Bulletin of Geography. Socio–economic Series / No. 32 (2016): 61–72

ISSN 1732–4254 quarterly

BULLETIN OF GEOGRAPHY. SOCIO–ECONOMIC SERIES
journal homepages:
http://www.bulletinofgeography.umk.pl/
http://wydawnictwoumk.pl/czasopisma/index.php/BGSS/index
http://www.degruyter.com/view/j/bog

Demographic development of Zachodniopomorskie voivodship in the years 2000-2012 in the light of transportation network accessibility

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How to cite:
Chądzyńska, E., 2016: Demographic development of Zachodniopomorskie voivodship in the years 2000-2012 in the light of transportation network accessibility. In: Szymańska, D. and Chodkowska-Miszczuk, J. editors, Bulletin of Geography. Socio-economic Series, No. 32, Toruń: Nicolaus Copernicus University, pp. 61–72. DOI: http://dx.doi.org/10.1515/bog-2016-0015

Abstract. The area of Zachodniopomorskie voivodship is characterized by specific features, resulting from its position in space. The location of the regional capital Szczecin at the mouth of the River Odra and near the Polish-German border, in the close vicinity of well-developed Nordic countries, and on the outskirts of the region creates special conditions for development. At the same time, the considerable remoteness of most small towns from the capital region and the inadequate network of connections in a natural North-South direction make it difficult to work with the assets of larger centres of development like Szczecin and Koszalin. The present approach is based on Webb's typology for the gminas of Zachodniopomorskie voivodship compared with the analysis of the characteristics of the transportation network. Traffic volume of real transportation network was simulated by using a model based on the idea of intervening opportunities. Two categories of movements were analysed: movements to work and, due to the specificity of the region, tourists' movements.

Article details:
Received: 23 June 2014
Revised: 19 November 2015
Accepted: 28 February 2016

Key words:
Demographical development,
Webb's typology,
transportation network.

Contents:

1. Introduction

The area of Zachodniopomorskie voivodship is characterized by specific features, resulting from its position in space. The location of the regional capital Szczecin at the mouth of the Odra River, near the Polish-German border, and in the close vicinity of the well-developed Nordic countries, and at the same time, on the outskirts of the region creates special conditions for development. The considerable remoteness of most cities from the capital of the region and the inadequate network of connections in the North-South direction makes it difficult to use the resources of the larger centres of development like Szczecin and Koszalin.

Most of the towns in the area of Region are small towns, with a population of less than

5,000 inhabitants. The area is one of the least populated areas of Poland, with a population density of 75 persons per km² and occupies the 13th place, with the national average of 122 people per km². In the area a decrease in the percentage of the population of pre-working age to the benefit of those of working-age and post-working age groups is maintained. Population forecasts by GUS for the region indicate a systematic decline from 2010 (1,691.5 thousand people) through 1,686.9 in 2015 to 1,676 thousand people in the year 2020.

Demographic conditions constitute one of the essential factors in the development of cities and their surroundings. The progressive decline in fertility, the ageing population and the increasing mobility of the population change opportunities and development potential of cities and regions.

In this study, an assessment of the basic demographic processes affecting the development of the population in the cities of the Zachodniopomorskie voivodship was made. The factors constituting gain and loss of the actual population size, and the degree of ageing of the population were analysed. Because the demographic processes taking place in towns and cities must be considered with regard to their process in areas surrounding the city, the gminas were also taken into consideration.

The aim of the analysis is to examine the spatial distribution of individuals in a good demographic situation and the weak one and attempt to determine the connection with the existing communication network.

2. Research materials and methods

All analyses are based on the Central Statistic Department data (Local Database). A study of the real gain of the population based on Webb's method. Webb's typology allows a synthetic way to connect the size of the natural growth and net migration. This classification distinguishes 8 unit types depending on the relationship between growth and natural wastage, and between positive and negative migration balance. Classes A, B, C, D mean the territorial units with population growth, while E, F, G, and H are those with a decline in the population. The most favourable demographic situation is exhibited by units classified in classes B and C, because they are characterized by a positive migration balance, as well as a positive natural growth. In the worst situation are units of the groups F and G, for which values of the two processes that make up the actual gain are negative (Sobala-Gwozdz, 2010). A description of the creation and interpretation of Webb's typology can be found in the work of J. Runge (3), D. Jędrzejczyk (4) and L. Kosiński (5).

Webb's typology was made for gminas, towns and cities of the Zachodniopomorskie voivodship and compared with the analysis of traffic volume and the directions of traffic in the transportation network. The spatial regularities were identified based on the created maps.

Traffic volume and traffic network load were simulated by using a model based on the idea of intervening opportunities (1). These models, derived from the classic version of the Schneider's (3) model were developed by T. Zipser (4) with research team. The model assumes that the number of journeys between the source area (the starting point) and the destination area (the ending points) depends not only on the number of trips being taken in the area of the source and the purpose of the latter, but also on the number of intermediate objectives, lying between the areas concerned. These intermediate objectives constitute the environment in which can ends the movements, which are sent by the source, and as a result, only a fraction of the trip can reach the area concerned.

Two categories of movements were analysed: movements to work and due to the specificity of the region, tourists' movements.

