaju specifične uvjete, pri čemu su promjene demografskih obilježja u najvećoj mjeri u ovisnosti s načinom povezivanja (npr. povezivanje

mostom¹) i udaljenošću od kopna.² Pritom udaljeniji otoci imaju slabiju mogućnost interakcije s kopnom, što

¹ Trenutno je pet većih hrvatskih otoka povezano s kopnom putem mosta: Krk, Pag, Vir, Murter i Čiovo.

² Hrvatske naseljene otoke s obzirom na njihovu udaljenost od kopna dijelimo na *unutarnje (priobalne)* i *vanjske otoke*. Unutarnjim (priobalnim) otocima pripadaju: Krk, Rab, Pag, Vir, Ugljan, Pašman, Vrgada, Murter, Prvić (kod Šibenika), Zlarin, Krapanj, Drvenik Mali, Drvenik Veli, Čiovo, Šolta, Brač, Šipan, Koločep i Lopud. Vanjskim otocima pripadaju svi ostali naseljeni hrvatski otoci (Nejašmić 1992).

lagging behind the processes that, in accordance with the circumstances, took place on the mainland and those islands that are closer to the mainland (Stražičić 1977).

The research area of this paper is the Cres-Lošinj area, and according to their distance from the mainland, these two islands belong to the outer islands (Nejašmić 1992, Podgorelec 1999). In addition to the larger islands of Cres and Lošinj, this area also includes several smaller islands: Ilovik, Susak, Unije, Male Srakane and Vela Srakane and a large number of uninhabited islets (Podgorelec 1999). According to the current administrative and territorial organization, the research area of this paper includes two local self-government units – the Town of Cres and the Town of Mali Lošinj, which are part of the Primorje-Gorski Kotar County. The Town of Cres comprises a total of 26 settlements located on the Island of Cres. The Town of Mali Lošinj comprises a total of 14 settlements, which are distributed on the area of the Island of Lošinj (5 settlements) and other islands: Cres (4 settlements), Male Srakane (1), Vele Srakane (1), Unije (1), Ilovik (1) and Susak (1) (Figure 1). The total surface of the research area is about 515.9 km², whereby the Town of Cres is slightly larger (291.6 km²) than the Town of Mali Lošinj (224.3 km²).

According to the last population census from 2021³, 10,303 inhabitants were recorded in the Cres-Lošinj area. The largest settlements are also the only urban-type settlements – Mali Lošinj (with 5,577 inhabitants, 2021) and Cres (2,205 inhabitants, 2021).

This study aims to carry out a spatial analysis of the changes in selected demographic characteristics of the Cres-Lošinj area by using the GIS model of population development of the Cres-Lošinj area. The model of this study used data from all censuses conducted so far (1857–2021), while a more detailed analysis was conducted for the period from the mid-20th century onwards (1948–2021). Among other methods, the model of this study used the Mean Center and Standard Deviational Ellipse (Directional Distribution) spatial analysis methods, which are an integral part of the basic software package ArcGIS Desktop version 10.0 produced by ESRI, and applied the methodology of O'Neill et al. (1989), whereby each analyzed phenomenon is observed on at least three levels. The aforementioned methodology was applied in this study of the development of demographic characteristics due to its hierarchical approach on which it is based. Thereby, a deeper analysis of

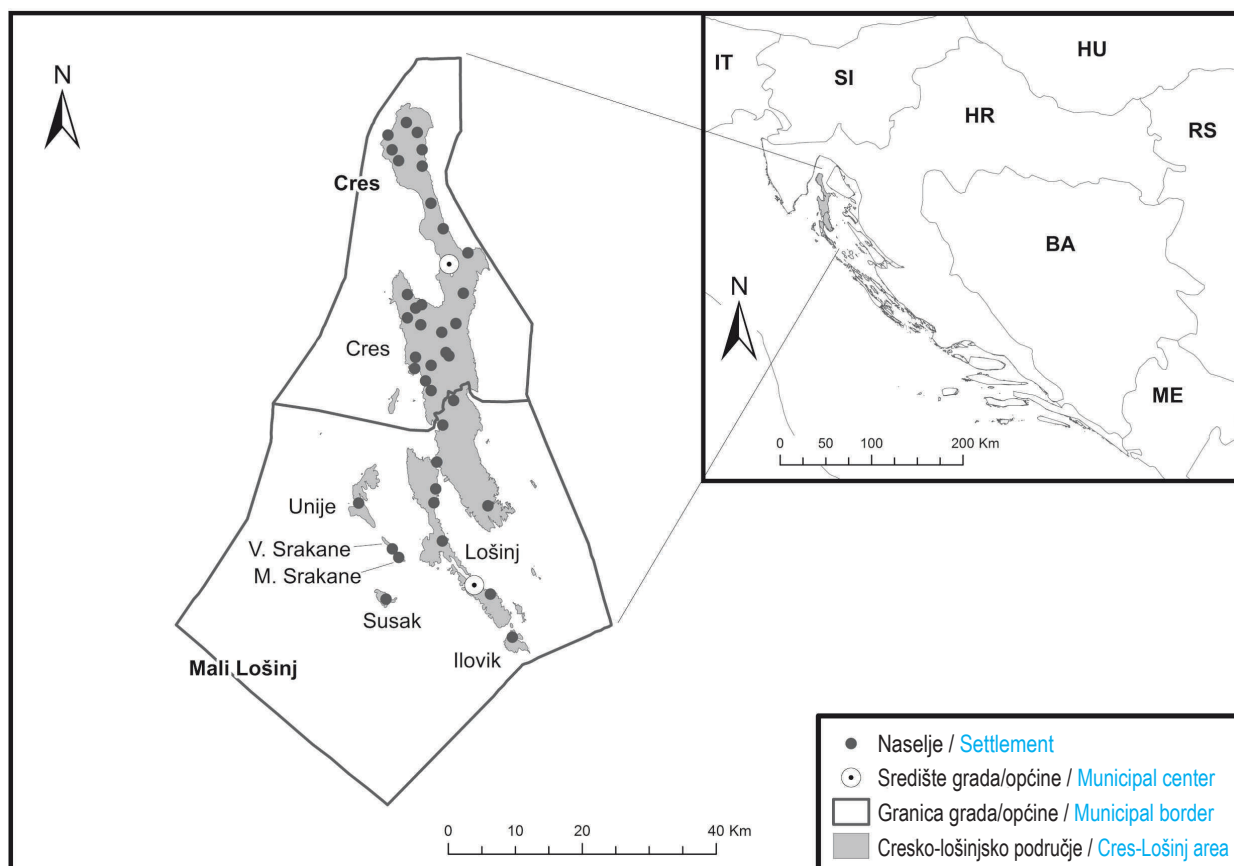
demographic processes was enabled, because local self-government units were observed at the focal level, settlements at a level below, and the Cres-Lošinj area as a whole at a level above. On the other hand, in previous research in which GIS technology was used, population dynamics in different contexts were analyzed on one level (e.g. Shi 2010, Nyussupova and Radionova 2011) or on two levels (e.g. Antipova et al. 2012, Ficior et al. 2021, Onyango et al. 2021, Wiatkowska et al. 2021).

Various methods have been used in previous studies related to the demographic characteristics of the Croatian islands at one point in time, i.e. to changes in the demographic characteristics of the Croatian islands over a shorter or longer period of time. In this sense, it can be said that in older studies, the demographic characteristics of the Croatian islands were conducted without the use of GIS technology (e.g. Novosel-Žic 1976, Novosel-Žic 1987, Stražičić 1977, Crkvenčić 1992, Nejašmić 1992, Lajić, 1993, Lajić and Nejašmić 1994, Podgorelec 1999, Lajić and Mišetić 2013a). In more recent studies, GIS technology was used, whereby we can differentiate between studies that only used it for cartographic displays (e.g. Lajić and Mišetić 2013b, Marinković 2020) and those in which spatial analysis methods were used (e.g. Jovanić 2011, Jovanić and Turk 2013).

The application of the model is not often represented in studies of individual Croatian islands. Lajić and Mišetić (2006) conducted a study on the state and contemporary demographic processes on the Croatian islands. Among other things, they constructed a multivariate model of the future demographic development of certain island groups. Šulc (2014, 2016) used the model to conduct a study related to the area of the Croatian islands. However, these models differ from the model used in this study in several segments. There are differences in the data used, which is in accordance with the differences in the purposes of the models. In the model applied in this study, it refers to current demography, while in other researches it is future demographic development (Lajić and Mišetić 2006) and tourism (Šulc 2014, 2016). Also, the above models do not contain methods of spatial analysis, while in this study, a GIS model was used that contains data and methods of spatial analysis along with the applied methodology of O'Neill et al. (1989) whereby each analyzed phenomenon is observed on at least three levels.

From the above, it is evident that this study stands out from previously conducted studies on the demography of the Croatian islands, primarily due to the application of a GIS model, which is comprised of selected demographic data and methods of spatial analyses, whereby a methodology was applied in which each analyzed phenomenon is observed on at least three levels.

³ At the time of writing this paper, only the first results of the 2021 census were published and available, as part of which only data on the total number of inhabitants were published.



Slika 1. Cresko-lošinjско područje – područje istraživanja. Izvor: DARH; SRPJ.

Fig. 1 Cres-Lošinj area – research area. Source: DARH; SRPJ.

će u konačnici rezultirati zaostajanjem u odnosu na procese koji su se u skladu s prilikama odvijali na kopnu i onim otocima bliže kopnu (Stražičić 1977).

Područje istraživanja ovog rada je cresko-lošinjско područje, a prema udaljenosti od kopna pripadaju vanjskim otocima (Nejašmić 1992, Podgorelec 1999). Uz površinski veće otoke Cres i Lošinj, ovo područje obuhvaća još i površinski manje otoke: Ilovik, Susak, Unije, Male i Vele Srakane te veći broj nenaseljenih otočića (Podgorelec 1999). Prema trenutnoj administrativno-teritorijalnoj organizaciji područje istraživanja ovog rada obuhvaća dvije jedinice lokalne samouprave – Grad Cres i Grad Mali Lošinj, koje su u sastavu Primorsko-goranske županije. Gradu Cresu pripada ukupno 26 naselja koja se nalaze na području otoka Cresa. Gradu Mali Lošinj pripada ukupno 14 naselja koja su raspoređena na području otoka Lošinja (5 naselja) te ostalih otoka: Cresa (4 naselja), Malih Srakana (1), Velih Srakana (1), Unija (1), Ilovika (1) i Suska (1) (slika 1). Ukupna je površina područja istraživanja oko 515,9 km², pri čemu je Grad Cres nešto veći (291,6 km²) od Grada Malog Lošinja (224,3 km²).

Prema posljednjem je popisu stanovništva iz 2021.³ godine na cresko-lošinjskom području zabilježeno 10 303 stanovnika. Najveća su naselja ujedno jedina naselja gradskog tipa – Mali Lošinj (s 5577 stanovnika, 2021) i Cres (2205 stanovnika, 2021).

Cilj je ovog istraživanja prostorno analizirati promjene odabranih demografskih obilježja cresko-lošinjskog područja primjenom GIS modela razvoja naseljenosti cresko-lošinjskog područja. U primijenjenom su modelu rada korišteni podatci svih do sada provedenih popisa stanovništva (1857–2021), a detaljnija je analiza provedena od sredine 20. stoljeća (1948–2021). Između ostalog, pri modelu su korištene metode prostorne analize *Mean Center* i *Standard Deviational Ellipse (Directional Distribution)* koje su sastavni dio osnovnog

³ U trenutku pisanja ovog rada bili su objavljeni i dostupni jedino prvi rezultati popisa stanovništva iz 2021. godine, u kojima su vidljivi samo podatci o ukupnom broju stanovnika.

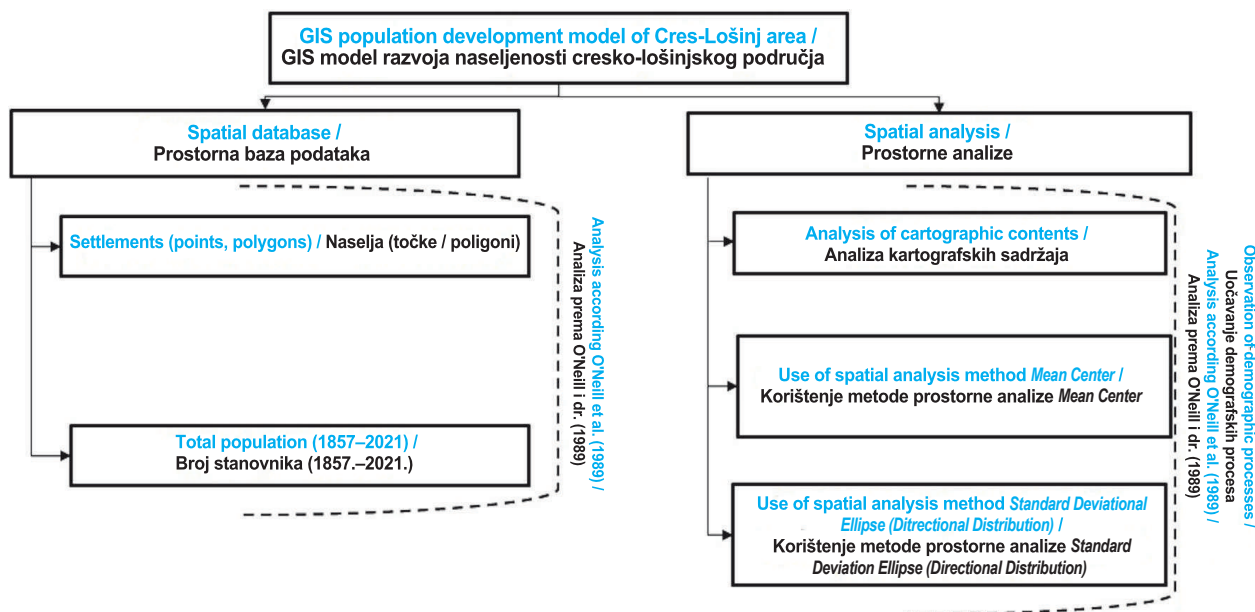


Fig. 2 GIS model of population development of the Cres-Lošinj area applied in this study.

Slika 2. GIS model razvoja naseljenosti cresko-lošinjskog područja primijenjen u ovom istraživanju.

2 Methodological Notes to the Application of the GIS Model of Population Development in the Cres-Lošinj Area

In this paper, the applied GIS model of population development in the Cres-Lošinj area consists of the data and spatial analyses used (Figure 2). The data used in this study refer to the census data entered in the spatial databases, while spatial analysis was used to determine demographic processes, i.e. trends in the Cres-Lošinj area. Namely, in this study, a general or neutral object-oriented GIS model was applied, which means it contains data related to settlements. This allowed for the application of content analysis on three levels – the aim of this study was to apply the methodology of O'Neill et al. (1989) as part of which each analyzed phenomenon is observed on at least three levels. Although it was created on examples of ecological systems, in this paper it was applied to the analysis of demographic characteristics of the Cres-Lošinj area due to its hierarchical approach, i.e. hierarchical theory. This means that the focal level or level of analysis is in the center of attention. It is limited by the control conditions of the level above (+1 level), whereby it receives a new function, and the level below (-1 level) with the connection elements of the focal level. Therefore, it can be said that in the conceptual model of the database of this paper, the local

self-government units are represented by grouped settlements within the corresponding local self-government units, whereby they become the basis for the analysis of the focal level or level of analysis (0 level). The level above (+1 level) is represented by the Cres-Lošinj area as a whole. The level below (-1 level) is represented by the settlements.

2.1 Methodological notes to the census data used

Within the spatial database of the applied GIS model of population development in the Cres-Lošinj area, there are census data entered into the spatial database. Of the geometric data, two databases were used in the paper to create the GIS model: *The Digital Atlas of the Republic of Croatia (DARH)*⁴ and *the Central Register of Spatial Units (SRPJ)*⁵. For the purpose of the spatial analysis of demographic trends in the Cres-Lošinj area, this paper used published data of all population censuses, i.e. in the 1857–2021 period, as attribute data at the settlement

⁴ This spatial base was used because of the data, i.e. the layers related to the display of the exact position of the settlements in the form of a point.

⁵ This spatial database is used for data, i.e. layers related to the representation of settlements in the form of polygons.

softverskog paketa ArcGIS Desktop verzije 10.0 proizvođača ESRI te je primijenjena metodologija O'Neill i dr. (1989) gdje se svaki analizirani fenomen promatra u najmanje trima razinama. Navedena je metodologija primijenjena u ovom istraživanju razvoja demografskih obilježja zbog svog hijerarhijskog pristupa na kojem se temelji. Pritom je omogućena dublja analiza demografskih procesa jer su promatrane jedinice lokalne samouprave na fokalnoj razini, naselja na razini ispod te cresko-lošinjsko područje u cjelini na razini iznad. S druge strane, u dosadašnjim se istraživanjima u kojima je korištena GIS tehnologija dinamika stanovništva u različitim kontekstima analizira na jednoj razini (npr. Shi 2010, Nyussupova i Radionova 2011) ili na dvjema razinama (npr. Antipova i dr. 2012, Ficior i dr. 2021, Onyango i dr. 2021, Wiatkowska i dr. 2021).

U dosadašnjim su istraživanjima, koja se odnose na demografska obilježja hrvatskih otoka u jednoj vremenskoj točki, odnosno promjena demografskih obilježja hrvatskih otoka kroz kraće ili duže vremensko razdoblje, korištene različite metode. Pritom se može reći da su u istraživanjima prvenstveno starijih datuma demografska obilježja hrvatskih otoka provedena bez korištenja GIS tehnologije (npr. Novosel-Žic 1976, Novosel-Žic 1987, Stražičić 1977, Crkvenčić 1992, Nejašmić 1992, Lajić, 1993, Lajić i Nejašmić 1994, Podgorelec 1999, Lajić i Mišetić 2013a). U pojedinim je novijim istraživanjima korištena GIS tehnologija, pri čemu se mogu razlikovati istraživanja u kojima je korištena samo za kartografske prikaze (npr. Lajić i Mišetić 2013b, Marinković 2020) od onih istraživanja u sklopu kojih su korištene metode prostorne analize (npr. Jovanić 2011, Jovanić i Turk 2013).

Primjena modela nije često zastupljena u istraživanjima pojedinih hrvatskih otoka. Lajić i Mišetić (2006) su proveli istraživanje stanja i suvremenih demografskih procesa na hrvatskim otocima. Između ostalog, pritom su konstruirali viševarijantni model budućega demografskog razvitka pojedinih otočnih skupina. Šulc (2014, 2016) je korištenjem modela proveo istraživanje koje se odnosi na prostor hrvatskih otoka. Međutim, navedeni se modeli razlikuju od modela korištenog u ovom istraživanju u više segmenata. Postoje razlike korištenih podataka, što je sukladno razlikama u svrhama modela. U modelu primijenjenom u ovom istraživanju to se odnosi na dosadašnju demografiju, dok je kod ostalih istraživanja to budući demografski razvitak (Lajić i Mišetić, 2006) i turizam (Šulc 2014, 2016). Također, navedeni modeli ne sadrže metode prostorne analize, dok je u ovom istraživanju korišten GIS model koji sadrži podatke i metode prostorne analize uz primijenjenu metodologiju O'Neill i

dr. (1989), gdje se svaki analizirani fenomen promatra u najmanje trima razinama.

Iz navedenog je vidljivo kako se ovo istraživanje izdvaja od prethodno provedenih istraživanja demografije hrvatskog otočja, prvenstveno zbog primjene GIS modela koji se sastoji od odabranih demografskih podataka i (metoda) prostornih analiza, pri čemu je primijenjena metodologija u kojoj se svaki analizirani fenomen promatra u najmanje trima razinama.

2. Metodološke napomene uz primjenu GIS modela razvoja naseljenosti cresko-lošinjskog područja

U ovom se radu primijenjeni GIS model razvoja naseljenosti cresko-lošinjskog područja sastoji od korištenih podataka i prostornih analiza (slika 2). Podatci koji su korišteni u ovom istraživanju odnose se na podatke popisa stanovništva koji su uneseni u prostorne baze podataka, dok su prostorne analize korištene kako bi se utvrdili demografski procesi, odnosno trendovi na cresko-lošinjskom području. Naime, u ovom je istraživanju primijenjen opći, odnosno neutralni GIS model koji je objektivno orijentiran, tj. sadrži podatke koji se odnose na naselja. Time je omogućena primjena analize sadržaja na trima razinama - u ovom se istraživanju težilo primijeniti metodologiju O'Neill i dr. (1989), gdje se svaki analizirani fenomen promatra u najmanje trima razinama. Premda je nastala na primjerima ekoloških sustava, u ovom je radu primijenjena za analizu demografskih obilježja cresko-lošinjskog područja zbog hijerarhijskog pristupa, odnosno hijerarhijske teorije. Tako je u središtu pozornosti fokalna razina ili razina analize. Ona je ograničena kontrolnim uvjetima razine iznad (razina +1), čime zaprima i novu funkciju, te razinom ispod (razina -1) s elementima povezanosti fokalne razine. Stoga se može reći kako su u konceptualnom modelu baze podataka ovoga rada jedinice lokalne samouprave predstavljene grupiranim naseljima razina -1 unutar pripadajućih jedinica lokalne samouprave, čime one postaju temelj za analizu fokalne razine ili razine analize (0 razina). Razinu iznad (razina +1) predstavlja cresko-lošinjsko područje u cjelini. Razinu ispod (razina -1) predstavljaju naselja.

2.1. Metodološke napomene uz korištene popisne podatke

Unutar prostorne baze podataka u ovom radu primijenjenog GIS modela razvoja naseljenosti cresko-lošinjskog područja nalaze se popisni podatci uneseni u prostornu bazu podataka. Od geometrijskih podataka u

level. Namely, the first modern general population census was conducted in Croatia in 1857, and 16 more censuses have been conducted since then⁶. This is why for the purpose of a basic analysis of demographic dynamics, that is, to gain a better insight into demographic trends over a longer period of time, all censuses conducted so far were observed. However, due to significant spatial changes in demographic trends – very strong emigration and then immigration processes conditioned by socio-economic processes that took place differently in the research area⁷, the time period from the mid-20th century onwards (1948–2021) was observed in more detail.

It should be noted that when analyzing the demographic indicators of the censuses considered, we should note the methodological differences of the censuses conditioned by different census conceptions and definitions. Namely, the censuses from 1857, 1948, 1953, 1961, 1971, 1981 and 1991 were conducted according to the concept of a permanent population (the so-called *de iure* population), while the censuses from 1869, 1880, 1890, 1900, 1910, 1921 and 1931 were conducted according to the concept of the present population (the so-called *de facto* population) (e.g. Nejašmić 1991, Lajić and Nejašmić 1994), whereas the last three censuses (2001, 2011, 2021) were conducted according to the adapted concept of a usual place of residence. It follows from the above that due to methodological differences, census results are not fully comparable (e.g. Pokos 2003, Lajić and Mišetić 2013a). Due to the lack of fully harmonized census indicators and for the purpose of presenting the general demographic trends as faithfully as possible, the official census results published on the official website of the CBS are used as factual results in this paper and are compared with each other. However, the described inconsistency of census indicators should be taken into account in the obtained results.

2.2 Methodological notes to the spatial analysis methods used

In accordance with the methodology of O'Neill et al. (1989) applied in this study (explained in more detail in Section 2 of this paper), the analyses were carried out

for the Cres-Lošinj area as a whole, then separately for the Town of Cres and the Town of Mali Lošinj, and then for the individual settlements (particularly the centers of the local self-government units). In this study, the *Mean Center* method of spatial analysis was used for the purpose of determining the central position of the settlement in relation to the position of all settlements, and the *Standard Deviational Ellipse (Directional Distribution)* method of spatial analysis was used for the purpose of determining the ellipse of settlement distribution in relation to the position of all settlements. Also, for the purpose of spatial analysis and determining the changes in demographic characteristics, when using the above methods, in addition to entering the location of the settlement, census data (number of inhabitants) of each settlement was also entered. This allowed for the spatial observation of the selected demographic characteristics. The methods used are an integral part of the basic software package ArcGIS Desktop version 10.0 produced by ESRI.