3. Research results

3.1. A brief description of the settlement network of Zachodniopomorskie voivodship

Zachodniopomorskie voivodship is located in the north-western part of Poland (Fig. 1). It occupies an area of 228,92 km^2. Within the province there are 64 towns. Three of them received municipal rights in recent years. They are Dziwnów (municipal rights – 01.01.2004), Tychowo (municipal rights – 01.01.2010) and Gościno (municipal rights – 01.01.2011). The capital city Szczecin now has 409,585 inhabitants. During the period 2000 - 2012 the loss of population in Szczecin was 1.6%.

Among the cities located in the province, 53 are small towns with a population not exceeding 20 thousand inhabitants, and 32 of them are towns of fewer than 5,000 inhabitants. The network of the region, in spite of the degree of concentration (one urban unit per 375 km^2, compared with the average for Poland of one per approximately 370 km^2), is highly diverse in terms of size of cities and their location within the Region. The settlement network of Zachodniopomorskie voivodship is characterized by:

- extreme (not central) location of the capital town,
- location of the largest cities (the exception is Stargard Szczeciński) on the outskirts, while in the centre part there are no medium-sized cities,
- the even distribution throughout the region of small towns with about 7-20 thousand inhabitants,
- the even distribution of small cities with a population of 4-7 thousand inhabitants and rural community centres.

Fig.1. Location of Zachodniopomorskie voivodship.

Source: Own compilation on the basis of numerical map.

Zachodniopomorskie voivodship has also large forest resources (35.2% of the surface compared with an average for Poland of 28.2%). On its territory there are natural minerals: petroleum, natural gas, limestone, marl, chalk, building stone and natural aggregate, mineral water, peat, geothermal water and brine. Noteworthy is the fact there is a rather large area of peat soils and black lands in the vicinity of Pyrzyce and Stargard Szczeciński. These features affected the developing of the settlement network and transportation system.

The network of national and provincial roads connects basic economic and administrative centres. A characteristic feature of the labour market in the region is the seasonality of employment. In the Zachodniopomorskie voivodship there are many small and medium-sized towns, which cannot create a sufficiently strong and stable labour market. Large

urban centres, such as Szczecin and Koszalin, are located on the outskirts of the province, which greatly complicates commuting to work in these cities.

3.2. Changes in the number of population

Change in population in a given area – that is, the gain or loss – is incurred as a result of the actions of two processes: the natural increment (difference between the number of births and the number of deaths) and net migration (the difference between the people who settled and those that left).

In this study, changes in the period 2000-2012 were investigated. To exclude random fluctuations in the annual demographic data, a three-year average was used, for the years 1999-2001 and 2010-2012 (Table 1). Given the fact that the process of suburbanization is still in progress, the migration balance for cities should be compared with the situation existing in their environment. As a result of suburbanization processes, the loss of the population in large and medium-sized cities is often connected with a positive migration balance in their suburban zone.

Table 1. Selected demographic characteristics of the cities of the Zachodniopomorskie voivodship.

Num	City	Population		Dynamics of changes (2000 = 100%)	Natural growth (2010-2012)	Migration balance (2010-2012)	Webb's Type (2010-2012)
		2000	2012				
1	Białogard	24,586	24,794	100.85%	-39.67	-34.33	F
2	Karlino	5,793	6,005	103.66%	9.00	-26.67	H
3	Tychowo	-	2,542	-	9.33	-15.00	H
4	Czaplinek	7,001	7,200	102.84%	3.67	10.67	C
5	Drawsko Pomorskie	11,255	11,895	105.69%	16.00	5.00	B
6	Kalisz Pomorski	4,072	4,333	106.41%	6.00	-0.33	A
7	Złocieniec	13,741	13,331	97.02%	20.33	-75.67	H
8	Kołobrzeg	45,107	46,951	104.09%	-25.00	-17.33	F
9	Gościno	-	2,527	-	1.00	13.50	B
10	Bobolice	4,463	4,271	95.70%	-5.67	-17.00	G
11	Polanów	2,971	3,076	103.53%	12.00	-0.50	A
12	Sianów	6,551	6,643	101.40%	0.67	-24.00	H
13	Darłowo	14,761	14,308	96.93%	-1.33	-50.50	G
14	Sławno	13,439	12,992	96.67%	-18.67	-61.50	G
15	Szczecinek	39,651	40,723	102.70%	-58.00	-48.00	F
16	Barwice	3,911	3,839	98.16%	2.00	-14.50	H
17	Biały Bór	2,141	2,246	104.90%	-4,67	1.00	E
18	Borne Sulinowo	3,568	4,850	135.93%	-17,00	51.50	D
19	Świdwin	16,055	15,798	98.40%	-5.00	-62.00	G
20	Połczyn-Zdrój	8,851	8,529	96.36%	-44.33	-3950	G
21	Wałcz	26,678	26,417	99.02%	-8.00	-53.00	G
22	Człopa	2,350	2,335	99.36%	-3.67	-17.50	G
23	Mirosławiec	3,003	3,072	102.30%	-2.33	4.50	D
24	Tuczno	1,966	1,985	100.97%	-2.67	1.00	E
25	Koszalin	108,899	109,343	100.41%	23.00	-100.50	H
26	Choszczno	15,845	15,800	99.72%	6.00	-129.50	H
27	Drawno	2,505	2,364	94.37%	-8.33	-16.50	G
28	Pełczyce	2,722	2,682	98.53%	-4.33	-17.00	G
29	Recz	2,962	2,973	100.37%	-1.00	-27.50	G