The *Mean Center* method is a method of spatial analysis applied for the purpose of determining the location that is the center of concentration of observed objects in the research area. The result of its application is a point with coordinate values that outline that location. In this study, two options of this method were used: the option in which only the position of all settlements is observed, which makes it possible to obtain a central position in relation to all settlements in the Cres-Lošinj area, and the option of the weighted mean center in which, in addition to the position of all settlements, the number of inhabitants of a particular census year is observed, which makes it possible to obtain the mean center of the population for that particular census year.

The *Standard Deviational Ellipse (Directional Distribution)* method is a method of spatial analysis that results in ellipses. In this study, its application determines the central tendency and concentration, that is, the dispersion of the observed settlements and population according to the census years.

3 Results

3.1 Census trends (1857—2021)

The paper observes trends in the total number of inhabitants of the Cres-Lošinj area on the basis of all the censuses published so far, i.e. 17 of them, which is how many were conducted in the 1857–2021 period. Observing the Cres-Lošinj area as a whole and at the level of the local self-government units, one can observe the persistence of two temporally unequal intervals that are

⁶ In addition to the census from 1857, censuses were also conducted in the following years: 1869, 1880, 1890, 1900, 1910, 1921, 1931, 1948, 1953, 1961, 1971, 1981, 1991, 2001, 2011 and 2021.

⁷ Shown in more detail in Section 3.1.

radu su za izradu GIS modela korištene dvije baze podataka: *Digitalni atlas Republike Hrvatske (DARH)*⁴ i *Središnji registar prostornih jedinica (SRPJ)*⁵. U svrhu prostorne analize demografskih kretanja cresko-lošinjskog područja u ovom su radu kao atributni podaci korišteni na razini naselja objavljeni podatci svih popisa stanovništva, tj. u razdoblju 1857–2021. Naime, na području Hrvatske je 1857. godine proveden prvi moderni opći popis stanovništva, a od tada je provedeno još 16 popisa.⁶ Time su u svrhu temeljne analize demografske dinamike, odnosno dobivanja boljeg uvida u demografska kretanja kroz duže vremensko razdoblje, promotreni svi do sada provedeni popisi. Međutim, zbog znatne prostorne promjene demografskih kretanja, vrlo snažnih emigracijskih, a potom i imigracijskih procesa uvjetovanih društveno-gospodarskim procesima koji su se na prostoru istraživanja različito odvijali,⁷ detaljnije je promotreno vremensko razdoblje od sredine prošlog stoljeća (1948–2021).

Potrebno je napomenuti da pri analizi demografskih pokazatelja razmotrenih popisa stanovništva treba imati u vidu metodološke razlike popisa uvjetovane različitim popisnim koncepcijama i definicijama. Naime, popisi iz 1857, 1948, 1953, 1961, 1971, 1981. i 1991. provedeni su prema koncepciji stalnog stanovništva (tzv. *de iure* stanovništvo), popisi iz 1869, 1880, 1890, 1900, 1910, 1921. i 1931. provedeni su prema koncepciji prisutnog stanovništva (tzv. *de facto* stanovništvo) (npr. Nejašmić 1991, Lajić i Nejašmić 1994), a posljednja tri popisa (2001, 2011, 2021) provedena su prema prilagođenoj koncepciji uobičajenog mjesta stanovanja. Iz navedenoga proizlazi kako zbog metodoloških razlika popisni rezultati nisu u potpunosti usporedivi (npr. Pokos 2003; Lajić i Mišetić 2013a). Uslijed nedostatka potpuno usklađenih popisnih pokazatelja i u svrhu što vjernijega prikaza općih demografskih trendova, službeni su popisni rezultati, koji su objavljeni na službenim stranicama DZS-a, u ovom radu korišteni kao činjenični i međusobno su komparirani. Međutim, opisano je neusklađenost popisnih pokazatelja potrebno uzeti u obzir pri dobivenim rezultatima.

⁴ Ova je prostorna baza korištena zbog podataka, odnosno slojeva koji se odnose na prikaz točne pozicije naselja u obliku točke.

⁵ Ova je prostorna baza korištena zbog podataka, odnosno slojeva koji se odnose na prikaz naselja u obliku poligona.

⁶ Uz navedeni popis iz 1857, provedeni su popisi stanovništva još sljedećih godina: 1869, 1880, 1890, 1900, 1910, 1921, 1931, 1948, 1953, 1961, 1971, 1981, 1991, 2001, 2011. i 2021.

⁷ Detaljnije prikazano u poglavlju 3.1.

2.2. Metodološke napomene uz korištene metode prostorne analize

Sukladno u ovom istraživanju primijenjenoj metodologiji O'Neill i dr. (1989) (objašnjeno u poglavlju 2 ovog rada), analize su provedene za cresko-lošinjsko područje u cjelini, zatim zasebno za Grad Cres i Grad Mali Lošinj te su promotrena i naselja (naročito sjedišta jedinica lokalne samouprave). U ovom je istraživanju korištena metoda prostorne analize težišta (*Mean Center*) u svrhu utvrđivanja središnjeg položaja naselja u odnosu na položaj svih naselja, a metoda prostorne analize elipsa standardnih devijacija (distribucija smjerova) (*Standard Deviational Ellipse (Directional Distribution)*) korištena je u svrhu utvrđivanja elipse razmještaja naselja u odnosu na položaj svih naselja. Također, u svrhu prostorne analize i utvrđivanja promjena demografskih obilježja pri korištenju navedenih metoda su, uz unos položaja naselja, uneseni i popisni podaci (broj stanovnika) svakog naselja. Time je omogućeno prostorno praćenje odabranih demografskih obilježja. Korištene su metode sastavni dio osnovnog softverskog paketa ArcGIS Desktop verzije 10.0 proizvođača ESRI.

Mean Center je metoda prostorne analize primijenjena u svrhu utvrđivanja lokacije koja je centar koncentracije promatranih objekata na području istraživanja. Rezultat je njezine primjene točka s vrijednostima koordinata koje ocrtavaju tu lokaciju. U ovom su istraživanju korištene dvije opcije ove metode: opcija pri kojoj se promatra samo položaj svih naselja, čime se omogućava dobivanje centralnog položaja u odnosu na sva naselja cresko-lošinjskog područja, te opcija ponderiranog težišta pri kojoj se, uz položaj svih naselja, dodatno promatra i broj stanovnika pojedine popisne godine, čime se omogućava dobivanje težišta naseljenosti za tu popisnu godinu.

Elipsa standardnih devijacija (Distribucija smjerova) (*Standard Deviational Ellipse (Directional Distribution)*) je metoda prostorne analize čiji su rezultat elipse s vrijednostima (za centar - koordinate X i Y; za radijuse elipse - standardne udaljenosti za X i Y; za rotaciju). U ovom se istraživanju njezinom primjenom utvrđuju centralna tendencija te koncentracija, odnosno raspršenost promatranih naselja i naseljenosti prema popisnim godinama.

3. Rezultati

3.1. Popisno kretanje (1857–2021)

Razmotreno je kretanje ukupnog broja stanovnika cresko-lošinjskog područja svih do sada objavljenih popisa stanovništva, dakle njih 17, koliko ih je provedeno u razdoblju 1857–2021. Promatrajući cresko-lošinjsko

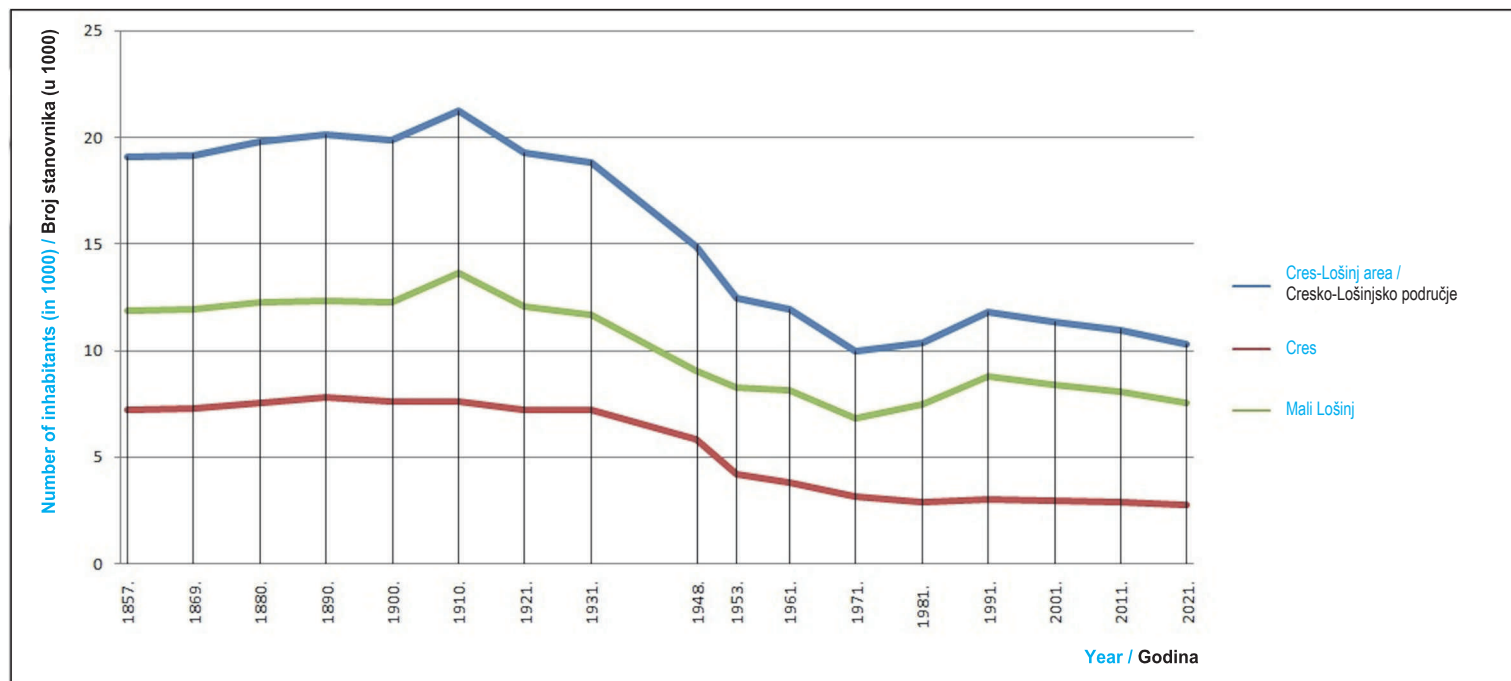


Fig. 3 Changes in the total number of inhabitants of the Cres-Lošinj area (1857–2021). Source: CBS (2022a, 2022b, 2022c).

Slika 3. Kretanje ukupnog broja stanovnika cresko-lošinjanskog područja (1857–2021). Izvor: DZS (2022a, 2022b, 2022c).

significant with regard to the prevailing trend of demographic dynamics (Figure 3):

- 1) The interval of demographic expansion with a predominant but discontinuous increase in the total number of inhabitants (1857–1910).
 - 2) The interval of demographic regression with a predominant but discontinuous decline in the total number of inhabitants (1910–2021).
- 1) Between 1857 and 1910, the total number of inhabitants of the Cres-Lošinj area increased from 19,085 to 21,260 inhabitants, which is the highest recorded number of inhabitants of this area so far. In this 53-year period, the number of inhabitants increased by 2,175 inhabitants, i.e. by an average of 41 inhabitants per year. The demographic increase, despite emigration, was a consequence of the entry of the population of the Cres-Lošinj area into the early sub-stage of the demographic transition. This means that a relatively high birth rate and a sharp reduction in death-rate have resulted in a very high natural increase.

Emigration affected both the surrounding islands (e.g. the Island of Krk) and the Cres-Lošinj area, and was conditioned by the demise of sailing ships and vine disease, which is why the population emigrated to overseas countries (Novosel-Žic 1987) and to Rijeka (Klempić-Bogadi and Podgorelec 2009). The

predominance of emigration against demographic growth affected Cres in the late 19th century, while in the early 20th century it also affected Lošinj and the islands of the Lošinj archipelago.