30	Gryfice	17,195	17,016	98.96%	-25.00	-45.00	G
31	Płoty	4,191	4,080	97.35%	-5.33	-14.50	G
32	Trzebiatów	10,131	10,250	101.17%	-13.00	-11.50	F
33	Barlinek	14,585	14,277	97.89%	32.67	-47.50	G
34	Dębno	14,038	14,124	100.61%	18.33	-67.50	H
35	Myślibórz	12,215	11,672	95.55%	-37.00	-28.00	F
36	Lipiany	4,254	4,142	97.37%	-18.33	-11.50	F
37	Pyrzyce	12,832	12,875	100.34%	-11.67	-56.50	G
38	Stargard Szczeciński	71,374	69,724	97.69%	-1.67	-207.50	G
39	Chociwel	3,311	3,216	97.13%	2.67	-12.00	H
40	Dobrzany	2,502	2,378	95.04%	-0.67	-10.00	G
41	Ińsko	2,050	2,066	100.78%	-0.67	8.00	D
42	Suchań	1,500	1,475	98.33%	-0.67	-3.00	G
43	Dobra	2,122	2,362	111.31%	-4.67	5.50	D
44	Łobez	10,793	10,549	97.74%	-12.33	-28.00	G
45	Resko	4,552	4,398	96.62%	-13.00	-19.50	G
46	Węgorzyno	3,005	2,906	96.71%	-3.33	-6.00	G
47	Szczecin	416,657	408,913	98.14%	-592.33	128.00	E
48	Goleniów	22,271	22,846	102.58%	31.00	-49.00	H
49	Maszewo	3,006	3,336	110.98%	2.00	34.00	C
50	Nowogard	16,796	16,974	101.06%	1.20	-7.50	H
51	Cedynia	1,687	1,685	99.88%	-1.33	-20.00	G
52	Chojna	7,005	7,353	104.97%	5.67	-8.50	H
53	Gryfino	21,847	21,589	98.82%	32.33	-116.00	H
54	Mieszkowice	3,596	3,609	100.36%	-2.00	1.05	E
55	Moryń	1,601	1,631	101.87%	-1.00	0.50	E
56	Trzcińsko-Zdrój	2,526	2,479	98.14%	-12.67	8.50	E
57	Dziwnów	-	2,779	-	-5.33	-31.50	G
58	Golczewo	2,722	2,756	101.25%	3.67	-5.00	H
59	Kamień Pomorski	9,177	9,190	100.14%	-10.33	-33.00	G
60	Międzyzdroje	5,641	5,561	98.58%	-27.00	-9.00	F
61	Wolin	4,975	4,968	99.86%	-6.33	-19.50	G
62	Nowe Warpno	1,250	1,246	99.68%	-1.67	-0.50	F
63	Police	34,518	33,816	97.97%	93.33	-202.50	H
64	Świnoujście	42,207	41,509	98.35%	-79.00	52.50	E

Source: Own elaboration based on the Central Statistic Department Data (Local Data Bank).

During the period of 2000 – 2012 population growth occurred primarily in small towns like Borne Sulinowo – 35.93%, Dobra – 10.98% and Maszewo – 10.98%. Borne Sulinowo is a special case – the town came into existence in 1993, after being vacated by the Russian army. The authorities, in order to populate the newly created town, sold homes on concessional terms, which resulted in a significant increase in the number of civilian people. Population growth is also exhibited by towns such as: Kalisz Pomorski – 6.41%, Drawsko Pomorskie – 5.69%, Chojna – 4.97%, Biały Bór - 4.90%, Kołobrzeg – 4.09% and Karlino – 3.66%. Among the major cities a small increment occurred in Koszalin – 0.41%.

The largest population loss occurred in Drawno – 5.63%, Dobrzany – 4.96%, Myślibórz – 4.45% and in Bobolice – 4.30%. A decline in the number of people occurs in Szczecin – 1.86% and Stargard Szczeciński – 2.31% too.

In order to depict the current demographic situation in the West Pomerania cities and towns Webb's typology was used. Spatial location of towns classified by the method is shown in figure 3. In addition, analysing the information contained in table 2, it can be concluded that the most favourable type B occurs only in two towns – Drawsko Pomorskie and Gościno. Similarly, type C occurs in Czaplinek and Maszewo. Slightly less favourable, but still population growth type A occurred in Kalisz Pomorski and Polanowo. The last of the Webb types D associated with natural population growth includes four towns: Borne Sulinowo, Ińsko, Mirosławiec and Dobra.

The loss of the actual population occurred in 54 West Pomerania towns. It was caused largely by negative migration balance (types F and G). In 32 of them, negative natural growth occurred at the same time. Type E is represented by seven towns, including Szczecin and Świnoujście (Fig. 2). The most numerous group of towns (24) represents type G with a negative natural growth and negative migration balance exceeding it. These include towns such as Wolin, Kamień Pomorski, Pyrzyce, Stargard Szczeciński and Wałcz. Type F is present in 8 towns including Kołobrzeg, Międzyzdroje, Szczecinek and Nowe Warpno. Quite well represented is also type H, which covers 15 towns. Among the towns included in this type were Police, Goleniów, Koszalin and Karlino.