- 2) Between 1910 and 2021, the research area recorded a double decrease in the total number of inhabitants (from 21,260 to 10,303), that is, by 10,957 inhabitants, i.e. by an average of 99 inhabitants per year. Figure 3 shows that from 1910 to 1971 and from 1991 to 2021, each census recorded a decline in the total number of inhabitants of the entire Cres-Lošinj area, as well as the towns of Cres and Mali Lošinj. The emergence and strengthening of such continuous depopulation was influenced by the demographic and other consequences of the world wars, the emigration of the predominantly Italian population due to the change in the jurisdiction over the Cres-Lošinj area, followed by the strengthening of migration from the countryside to the cities and the departure of the population to so-called temporary work abroad, particularly of the younger vital and fertile population, as well as demographic aging, natural population decline, etc.

It should be noted that in both of these time intervals, one and two inter-census periods were recorded with a decrease and an increase in the number of inhabitants in the Cres-Lošinj area as a whole. The first interval

područje u cjelini te na razini jedinice lokalne samouprave, može se uočiti postojanost dvaju vremenski nejednakih, ali s obzirom na prevladavajući trend demografske dinamike signifikantnih intervala (slika 3):

- 1) intervala demografske ekspanzije s prevladavajućim, ali nekontinuiranim porastom ukupnog broja stanovnika (1857–1910)
 - 2) intervala demografskog regressa s prevladavajućim, ali nekontinuiranim padom ukupnog broja stanovnika (1910–2021).
- 1) Između 1857. i 1910. ukupan je broj stanovnika cresko-lošinjskog područja povećan s 19 085 na 21 260 stanovnika, što je najveći do sada zabilježen broj stanovnika toga područja. U tom se razdoblju od 53 godine broj stanovnika povećao za 2175 stanovnika, tj. prosječno godišnje za 41 stanovnika. Demografski je porast, unatoč emigraciji, bio posljedica ulaska stanovništva cresko-lošinjskog područja u ranu podetapu demografske tranzicije. To znači da su relativno visok natalitet i snažno smanjenje mortaliteta rezultirali vrlo visokim prirodnim prirastom. Emigracija je zahvatila kako okolne otoke (npr. otok Krk), tako i cresko-lošinjsko područje, a uvjetovana je propašću jedrenjaka i bolesti vinove loze, zbog čega stanovništvo emigrira u prekomorske zemlje (Novosel-Žic 1987) i u Rijeku (Klempić-Bogadi i Podgorelec 2009). Prevaga iseljavanja naspram demografskom porastu zahvatila je Cres krajem 19. stoljeća, dok je početkom 20. stoljeća zahvatila i Lošinj te otoke lošinjskog arhipelaga.
- 2) Između 1910. i 2021. prostor istraživanja zabilježio je smanjenje ukupnoga broja stanovnika za dva puta (s 21 260 na 10 303), odnosno za 10 957 stanovnika, tj. prosječno godišnje za 99 stanovnika. Na slici 3 vidljivo je da je od 1910. do 1971. te od 1991. do 2021. svakim popisom zabilježen pad ukupnog broja stanovnika cresko-lošinjskog područja u cijelosti te Grada Cresa i Grada Malog Lošinja. Na pojavu i jačanje takve kontinuirane depopulacije utjecale su demografske i druge posljedice svjetskih ratova, iseljavanje pretežno talijanskog stanovništva zbog promjene nadležnosti vlasti nad cresko-lošinjskim područjem, zatim jačanje migracije iz sela u gradove te odlazak na tzv. privremeni rad u inozemstvo, napose mlađeg vitalnog i fertilnog stanovništva, kao i demografsko starenje, prirodni pad stanovništva itd.

Potrebno je izdvojiti da je u obama navedenim vremenskim intervalima zabilježeno po jedno, odnosno dva međupopisna razdoblja s padom, odnosno porastom broja stanovnika na cresko-lošinjskom području u cjelini. U prvome je intervalu riječ o međupopisu 1890–1900 tijekom kojega je zabilježen manji demografski pad

(–1,2%). S druge strane, u drugom je intervalu riječ o međupopisima 1971–1981 i 1981–1991 u kojima je za cresko-lošinjsko područje u cjelini zabilježen znatan demografski porast (3,7%, odnosno 13,9%). Međutim, potrebno je naglasiti da je u međupopisu 1971–1981 zabilježen rezultat porasta broja stanovnika na području Grada Malog Lošinja (točnije samo kod naselja Mali Lošinj i Veli Lošinj). Razlog tome je smanjenje iseljavanja s jedne strane i useljavanje zbog razvoja turizma s druge strane, što je vidljivo kao pozitivni migracijski saldo i pozitivna prirodna promjena (Lajić 1993). Na području je Grada Cresa u tom međupopisu zabilježen pad ukupnog broja stanovnika jer je izostao značajniji razvoj turizma te je došlo do daljnjeg pada broja stanovnika kod većine naselja (osim kod naselja Cres, Filozići, Miholašćica i Loznati gdje je zabilježen porast broja stanovnika). U drugom je spomenutom međupopisu (1981–1991) zabilježen znatan porast ukupnog broja stanovnika (13,9%), a rezultat je porasta na području Grada Cresa i Grada Lošinja.

3.2. Popisno kretanje (1948–2021)

Popisno se kretanje u razdoblju 1948–2021 u ovom istraživanju promatra izdvojeno. Naime, nakon Drugog svjetskog rata ovo je područje zahvatio proces deagrarijacije, tj. prestanak bavljenja poljoprivredom uz prelazak na druge djelatnosti (Crkvenčić 1992) koje su na ovom području prvenstveno vezane uz turizam. Posljedično su u ovom razdoblju zabilježene znatne prostorne promjene demografskih kretanja – vrlo snažni emigracijski, a potom i imigracijski procesi koji su se na prostoru istraživanja različito odvijali.

U prvim je poslijeratnim godinama nastavljen proces pada ukupnog broja stanovnika u cresko-lošinjskom području u cjelini, kao i na području Grada Cresa i Grada Malog Lošinja (tablica 1). Uvjetovan je prvenstveno iseljavanjem zbog razmjerno visoke agrarne gustoće, a potom i iseljavanjem uglavnom talijanskog stanovništva zbog vraćanja otoka Cresa i Lošinja Hrvatskoj. Osim toga, krajem šezdesetih, kao što su iseljavali iz ostalih krajeva Hrvatske, tako je dio cresko-lošinjskog stanovništva iselio u zapadnoeuropske zemlje, a zamjetna su i iseljavanja s malih lošinjskih otoka u prekomorske zemlje (npr. s otoka Suska u SAD) (Podgorelec 1999).

Obrat od snažnih iseljavanja prema useljavanjima započinje šezdesetih godina kada je zabilježeno useljavanje na otok Lošinj, a sedamdesetih na Cres. To je u kretanjima ukupnog broja stanovnika vidljivo u porastu broja stanovnika prvo Grada Malog Lošinja (međupopis 1971–1981), a potom Grada Cresa (međupopis 1981–1991). Razlog tome je izgradnja modernih hotela zbog čega je bila potreba za

is the inter-census period of 1890–1900, during which a smaller demographic decline was recorded (–1.2%). On the other hand, the second interval is represented by the intercensal periods of 1971–1981 and 1981–1991, during which a significant demographic increase was recorded for the Cres-Lošinj area as a whole (3.7% and 13.9%). However, it should be emphasized that in the intercensal period of 1971–1981, the recorded increase is the result of the increase in the number of inhabitants in the area of the Town of Mali Lošinj (specifically only in the settlements of Mali Lošinj and Veli Lošinj). The reason for this is the reduction of emigration on the one hand and immigration due to the development of tourism on the other hand, which manifested itself as a positive migration balance and a positive natural change (Lajić 1993). In the area of the Town of Cres, during this intercensal period, a decrease in the total number of inhabitants was recorded, because there was no significant development of tourism, and there was a further decrease in the number of inhabitants in most settlements (except for the settlements of Cres, Filozici, Miholaščica and Loznati, where an increase in the number of inhabitants was recorded). In the second indicated intercensal period (1981–1991), a significant increase in the total number of inhabitants was recorded (13.9%), and the result was an increase in the population of the areas of the Town of Cres and the Town of Lošinj.

3.2 Census trends (1948–2021)

Census trends during the 1948–2021 period are observed separately in this study. Namely, after World War II, this area was affected by the process of deagrarianization, i.e. the abandonment of farming and the transition to other activities (Crkvenčić 1992), primarily related to tourism in this area. As a result, significant spatial changes in demographic trends were recorded in this period – very strong emigration and then immigration processes, which took place differently in the research area.

In the first post-war years, the process of decline in the total number of inhabitants continued in the Cres-Lošinj area as a whole, as well as in the area of the Town of Cres and the Town of Mali Lošinj (Table 1). It was conditioned primarily by emigration due to relatively high agrarian density, and then by the emigration of the mainly Italian population due to the return of the islands of Cres and Lošinj to the territory of Croatia. In addition, at the end of the 1960s, just as people emigrated from other parts of Croatia, part of the Cres-Lošinj population also emigrated to Western European countries, and emigration from the small islands of the Lošinj area

to overseas countries was also noticeable (e.g. from the Island of Susak to the USA) (Podgorelec 1999).

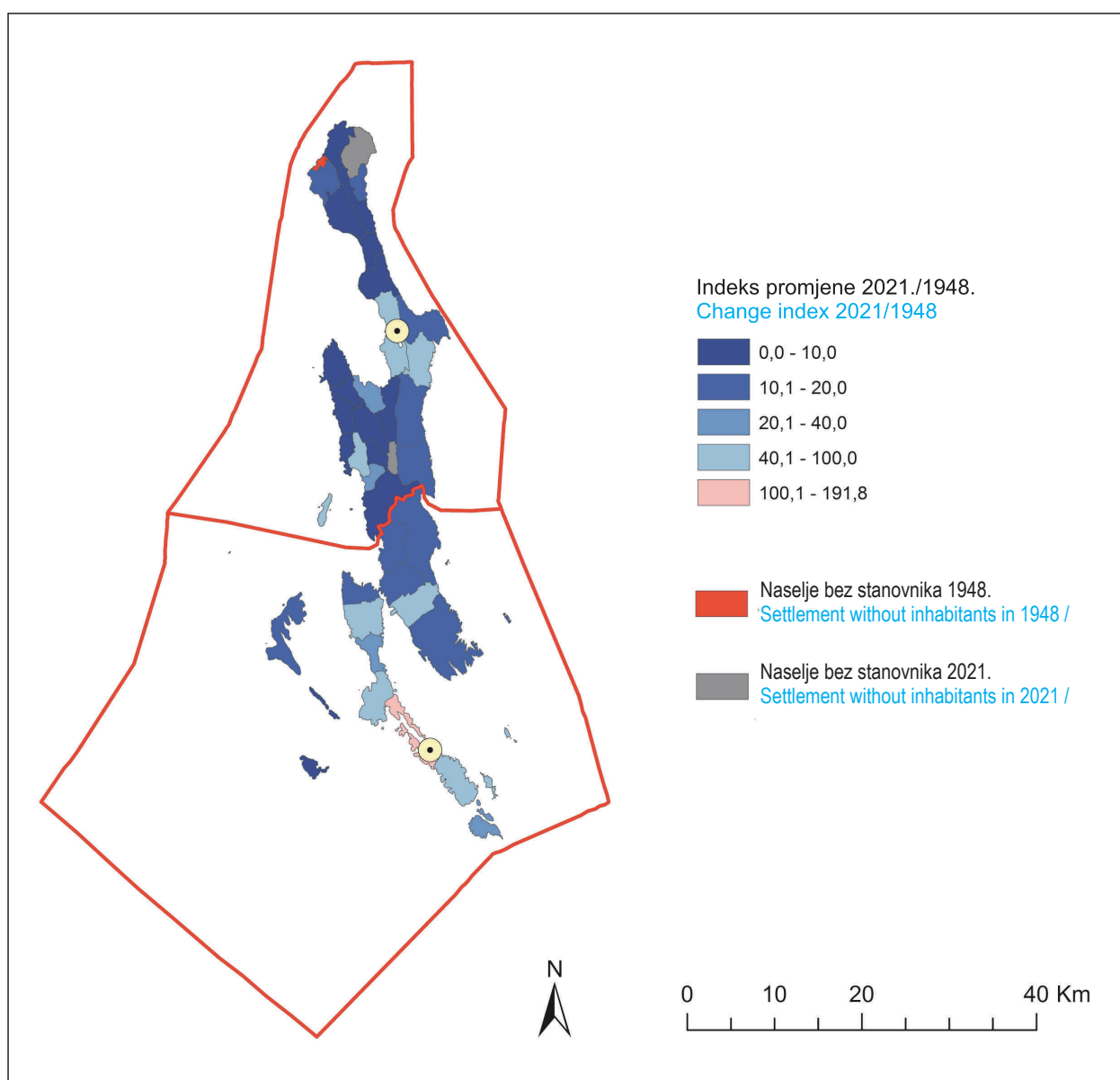
The turn from strong emigration to immigration began in the 1960s, when immigration to the island of Lošinj was recorded, and in the 1970s when immigration to the Island of Cres was recorded. When it comes to the changes in the total number of population, this is evident in the increase in the number of inhabitants, first of the Town of Mali Lošinj (intercensal period of 1971–1981) and then of the Town of Cres (intercensal period of 1981–1991). The reason for this is the construction of modern hotels, which created the need for labor in the fields of construction and tourism, but there was also the emigration of a large number of the local population because there were no jobs offered for other professions (Podgorelec 1999). In the last few censuses, a large share of the immigrant contingent has a "fictitious population", as is the case with other Kvarner islands (e.g. Lajić and Mišetić 2013b, Jovanić and Turk 2013), but despite this, since the census year 1991, a continuous population decline is recorded for the entire Cres-Lošinj area, as well as the towns of Cres and Mali Lošinj. Still, according to the latest population census (2021), on the island territory of the Republic of Croatia, with 7,565 inhabitants, the Town of Mali Lošinj is the most populated local self-government unit, and the settlement Mali Lošinj (5,577 inhabitants) the most populated settlement.

Observed by the level of settlements, it is noticeable that according to the last census (2021), all settlements, except for the town of Mali Lošinj, have fewer inhabitants than in 1948 (Figure 4). The centers of local self-government units and settlements closer to them have more favorable indicators, while settlements further away show less favorable indicators. Also, it is evident that the settlements in the area of the Town of Mali Lošinj have more favorable indicators than in the area of the Town of Cres, where according to the latest census, two settlements are without inhabitants (the settlements of Stanić and Važminec).

In the last three censuses in the Cres-Lošinj area as a whole, at the level of the self-governing unit and in almost all settlements of the Cres-Lošinj area, a continuous decrease in the number of inhabitants is recorded. This is recorded despite a slight increase in the number of inhabitants in the intercensal period of 1971–1981 in the area of the Town of Mali Lošinj, and in the intercensal period of 1981–1991 in the area of the Town of Cres and the Town of Mali Lošinj, conditioned primarily by the increase in the population of larger, i.e. coastal settlements (e.g. Cres, Mali Lošinj and Veli Lošinj) related to the emergence and development of tourism, but also the so-called "fictitious" population census. Only in the last

Tablica 1. Kretanje ukupnog broja stanovnika cresko-lošinjskog područja (1948–2021). Izvor: DZS (2022a, 2022b, 2022c).
Table 1 Changes in the total number of inhabitants of the Cres-Lošinj area (1948–2021). Source: DZS (2022a, 2022b, 2022c).

JLS / Sjedište Local Self-Government Unit / Centre	1948	1953	1961	1971	1981	1991	2001	2011	2021	2021 /1948	2021 /2011
CRES	5843	4221	3786	3145	2895	2971	2959	2879	2738	46,9	95,1
Cres	2472	1670	1866	1823	1938	2234	2333	2289	2205	89,2	96,3
MALI LOŠINJ	9079	8287	8168	6844	7466	8825	8388	8116	7565	83,3	93,2
Mali Lošinj	2908	3247	3882	4278	5244	6566	6296	6091	5577	191,8	91,6
CRESKO-LOŠINJSKO PODRUČJE UKUPNO / CRES-LOŠINJ AREA SUM	14 922	12 508	11 954	9 989	10 361	11 796	11 347	10 995	10 303	69,1	93,7



Slika 4. Indeks promjene broja stanovnika cresko-lošinjskog područja (2021/1948).
Fig. 4 Index of changes in the number of inhabitants of the Cres-Lošinj area (2021/1948).

census can a slight increase in the number of inhabitants be seen in several smaller settlements, probably due to the so-called "fictitious" census⁸.

The negative natural change that has been present on the Kvarner islands for several decades (Lajić and Mišetić 2013b) and the strong long-term emigration from the settlements in the interior of the island of Cres and from all the islands of the Lošinj archipelago have resulted in a large number of elderly, single and abandoned households (Podgorelec 1999) and a large number of very small settlements. According to the latest population census from 2021, only Cres and Mali Lošinj are settlements with over 2,000 inhabitants. The next largest towns (Veli Lošinj and Nerezine) have over 300 inhabitants, while the remaining settlements are smaller. This means that only a total of eight settlements, or 20.0% of the settlements in the Cres-Lošinj area, had more than 100 inhabitants. There are a total of six of them in the area of the town of Mali Lošinj, while two are in the area of the town of Cres, where the disparity in the size of the settlements is particularly pronounced. Cres (2,205 inhabitants) has several times more inhabitants than the remaining 25 settlements, with only one settlement larger than 100 inhabitants - Martinšćica (106 inhabitants).

3.3 Shifts in mean centers of population

As described above (Section 2.2), different methods were used in this study in order to spatially analyze and determine the mean centers of settlements in the Cres-Lošinj area and changes in demographic characteristics. In addition to the method in which only the position of the settlement is entered, whereby a point is obtained that actually represents the central position in relation to all the observed settlements, this study also used a method of spatial analysis which, in addition to entering the position of the settlement, also enters the census data (number of inhabitants) of each settlement.

Taking into account only the location of the settlements in the Cres-Lošinj area as a whole, the results showed that the central location of the settlements is located in the central part of the island of Cres, within

the local self-government unit of the Town of Cres (Figure 5). On the other hand, taking into account the location of the settlements and the number of inhabitants of each settlement in each census year, it is evident that the mean center of the population in each observed census year is located south of the central location of the settlement and is located on the southern part of the island of Cres, within the local self-government unit of the Town of Mali Lošinj. This shows that a larger number of smaller settlements are located in the northern part of the research area, while larger settlements (with a larger number of inhabitants) are located in the southern part.

Observing the shifts in the mean center of the population of the Cres-Lošinj area as a whole, it is evident that from the first population census (1857) to the mid-20th century (1948), the tendency was towards the north. The reason for this is primarily that in the southern area (within the local self-government unit of the City of Mali Lošinj) there was a strong decrease in the number of inhabitants (for example, the settlement of Mali Lošinj decreased by 2,718 inhabitants, and Veli Lošinj decreased by 898 inhabitants). Namely, Section 3.1 describes that until 1910, an increase in the number of inhabitants was recorded in the Cres-Lošinj area as a whole, as well as in both local self-government units, which was conditioned primarily by an increase in the birth rate. Figure 5 shows that during this period there was no major shift in the mean center of the population. However, after 1910 there was a decrease in the number of inhabitants, primarily due to emigration. From the movement of the mean center of the population towards the north from 1910 to 1948, it is evident that this decrease in the number of inhabitants (emigration) was more pronounced in the southern part of the research area, that is, less pronounced in the northern part of the research area.

From the mid-20th century, more precisely from 1948 to 1991, there was a significant shift in the mean center towards the southern part of the research area. Namely, as described above (Sections 3.1 and 3.2), a decrease in the number of inhabitants was recorded from 1948 to 1971, and from the movement of the mean center of the population towards the southwest, it is evident that this decrease was more pronounced in the northern part of the research area, that is, less pronounced in the southern part. In the following intercensal periods, from 1971 to 1981 and from 1981 to 1991, in conditions of population growth in the Cres-Lošinj area as a whole, the mean center of the population continued to move towards the southwest. In the intercensal period from 1971 to 1981, the movement of the

⁸ When during the formal population census, for example, individuals indicate their place of residence on the islands and thereby try to obtain certain benefits (avoidance of paying vacation home taxes, etc.). This is a problem in the demographic analysis of other islands as well (Lajić and Mišetić 2013b) because the real demographic picture of a certain area is not shown.

radnom snagom iz područja građevine i turizma, ali uz iseljavanje velikog broja domaćeg stanovništva jer se ne nude radna mjesta za druge struke (Podgorelec 1999). U posljednjih nekoliko popisa velik udio u useljeničkom kontingentu ima „fiktivno stanovništvo“, kao što je to slučaj i kod ostalih kvarnerskih otoka (npr. Lajić i Mišetić 2013b, Jovanić i Turk 2013), ali unatoč tome se od popisne godine 1991. bilježi kontinuirani pad broja stanovnika cresko-lošinjskog područja u cijelosti, kao i Grada Cresa i Grada Malog Lošinja. Ipak, prema posljednjem popisu stanovništva (2021.), na otočnom području Republike Hrvatske Grad Mali Lošinj je sa 7565 stanovnika najnaseljenija jedinica lokalne samouprave, a grad Mali Lošinj (5577 stanovnika) najnaseljenije naselje.

Promatrajući razinu naselja, primjetno je da prema posljednjem popisu (2021) sva naselja, osim grada Malog Lošinja, bilježe manje stanovnika nego promatrane 1948. godine (slika 4). Povoljnije pokazatelje imaju sjedišta jedinica lokalne samouprave te naselja bliže njima, dok su s udaljavanjem nepovoljniji pokazatelji. Također, vidljivo je kako naselja na području Grada Malog Lošinja imaju povoljnije pokazatelje nego što je to na području Grada Cresa, gdje su prema posljednjem popisu dva naselja bez stanovnika (naselja Stanić i Važminec).

U posljednjim se trima popisima na cresko-lošinjskom području u cjelini, na razini jedinice samouprave i kod gotovo svih naselja cresko-lošinjskog područja bilježi kontinuirani pad broja stanovnika. To je zabilježeno unatoč blagom porastu broja stanovnika u međupopisu 1971–1981 na području Grada Malog Lošinja te u međupopisu 1981–1991 na području Grada Cresa i Grada Malog Lošinja, a koji su uvjetovani prvenstveno porastom stanovnika većih, odnosno obalnih naselja (npr. Cres, Mali Lošinj i Veli Lošinj) vezano uz pojavu i razvoj turizma, ali i tzv. „fiktivno“ popisivanje. Tek se u posljednjem popisu kod nekoliko manjih naselja može vidjeti blago povećanje broja stanovnika, vjerojatno zbog tzv. „fiktivnog“ popisivanja.⁸

Negativna prirodna promjena koja je na kvarnerskim otocima prisutna već nekoliko desetljeća (Lajić i Mišetić 2013b) i snažno dugotrajno iseljavanje iz naselja u unutrašnjosti otoka Cresa i sa svih otoka lošinjskog arhipelaga za posljedicu imaju veliki broj staračkih, samaćkih, ali i napuštenih domaćinstava (Podgorelec

1999) te veliki broj vrlo malih naselja. Prema posljednjem popisu stanovništva iz 2021. godine samo su Cres i Mali Lošinj naselja s više od 2 000 stanovnika. Sljedeća po veličini (Veli Lošinj i Nerezine) bilježe više od 300 stanovnika, a preostala naselja imaju manji broj stanovnika. Time je samo kod ukupno osam naselja, odnosno 20,0% naselja cresko-lošinjskog područja, zabilježeno više od 100 stanovnika. Pritom ih je na području Grada Malog Lošinja ukupno šest, dok su dva na području Grada Cresa gdje je nesrazmjernost veličine naselja posebno naglašen. Cres (2205 stanovnika) ima višestruko više stanovnika od preostalih 25 naselja, pri čemu je još samo jedno naselje veće od 100 stanovnika (Martinšćica, 106 stanovnika).