The migration balance for towns was compared with the situation existing in their environment. As a result of suburbanization processes, the loss of people in large and medium-sized cities often accompanied positive migration balance in their suburban zone. Such a situation occurs in Szczecin, Goleniów, Stargard Szczeciński, Koszalin and Kołobrzeg. It shows that the loss of population in the cities is largely the result of suburbanization processes that lead to settlement of the population in the functional areas of cities.

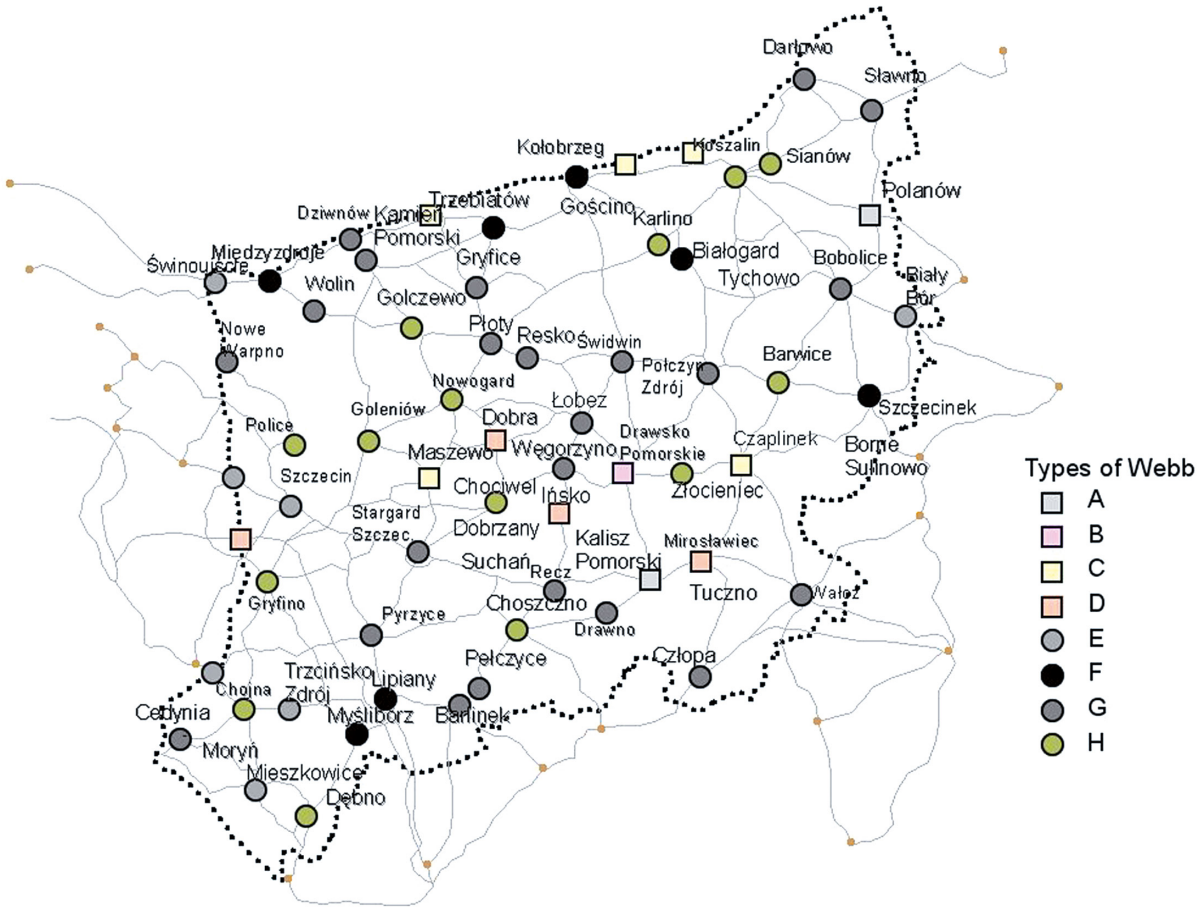

Fig. 2. Webb's typology for cities of Zachodniopomorskie voivodship (the average for years 2010-2012).

Source: Own figure on the basis of the Central Statistic Department data (Local Database).

Small towns with a growth in population are located primarily in the central part of the Zachodniopomorskie voivodship. Towns with the same situation also include, in the north, Gościno and, in the north-east, Polanów. They are quite loosely scattered and do not form a close-knit group. Small towns with a decrease in population are in a worse situation than larger ones, around which the number of citizens increases. In the case of West Pomerania they take up one compact portion of the area covering most of the towns near Szczecin and Stargard Szczeciński.