3.3. Kretanje težišta naseljenosti

Kao što je prethodno opisano (poglavlje 2.2), u ovom su istraživanju korištene različite metode kako bi se prostorno analizirali i utvrdili središnji položaj naselja cresko-lošinjskog područja te promjene demografskih obilježja. Tako je, uz metodu pri kojoj se unosi samo položaj naselja pri čemu se dobiva točka koja zapravo predstavlja središnji položaj u odnosu na sva promatrana naselja, u ovom istraživanju korištena metoda prostorne analize pri kojoj se, uz unos položaja naselja, unose i popisni podatci (broj stanovnika) svakog naselja.

Uzimajući u obzir samo položaj naselja cresko-lošinjskog područja u cjelini, rezultati su pokazali da se središnji položaj naselja nalazi u središnjem dijelu otoka Cresa, unutar jedinice lokalne samouprave Grada Cresa (slika 5). S druge strane, uzimajući u obzir položaj naselja i broj stanovnika svakog naselja pojedine popisne godine, vidljivo je kako se težište naseljenosti svake promatrane popisne godine nalazi južnije od središnjeg položaja naselja te se nalaze na južnom dijelu otoka Cresa, unutar jedinice lokalne samouprave Grada Malog Lošinja. Time je vidljivo kako se veći broj manjih naselja nalazi na sjevernijem dijelu područja istraživanja, dok se veća naselja (s većim brojem stanovnika) nalaze na južnijem dijelu.

Promatrajući kretanje težišta naseljenosti cresko-lošinjskog područja u cjelini, vidljivo je kako je od prvog popisa stanovništva (1857) do sredine 20. stoljeća (1948) tendencija pomicanja bila prema sjeveru. Razlog je tome prvenstveno što je na južnijem području (unutar jedinice lokalne samouprave Grada Malog Lošinja) došlo do snažnog pada broja stanovnika (npr. naselja Mali Lošinj pad za 2 718, a Veli Lošinj pad za 898 stanovnika). Naime, u prethodnom je poglavlju (poglavlje 3.1) opisano kako je do 1910. godine zabilježeno povećanje broja stanovnika na cresko-lošinjskom području u cijelosti, kao i u objema jedinicama lokalne samouprave, a uvjetovano je prvenstveno povećanjem nataliteta. Na slici 5 vidljivo je

⁸ Kada pri formalnom popisivanju stanovništva, na primjer, pojedinci navode mjesto prebivališta na otocima i time pokušaju ostvariti određene beneficije (izbjegavanje plaćanja poreza kuća za odmor i sl.), to predstavlja problem kod demografske analize i ostalih otoka (Lajić i Mišetić 2013b) jer se ne prikazuje stvarna demografska slika određenog područja.

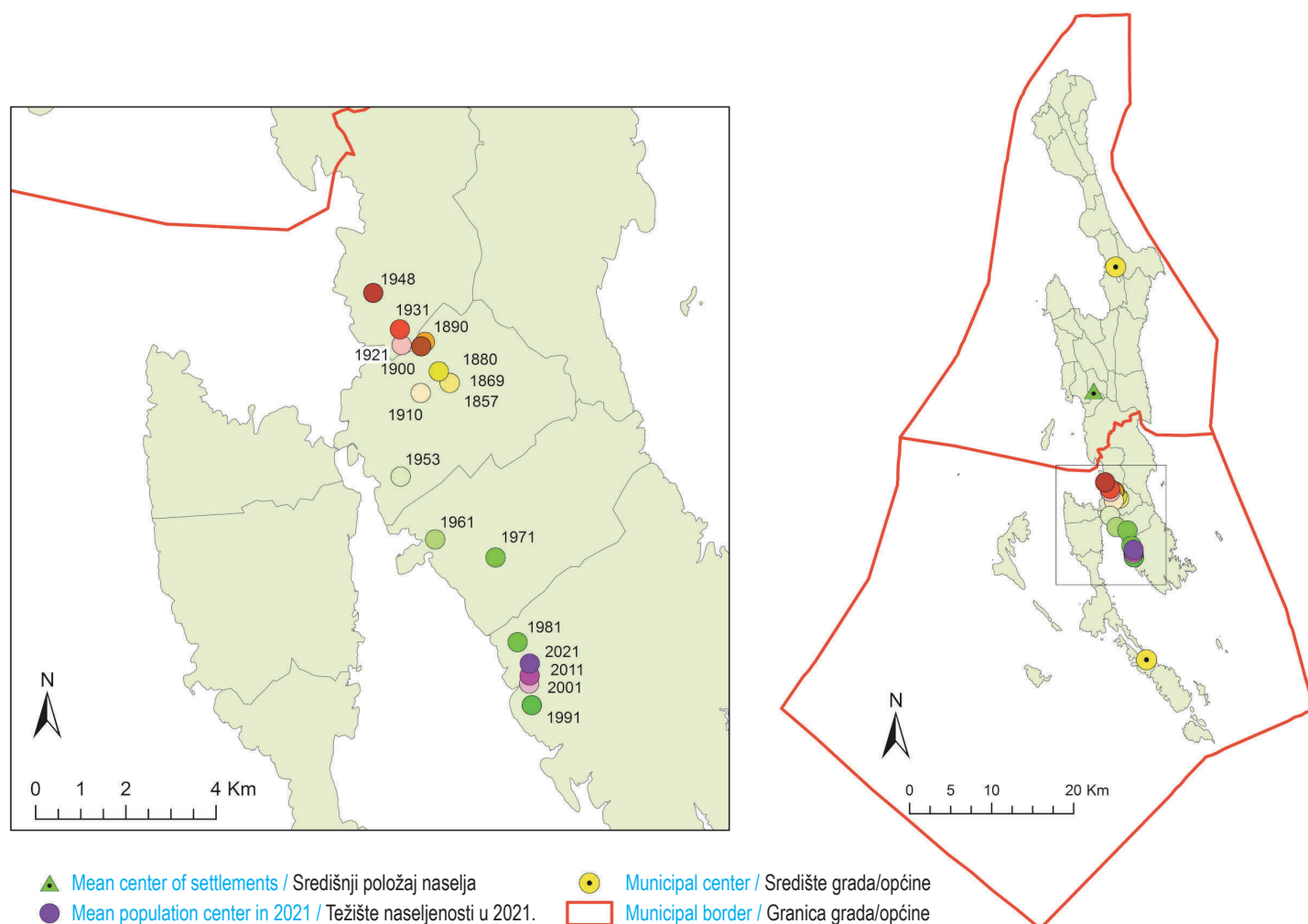


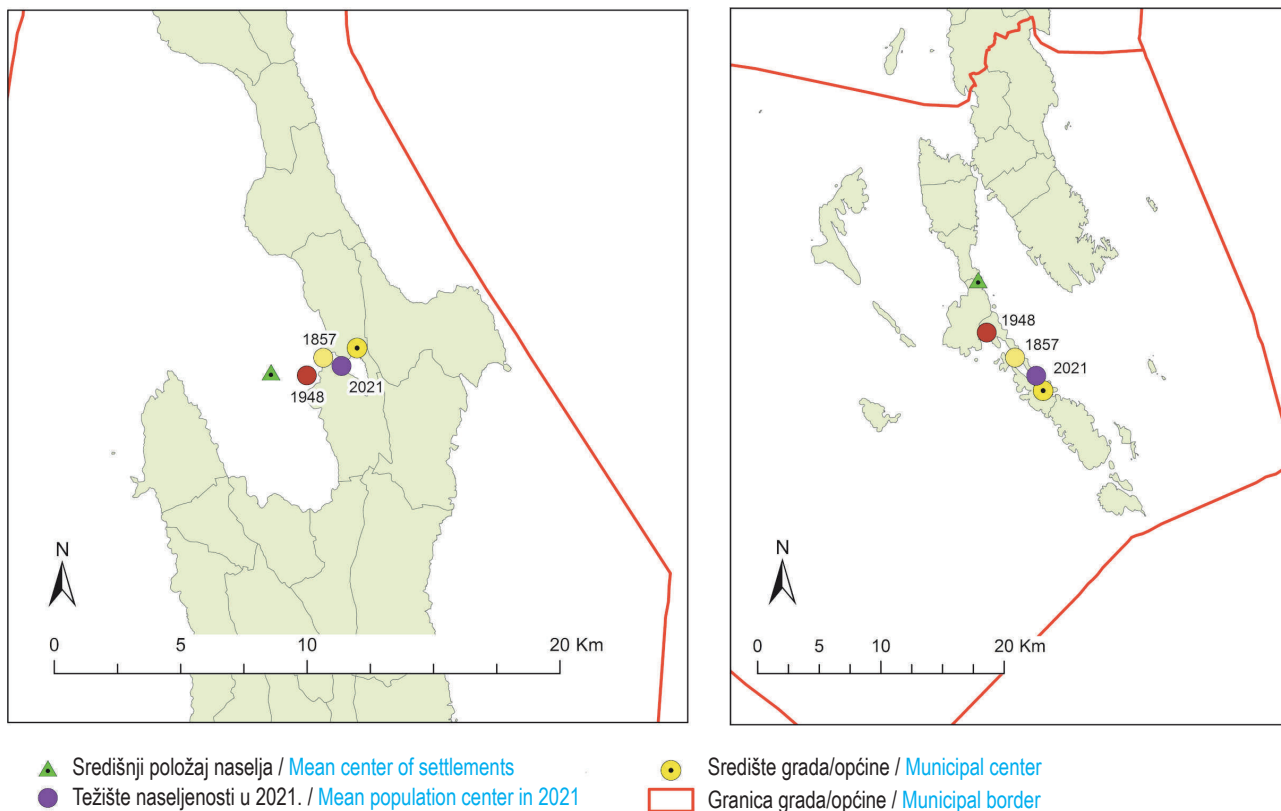
Fig. 5 Shifts in the mean center of the population of the Cres-Lošinj area as a whole (1857–2021).
Slika 5. Kretanje težišta naseljenosti cresko-lošinjškog područja u cjelini (1857–2021).

mean center of the population towards the south is the result of the increase in the number of inhabitants recorded in the area of the Town of Mali Lošinj (more precisely, only in the settlements of Mali Lošinj and Veli Lošinj) and the decrease in the total number of inhabitants in the area of the Town of Cres. In the second indicated intercensal period (1981–1991), an increase in the total number of inhabitants was recorded, both in the Town of Cres and the Town of Lošinj, as well as in the Cres-Lošinj area as a whole, and from the shift of the mean center of population towards the southwest, it is evident that the increase in the number of inhabitants was more significant in the southern part of the research area.

In the following census years (2001, 2011 and 2021), a decrease in the total number of inhabitants was recorded both in the Cres-Lošinj area and in both local

self-government units. From the slight movement of the mean center of the population towards the north, it is evident that this decrease in the total number of inhabitants is less pronounced in the northern part, and more pronounced in the southern part, where the majority of the population is located.

Among the local self-government units, there are noticeable differences in the shifts in the mean center of population (1857–2021) related to the distance and direction of movement (Figure 6). Thus, in the case of the Town of Cres, the mean center of the population has only shifted by a very short distance (about 2.5 km) and in the west-east direction, while in the case of the Town of Mali Lošinj, the mean center of the population has shifted by a slightly greater distance (about 5 km) in the northwest-southeast direction. However, a common feature of the movement of the mean center of the



Slika 6. Kretanje težišta naseljenosti za Grad Cres i Grad Mali Lošinj (1857–2021).
Fig. 6 Shift in the mean center of the population for the Town of Cres and the Town of Mali Lošinj (1857–2021).

da tijekom toga razdoblja nije došlo do velikog pomicanja težišta naseljenosti. Međutim, nakon 1910. godine dolazi do smanjenja broja stanovnika, uvjetovanog prvenstveno iseljavanjima. Prema pomicanju težišta naseljenosti na sjever od 1910. do 1948., vidljivo je da je to smanjenje broja stanovnika (iseljavanje) bilo izraženije na južnijem dijelu područja istraživanja, odnosno manje izraženo na sjevernijem području istraživanja.