The situation in the municipalities is much better. By analysing the picture of Webb's typology for municipalities (Fig. 3) we notice a compact group of municipalities surrounding Szczecin and Stargard Szczeciński, in which there has been in recent years (the average for the years 2010-2012), actual population growth, mainly due to the positive net migration (type C) and, in a smaller measure, a positive birth rate (type B). The second cluster of such municipalities is located in the range between Kołobrzeg and Sławno, where there are also municipalities in which the population is increasing because of positive natural growth which is larger than negative migration balance (type A). In the southern part of the province are located municipalities characterized by population growth thanks mainly to positive natural growth (Boleszkowice, Nowogródek Pomorski and Kalisz Pomorski) and positive balance migration (type D-Borne Sulinowo). In these municipalities, as well as in central, north-western and eastern parts of the region municipalities are characterized by a decrease in the number of residents due to negative migration balance and negative natural growth. A spatially quite compact group of municipalities losing population of type H (negative migration balance is not compensated by the positive natural growth) comprises the vast majority of municipalities

forming compact subdivisions in the southwest, central and eastern parts of the province (Fig. 3).

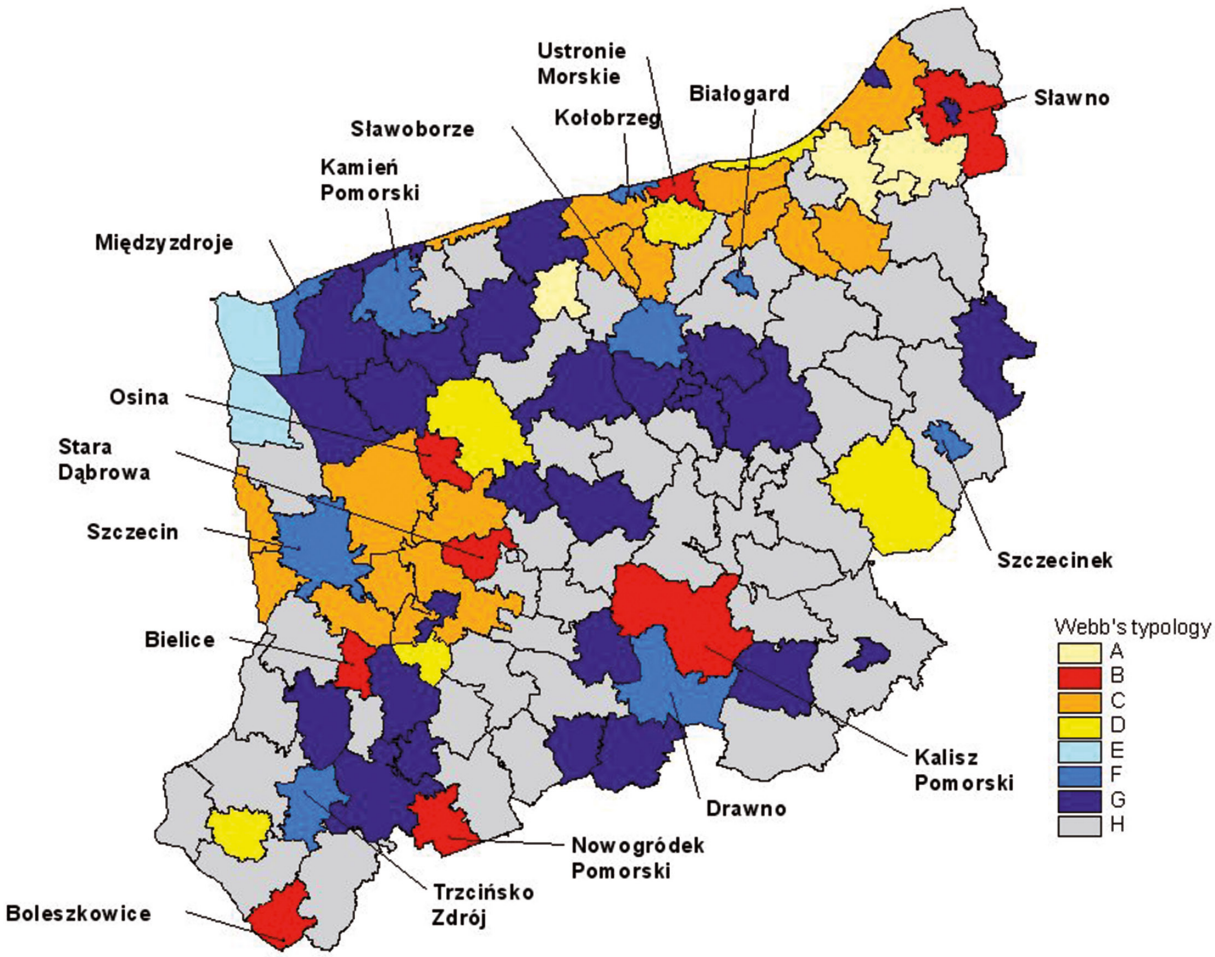

Fig. 3. Typology of Webb for municipalities of West Pomerania (the average for years 2010-2012).

Source: Own figure on the basis of the Central Statistic Department data (Local Database).

3.3. The ageing of population

The loss of the population in most towns of the Zachodniopomorskie voivodship accompanies a systematic process of ageing. Good illustrations of the transition from a young to an old age structure of the population in the towns are changes in the value of the demographic age index. This indicator describes the relationship between the participation of children and young people up to the age of 14, and the participation of people aged 65 years and more. Index values exceeding 100 indicate a broad advantage of older people over generations of children and youth.

Comparison of values of the old age demographic index of 2000 and 2012 points to the significant differences in the pace of ageing of the population. In 2012 (in analyzed region), there were 13 towns which had a predominance of the population aged 65 years and more over the number of children and young people up to the age of 14, while in 2000, there was not one such city. A unfavourable demographic structure characterizes Szczecin (130.94) as well as Świnoujście (134.70), Międzyzdroje (116.70), Kamień Pomorski (110.76) and Dziwnów (115.28).

A similar situation occurs in the sub-region of Koszalin (131.28), and covers such towns as Sławno (104.93), Darłowo (109.69), Szczecinek (103.92) and Połczyn Zdrój (104.86). The highest values of the index are found in Świnoujscie, Kołobrzeg (125.75), Szczecin and Koszalin. The high proportion of elderly people relative to younger is characteristic in large cities, as well as in the towns with health resort and leisure functions. The best demographic situation occurs in Maszewo (60.99) – a sub-region of Szczecin – and Gościno (64.65), Polanów (69.21) and Sianów (64.93) in the Koszalin sub-region.

3.4. Traffic modelling

The method applied in this part is based on the use of communication models of traffic exchange based on the idea of intervening opportunities. The model operates with only one parameter – the selectivity – reflecting the preferences of travellers and the tendency for longer or shorter trips. In this research the version of the traffic exchange model with reversing of surplus was used and the network load of one of the shortest routes. The simplicity of the model consists in running a network of one route; in the case of modification of the draft plan there is a kind of advantage. The calculated loads are not dissipated in different routes, and the load tour, combining the shortest way connecting origins and destinations of traffic, allows for a clear diagnosis of change to the network (10).

The modelling included the area of the Zachodniopomorskie voivodship with the provincial and national road network. Selected cities and towns were treated as calculating units. To calculate the number of origins in the units, the size of the population multiplied by 0.7 (percentage of the working population) was used. The number of the destinations was represented by the number of those working, and in the second version of modelling the number of those granted accommodation was added (11).

As a result of modelling, the number of journeys between all pairs of units (towns) in straight lines was received, which was then distributed to the existing transport network giving in result the network load. The number of journeys in straight lines for three selected cities – Szczecin, Koszalin and Wałcz – is illustrated in Figure 4. This is a picture of travel to these cities. The largest number of journeys takes place between Szczecin and Słupsk and Szczecin and Świnoujście and on the Koszalin - Słupsk and Koszalin – Darłowo routes. This result of modelling shows that the greatest volume of traffic takes place along national road No. 6. The resulting picture of the journeys allows the most stable connections in existing conditions to be selected and the parts of the network which are overloaded to be observed.

In the journeys to work the prevailing direction was horizontal. The greatest load (between 36 and 73,000 people) occurs along national road No 6, throughout its course, slightly smaller on national road No. 20 (9-18,000 persons) on the stretch between Szczecin and Czaplinek and on national road No 10. Among the roads in the vertical direction the most heavily used are national road No. 3 (for passages where it replaces the S3) for the distance between Szczecin and Goleniów (36-73,000 people), for the distance between Gorzów Wielkopolski and Pyrzyce (18-36 thousand people), and the stretch