Od sredine 20. stoljeća, točnije od 1948. do 1991. godine, došlo je do značajnog pomicanja težišta naseljenosti prema južnom dijelu područja istraživanja. Naime, kako je prethodno opisano (poglavlja 3.1 i 3.2) od 1948. do 1971. došlo je do smanjenja broja stanovnika, a prema pomicanju težišta naseljenosti prema jugozapadu vidljivo je da je to smanjenje bilo više izraženo na sjevernom dijelu područja istraživanja, odnosno manje izraženo na južnom dijelu. U sljedećim međupopisima 1971–1981 i 1981–1991, u uvjetima demografskog porasta na cresko-lošinjском području u cjelini, nastavljeno je kretanje težišta naseljenosti prema jugozapadu. U međupopisu 1971–1981 kretanje težišta naseljenosti prema jugu rezultat je porasta broja stanovnika koji je zabilježen na području Grada Malog Lošinja (točnije samo kod naselja

Mali Lošinj i Veli Lošinj) te pada ukupnog broja stanovnika na području Grada Cresa. U drugom je spomenutom međupopisu (1981–1991) zabilježen porast ukupnog broja stanovnika, kako Grada Cresa i Grada Lošinja, tako i cresko-lošinjского područja u cjelini, a prema pomicanju težišta naseljenosti prema jugozapadu, vidljivo je da je porast broja stanovnika bio značajniji na južnom dijelu područja istraživanja.

U sljedećim je popisnim godinama (2001, 2011. i 2021.) zabilježen pad ukupnog broja stanovnika, kako na cresko-lošinjском području, tako i u objema jedinicama lokalne samouprave. Prema blagom kretanju težišta naseljenosti prema sjeveru, vidljivo je da je to smanjenje ukupnog broja stanovnika manje izraženo na sjevernom dijelu, odnosno izraženije je na južnijem dijelu gdje se nalazi većina stanovništva.

Među jedinicama lokalne samouprave zamjetne su razlike kretanja težišta naseljenosti (1857–2021) koje se odnose na udaljenost i smjer pomicanja (slika 6). Tako je za Grad Cres to kretanje težišta naseljenosti na vrlo maloj udaljenosti (oko 2,5 km) i pomiče se u smjeru zapad-istok, a za Grad Mali Lošinj je na nešto većoj udaljenosti (oko 5 km) i pomiče se u smjeru sjeverozapad-jugoistok.

population is that in the observed period (1857–2021), and particularly the last observed year (2021), the mean centers of the population are very close to the center of the town/municipality. Also, compared to the shifts in the mean center of population in the Cres-Lošinj area as a whole (Figure 5), where it is evident that the mean center of population of each observed census year is located at a greater distance (10 to 20 km) from the central location of the settlement, for the Town of Cres and the Town of Mali Lošinj it is evident that the mean center of population is closer to the central location of the settlement.

3.4 Population direction trends

In addition to the mean center method of spatial analysis, for the purpose of determining and spatially analyzing the demographic characteristics of the Cres-Lošinj area, this paper also applied the standard deviation ellipse (directional distribution) method of spatial analysis. As described above (Section 2.2), the result of the application of this method is an ellipse of settlement distribution and an ellipse for each observed census year, which differ according to position, shape and direction of extension.

The results showed (Figure 7) that the ellipse of settlement distribution is located in the northern part of the research area, because a larger number of settlements are located here, that is, a smaller number of settlements are located in the southern research area.

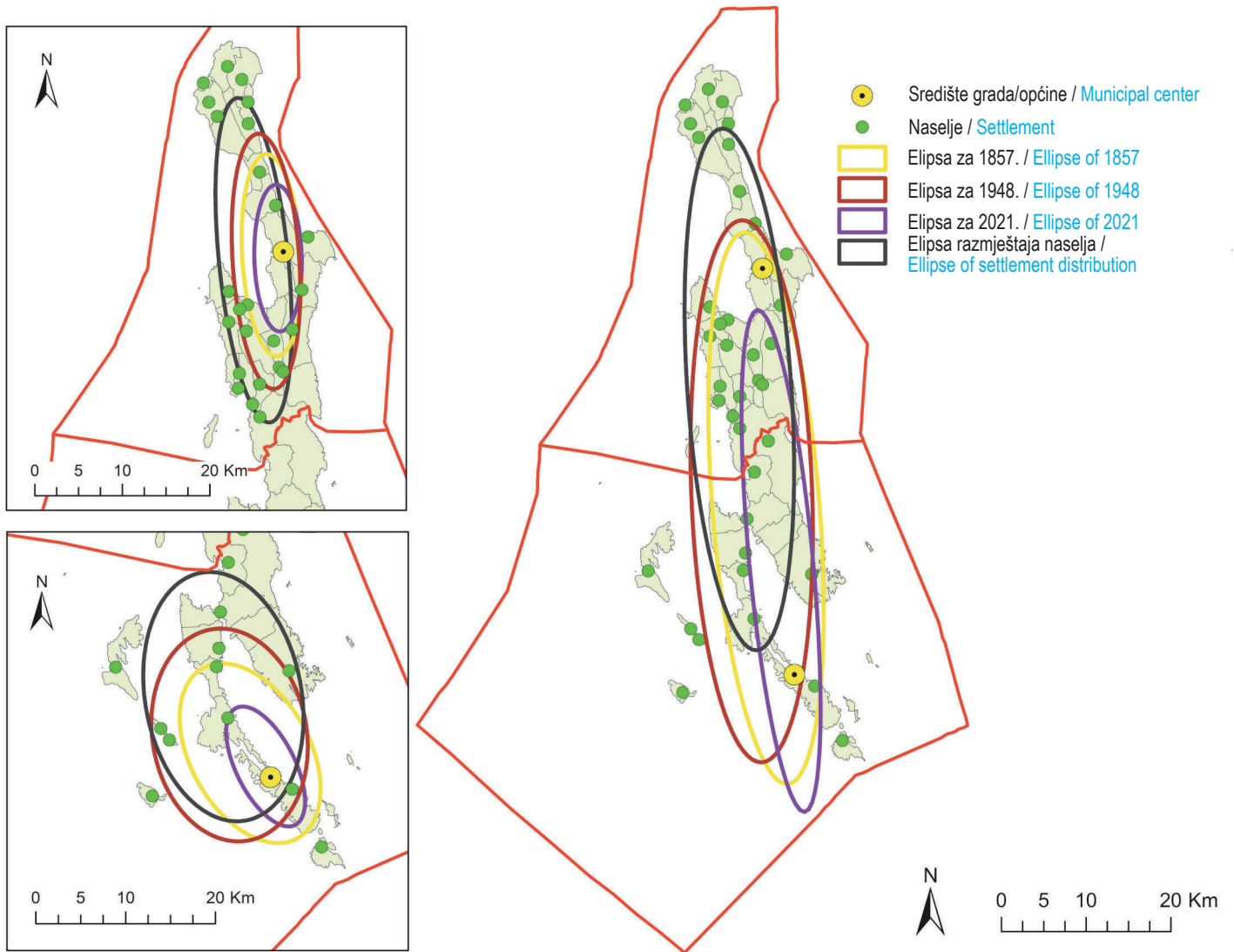
Observing the ellipses of the observed census years, the results showed that they are located further south than the ellipse of settlement distribution. The reason for this, as with the previously obtained results related to the mean center of the population, is the smaller number of larger settlements located in the southern part of the research area. Due to these, the ellipses for the census years are located further south, i.e. the population ellipse is located further north due to the greater number of smaller settlements in the northern part of the research area. Also, as with the previously obtained results related to the mean center of the population, of the observed census years, the ellipse for 1948 is the most northern, while the ellipse for 2021 is the most southern. This is in accordance with the trend in the number of inhabitants of the town of Mali Lošinj, where in 1948 the lowest number of inhabitants was recorded until then, which was followed by a strong growth (by 2,669 inhabitants). Observing the shape, it is evident that the ellipse for 2021 has the most elongated shape, which speaks in favor of the fact that larger settlements (Mali Lošinj, Cres and Veli Lošinj) have an increasing influence

on the direction of the population. This is also confirmed by the ellipses for 1948 and 2021 at the level of the local self-government units of the Town of Cres and the Town of Mali Lošinj, where it is evident that the population is concentrated closer to the larger settlements, i.e. the centers of the local self-government units. When observing the remaining settlements, it can be said that due to the smaller increase, that is, due to the larger decrease in the number of inhabitants, their influence on the direction of the population is decreasing.

4 Discussion and Concluding Remarks

This paper presents the complex issue of the demography of the Cres-Lošinj area, which was carried out through a spatial analysis of demographic characteristics by using a GIS model that is comprised of the data and spatial analyses used. In this paper, the methodology was used, as part of which each analyzed phenomenon is observed on at least three levels. With regard to the changes in the total number of inhabitants of the Cres-Lošinj area as a whole, but also at the level of the local self-government units (the Town of Cres and the Town of Mali Lošinj) in the period from the mid-19th century to the present day, the existence of two time intervals was established: the interval of demographic expansion with a predominant but discontinuous increase in the total number of inhabitants (1857–1910) and an interval of demographic regression with a predominant but discontinuous decline in the total number of inhabitants (1910–2021). In the last population census (2021), the number of inhabitants was determined to be more than twice as small as in 1910, when the highest recorded number of inhabitants was recorded both at the level of the Cres-Lošinj area as a whole, and at the levels of local self-government units and most settlements. The only exception to this is the Town of Mali Lošinj, which recorded more inhabitants in the last census than in 1910 (5,530 inhabitants in 1910; 5,567 inhabitants in 2021).

The period after World War II (1948–2021) was examined in more detail, where in the first decades depopulation was established primarily due to emigration, which occurred as a result of the abandonment of agriculture, i.e. the processes of deagrarianization and deruralization. In the intercensal periods of 1971–1981 and 1981–1991, an increase in the total number of population was recorded due to immigration related to tourism, particularly in larger coastal settlements (e.g. the Town of Mali Lošinj, the Town of Cres), but with simultaneous emigration of a part of the local population who could not be employed in various activities of the secondary and tertiary sectors in the Cres-Lošinj area. This



Slika 7. Trend usmjerenosti naseljenosti cresko-lošinskog područja u cjelini i na razini grad/općina (1857–2021).
Fig. 7 Population direction trends in the Cres-Lošinj area as a whole and at the town/municipality level (1857–2021).

Međutim, zajedničko je obilježje kretanja težišta naseljenosti to da su u promatranom razdoblju (1857–2021), a pogotovo posljednje promatrane godine (2021), vrlo blizu sjedištu grada/općine. Također, u usporedbi s kretanjem težišta naseljenosti na cresko-lošinskom području u cjelini (slika 5), gdje je vidljivo da se težište naseljenosti svake promatrane popisne godine nalazi na većoj udaljenosti (10 do 20 km) od središnjeg položaja naselja, za Grad Cres i Grad Mali Lošinj je vidljivo da su bliže središnjem položaju naselja.

3.4. Trend usmjerenosti naseljenosti

Uz metodu prostorne analize težište naseljenosti (*Mean Center*), u svrhu utvrđivanja i prostornog analiziranja

demografskih obilježja cresko-lošinskog područja, u ovom je radu primijenjena i metoda prostorne analize elipsa standardnih devijacija (distribucija smjerova) (*Standard Deviational Ellipse (Directional Distribution)*). Kao što je prethodno opisano (poglavlje 2.2), rezultat su primjene ove metode elipsa razmještaja naselja i elipse za svaku promatranu popisnu godinu, a koje se razlikuju prema položaju, obliku i smjeru pružanja.

Rezultati su pokazali (slika 7) da se elipsa razmještaja naselja nalazi na sjevernijem području istraživanja jer se veći broj naselja smjestio na sjevernijem području u odnosu na manji broj naselja na južnijem području.

Promatrajući elipse promatranih popisnih godina, rezultati su pokazali da se one nalaze južnije od elipse razmještaja naselja. Razlog tome je, kao i kod prethodno

means that the long-term depopulation in this area is brought into complex interrelationships with the processes of littoralization, deruralization, deagrarianization, the affirmation of new directions of European migration, the expansion of tourism, the general aspirations of education and specialization, etc. (Lajić 1993). In the last three censuses, there is a decrease in the total number of inhabitants in the Cres-Lošinj area as a whole, at the level of the self-government units and in most settlements. Only in the last census can a slight increase in the number of inhabitants be seen in several smaller settlements, probably due to the so-called "fictitious" census. The result of all of the above is that in the last census, all settlements, except for the Town of Mali Lošinj, recorded fewer inhabitants than in the mid-20th century.

As a result of the above demographic trends, this paper analyzed the spatial shift of the mean center of the population and the ellipse, which were observed in the period from the mid-19th century onwards. The analysis of the shift of the mean center of the population (carried out by using the Mean Center method of spatial analysis) determined for the Cres-Lošinj area as a whole that from the first population census (1857) to the mid-20th century (1948) the tendency was towards the north, the central position of the settlements. The reason for this is primarily that in the southern area (within the local self-government unit of the City of Mali Lošinj) there was a strong decrease in the number of inhabitants. From the mid-20th century, more precisely from 1948 to 1991, there was a significant shift in the mean center towards the southern part of the research area. In the following census years (2001, 2011 and 2021), a decrease in the total number of inhabitants was recorded both in the Cres-Lošinj area and in both local self-government units. Given that there has been a moderate movement of the mean center of the population towards the north, it is evident that the decrease in the total number of inhabitants of the Cres-Lošinj area is less pronounced in the northern part, that is, it is more pronounced in the southern part. For the area of local self-government units, a similar shift of the mean center of population was also determined, whereby the mean center for 1948 was closest to the central location of the settlement, for 1857 it was a little further away, and for 2021 it was the furthest away from the central location of the settlement.

Using the standard deviational ellipse (directional distribution) method, it was determined that larger

settlements (Mali Lošinj, Cres and Veli Lošinj) have an increasing influence on the population direction, and it was determined that the population is concentrated closer to the larger settlements, i.e. to the centers of local self-government, while at the same time the population of a large number of small settlements in the northern part of the research area is decreasing more and more.

Compared to other Croatian islands, it can be said that the demographic trends in the Cres-Lošinj area are partially similar to those of most small islands in the Adriatic - continuous depopulation, disappearance of the youngest population and an accelerated increase in the share of the old population (Lajić and Mišetić 2013b). On the other hand, the Island of Krk, which is connected to the mainland by a bridge, is a very rare example because it has continuously recorded an increase in the number of its inhabitants since 1971 (Jovanić 2011). Thus, unless more significant measures of demographic and economic revitalization are introduced, which would, for example, enable the return of a large number of emigrants or their descendants, further disappearance of the population of the Cres-Lošinj area can be expected. With the aim of better spatial targeting of comprehensive demographic and economic revitalization measures, this GIS model can be used for spatial monitoring of demographic trends and spatial planning, especially in those areas where further negative demographic trends are indicated. It should be emphasized that this model is suitable for areas with a small number of inhabitants. Namely, according to the last population census (2021), it was determined that only 8 settlements (20.0%) have over 100 inhabitants, and thus it is evident that this research area is included in the so-called "small populations" (Lajić and Mišetić 2013b according to Magaš 2008), which are subject to the laws of the so-called "small numbers" (Podgorelec 1999) and thus relatively misleading analysis results. However, this was taken into account in this study, where the applied GIS model is comprised of data related to the total number of inhabitants of all censuses conducted so far and (methods of) spatial analysis that were implemented at multiple spatial levels, use absolute numbers and enable a better insight into spatial processes.

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dobivenih rezultata koji se odnose na težište naseljenosti, manji broj većih naselja koja se nalaze na južnijem području istraživanja zbog kojih se elipse za popisne godine nalaze južnije, odnosno veći je broj manjih naselja na sjevernijem području istraživanja zbog kojih se elipsa naseljenosti nalazi sjevernije. Također, kao i kod prethodno dobivenih rezultata koji se odnose na težište naseljenosti, od promatranih se popisnih godina elipsa za 1948. godinu nalazi najsjevernije, dok se elipsa za 2021. nalazi najjužnije. To je sukladno kretanju broja stanovnika grada Malog Lošinja, gdje je 1948. zabilježen do tada najmanji broj stanovnika, nakon čega je uslijedio snažan rast (za 2669 stanovnika). Promatrajući oblik, vidljivo je da elipsa za 2021. ima najizduženiji oblik, što govori u prilog tome da veća naselja (Mali Lošinj, Cres i Veli Lošinj) imaju sve veći utjecaj na usmjerenost naseljenosti. To potvrđuju i elipse za 1948. i 2021. godinu na razini jedinice lokalne samouprave Grada Cresa i Grada Malog Lošinja, gdje je vidljivo kako se stanovništvo koncentrira bliže navedenim većim naseljima, odnosno sjedištima lokalne samouprave. Gledajući preostala naselja, može se reći da je zbog sve manjeg rasta broja stanovnika, odnosno u drugima zbog većeg pada, njihov utjecaj na usmjerenost naseljenosti sve manji.

4. Rasprava i zaključna razmatranja

U ovom je radu prikazana složena problematika demografije cresko-lošinjskog područja koja je provedena kroz prostornu analizu demografskih obilježja primjenom GIS modela koji se sastoji od korištenih podataka i prostornih analiza. Pritom je primijenjena metodologija gdje se svaki analizirani fenomen promatra u najmanje trima razinama. S obzirom na kretanje ukupnog broja stanovnika cresko-lošinjskog područja u cjelini, ali i na razini jedinice lokalne samouprave (Grad Cres i Grad Mali Lošinj) u razdoblju od sredine 19. stoljeća do danas, utvrđeno je postojanje dvaju vremenskih intervala: intervala demografske ekspanzije s prevladavajućim, ali nekontinuiranim porastom ukupnog broja stanovnika (1857–1910) i intervala demografskog regressa s prevladavajućim, ali nekontinuiranim padom ukupnog broja stanovnika (1910–2021). U posljednjem je popisu stanovništva (2021) utvrđen više nego dvostruko manji broj stanovnika nego 1910. godine kada je bio najveći zabilježeni broj stanovnika, kako na razini cresko-lošinjskog područja u cjelini, tako i na razinama jedinice lokalne samouprave i većine naselja. Izuzetak je jedino grad Mali Lošinj koji u posljednjem popisu bilježi više stanovnika nego navedene 1910. godine (5530 stanovnika 1910.; 5567 stanovnika 2021.).

Detalnije je promotreno razdoblje nakon Drugog svjetskog rata (1948–2021), pri čemu je u prvim desetljećima

ustanovljena depopulacija uvjetovana prvenstveno iseljavanjima zbog napuštanja poljoprivrede, odnosno procesima deagrarizacije i deruralizacije. U međupopisima 1971–1981 i 1981–1991 zabilježen je porast ukupnog broja stanovnika zbog useljavanja vezanih uz turizam, naročito većih obalnih naselja (npr. grad Mali Lošinj, grad Cres), ali uz istovremena iseljavanja dijela domaćeg stanovništva koji se nije mogao zaposliti u različitim djelatnostima sekundarnog i tercijarnog sektora na cresko-lošinjskom području. Time se dugotrajna depopulacija na ovom području dovodi u kompleksne međuodnose s procesima litoralizacije, deruralizacije, deagrarizacije, afirmacijom novih smjerova europske migracije, ekspanzijom turizma, općim težnjama obrazovanja i specijalizacije itd. (Lajić 1993). U posljednjim se trima popisima bilježi pad ukupnog broja stanovnika na cresko-lošinjskom području u cjelini, na razini jedinice samouprave i u većini naselja. Tek se u posljednjem popisu (2021.) kod nekoliko manjih naselja može vidjeti povećanje stanovnika, vjerojatno zbog tzv. „fiktivnog“ popisivanja. Rezultat svega navedenog jest da je u posljednjem popisu kod svih naselja, osim kod grada Malog Lošinja, zabilježeno manje stanovnika nego sredinom 20. stoljeća.

Kao rezultat navedenih demografskih kretanja, u ovom je istraživanju promatrano prostorno pomicanje težišta naseljenosti i elipse u razdoblju od sredine 19. stoljeća. Pomicanjem težišta naseljenosti (metoda prostorne analize Mean Center) za cresko-lošinjsko područje u cjelini utvrđeno je da je od prvog popisa stanovništva (1857) do sredine 20. stoljeća (1948) tendencija pomicanja bila prema sjeveru, prema središnjem položaju naselja. Razlog tome je prvenstveno što je na južnijem području (unutar jedinice lokalne samouprave Grada Malog Lošinja) došlo do snažnog pada broja stanovnika. Od sredine 20. stoljeća, točnije od 1948. do 1991. godine, došlo je do značajnog pomicanja težišta naseljenosti prema južnom dijelu područja istraživanja. U sljedećim je popisnim godinama (2001, 2011. i 2021.) zabilježen pad ukupnog broja stanovnika, kako na cresko-lošinjskom području, tako i u objema jedinicama lokalne samouprave. S obzirom da je došlo do umjerenog kretanja težišta naseljenosti prema sjeveru, vidljivo je da je to smanjenje ukupnog broja stanovnika cresko-lošinjskog područja manje izraženo na sjevernom dijelu, odnosno izraženije na južnijem dijelu. Za područje jedinica lokalnih samouprava također je utvrđeno slično kretanje težišta naseljenosti, pri čemu je težište za 1948. godinu najbliže središnjem položaju naselja, za 1857. malo dalje, a za 2021. najdalje od središnjeg položaja naselja.

Metodom prostorne analize elipse standardnih devijacija (*Standard Deviatonal Ellipse (Directional Distribution)*) utvrđeno je da veća naselja (Mali Lošinj, Cres i Veli

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Lošinj) imaju sve veći utjecaj na usmjerenost naseljenosti te je utvrđeno koncentriranje stanovništva bliže navedenim većim naseljima, odnosno sjedištima lokalne samouprave, uz istovremeno sve snažnije smanjivanje broja stanovnika velikog broja malih naselja na sjevernom dijelu područja istraživanja.

Uspoređujući s drugim hrvatskim otocima, može se reći da su demografska kretanja na cresko-lošinjskom području djelomično sličnih obilježja kao i kod većine malih otoka Jadrana – kontinuirana depopulacija, nestanak najmlađe populacije i ubrzano povećanje udjela starog stanovništva (Lajić i Mišetić 2013b). S druge strane, vrlo su rijetki primjeri kao što je s mostom povezan otok Krk koji od 1971. godine kontinuirano bilježi povećanje broja stanovnika (Jovanić 2011). Time, ukoliko se ne uvedu značajnije mjere demografske i ekonomske revitalizacije, pri čemu je, na primjer, moguć povratak brojnog iseljenog stanovništva, odnosno njihovih potomaka, može se očekivati daljnji nestanak stanovništva cresko-lošinjskog područja. Time se, u cilju boljeg prostornog usmjerenja sveobuhvatnih mjera demografske i ekonomske revitalizacije, ovakav GIS model može primijeniti

za prostorno praćenje demografskih kretanja te prostorno planiranje, pogotovo za područja u kojima demografska kretanja ukazuju na daljnje negativne trendove. Potrebno je posebno naglasiti da je ovakav model pogodan za područja s malim brojem stanovnika. Naime, prema posljednjem popisu stanovništva (2021) utvrđeno je da samo 8 naselja (20,0%) ima više od 100 stanovnika i time je vidljivo da se područje ovog istraživanja ubraja u tzv. „male populacije“ (Lajić i Mišetić 2013b prema Magaš 2008) koje podliježu zakonima tzv. „malih brojeva“ (Podgorelec 1999) i time relativno varljivim rezultatima analiza. Međutim, to je uzeto u obzir u ovom istraživanju, pri čemu primijenjeni GIS model sadrži podatke koji se odnose na ukupni broj stanovnika svih do sada provedenih popisa stanovništva te (metoda) prostornih analiza koje su provedene na više prostornih razina, koriste apsolutne brojeve i omogućavaju bolji uvid u prostorne procese.

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