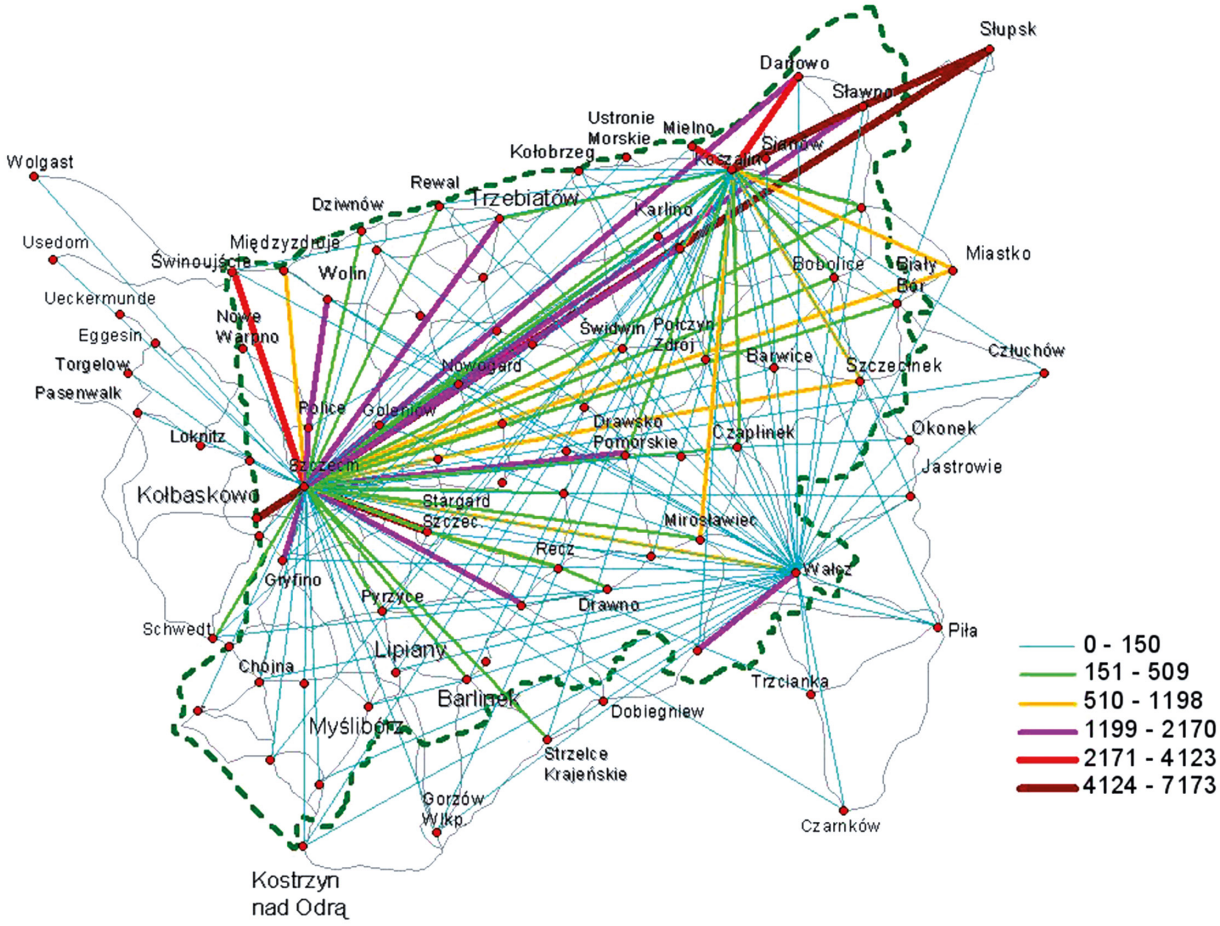

Fig. 4. Exchange of traffic (inbound travel) for Szczecin, Koszalin and Wałcz.

Source: Own figure on the basis of the Central Statistic Department data (Local Database)and the model of intervening opportunities.

between Goleniów and Międzyzdroje to Świnoujście, national route 11 for the distance between Piła and Bobolice and further along provincial road No. 205 from Boblice to Sławno.

On the provincial roads the largest load in the category travelling to work occurred on road No. 163 (4-9 thousand people) between Czarnków and Czaplinek and (1.5-4 thousand people) between Czaplinek and Kołobrzeg and on road No. 109, mainly on the section Płoty - Trzebiatów (9-18 thousand people).

Then the modelling for the purposes of travel plus the number of people in accommodation was conducted. The result is shown in Figure 5. This is a picture of a situation similar to that which occurs during the summer. Load layout changed direction to the vertical. While national road No. 6, as the only quick route along the coast and, in addition, to large centres (Szczecin, Koszalin, and Kołobrzeg) is still heavily used. The destination network picture for this case points to the significant predominance of national roads in the horizontal direction. These are national road No. 3 and S3, road No. 11 and roads No. 109, 110, 162 and 163, and as we get closer to the coast the load of these roads increases (36-127 thousand people). The model mechanism works on the principle of strengthening of centres offering the purposes that may attract a large number of journeys. An additional advantage is its location in the transportation network, which ensures a quick connection to the centre for most of the potential customers.

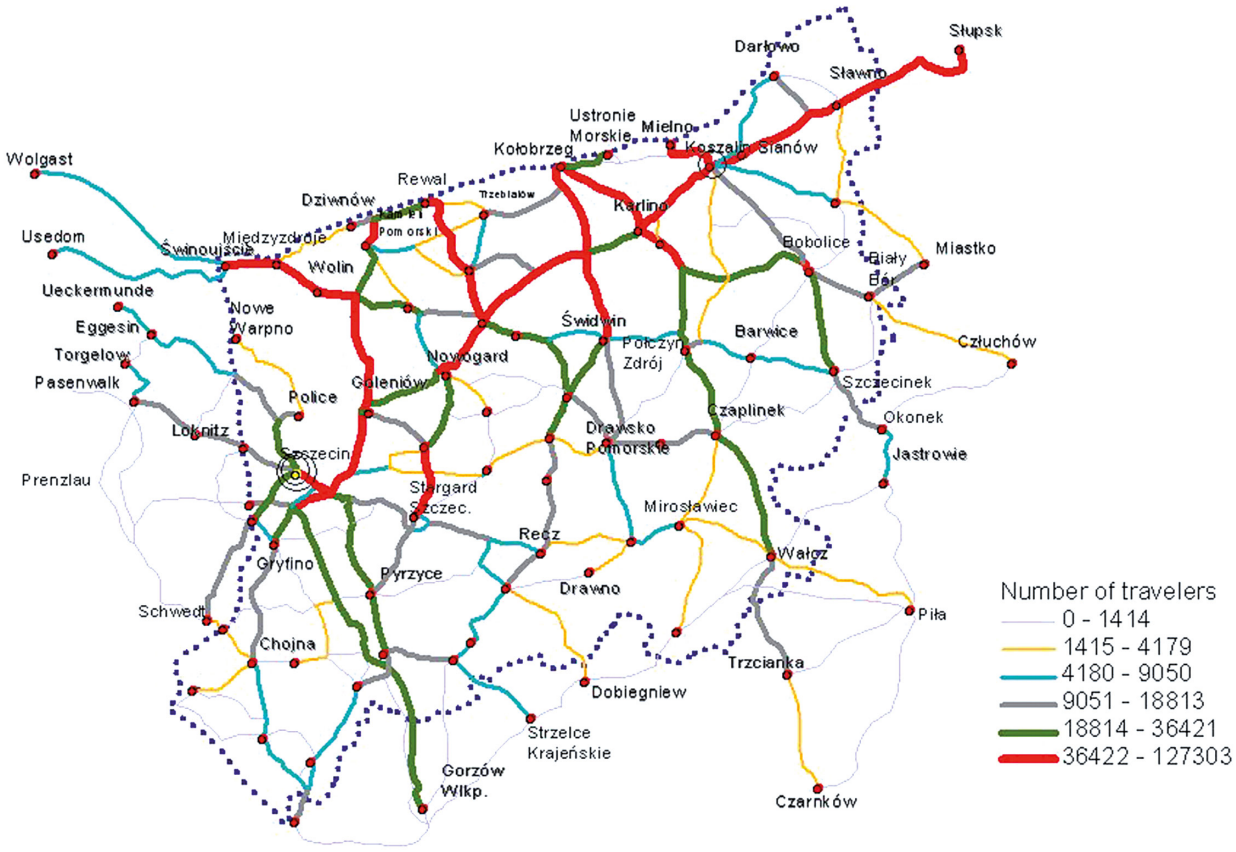

Fig. 5. Load of communication network – trips to work and tourist traffic.

Source: Own figure on the basis of the Central Statistic Department data (Local Database)and the model of intervening opportunities.

4. Discussion

The analysis of the demographic situation in the area of Zachodniopomorskie voivodeship points to the wide variety of demographic types in the individual units. You can highlight a few characteristic phenomena that affect the demographic situation in the region. An accelerated process of suburbanization causes the loss of population in major cities (Szczecin, Stargard Szczeciński, Koszalin, and Kołobrzeg) and at the same time, the increase in the number of the population in the municipalities adjacent to those cities. In West Pomerania the largest aggregations of such municipalities are located in the area of Szczecin Agglomeration and extend in the direction of Koszalin. Similarly, in the area of Koszalin and Kołobrzeg, surrounding municipalities have increased in recent times the number of the population from the largely positive migration balance (types C and D).

In this way a band is formed along national road No 6 and a little below the road. At the same time the modelling carried out shows that this is the direction of most lively contacts not only in interregional relationships, but also for travel to work in the area of the province. We may assume that in the case of the implementation of the planned way S6 (12), which is expected to reinforce this direction, a compact range of communes with high demographical potential will be formed. Figure 4 shows that there are for the most part units with increased population from migration (type C, D and only two of them type B).

A major factor in lowering the pace of demographic development in the voivodship (mainly in towns) was a decline in the birth rate (1990 – 2000). Recently an important component of the real growth of the population is migration (15).

The central, south west and eastern part of the province shows a negative demographic situation. Towns and villages lying in this area are gradual-

ly losing the population mainly due to negative net migration (type G and H), and also because of the negative natural increment (type F). This is an area that is poorly landscaped, containing mostly small and very small towns, often with one function only.

5. Conclusion

The analysis of daily routine movements to work shows weak cohesion of areas in Zachodniopomorskie voivodship. There is the situation characteristic for the Polish transport system, in which the main functions of transit are limited to supporting the east-west direction, while the north-south direction, natural for Poland, is less represented by the existing transport infrastructure. This fact makes worse the situation of small, less developed towns, in which there follows the loss of population causing a "moving away" from these units to better developed larger centres in the region. Well develop units have not only good position in transportation network but have well develop and various labour markets.

The planned modernization of the transportation network of the province (12) may, in large part, improve the situation of many towns to "attract" to their area new residents and investors. A profitable location is one of the most important development factors, but not the only one. The current demographic situation in Zachodniopomorskie voivodship requires coordinated action at different levels of the administration.

The Updated Concept of Spatial Planning of the Country in 2020 specifies the increasing diffusion of development from well-developed to weakly developed areas, which may be better associated with the well-developed areas thanks to the development of transport infrastructure, as one of the goals of spatial planning. Modification of the transport system in West Pomeranian Region by increasing spatial cohesion of the area can contribute significantly to increasing the opportunities of development of problematic areas in this province. Improvement of accessibility does not solve all the problems but it can help to increase the coherence of the area and increase the opportunities for the development of weak units.

Notes

(1) The version of the model was made by J. Sławski to the course of Regional Planning.
(2) Development Strategy of Zachodniopomorskie voivodship to the year 2020. Ćwiczenia do przedmiotu Planowanie Regionalne
(3) Runge J., Research methods in socio-economic geography, elements of the methodology, selected research tools, Katowice 2006.
(4) Jędrzejczyk D., The basics of geography of population, Wydawnictwo Akademickie Dialog, Warszawa.
(5) Kosiński L., Geography of population, PWN, Warszawa 1967.
(6) The list of Webb's types in figure 3 below:
Type A - positive natural growth exceeds the negative migration balance
Type B - positive population growth is higher than the positive migration balance
Type C - positive natural growth is lower than the positive migration balance
Type D - positive migration balance with surplus compensates the negative natural growth
Type E - negative natural growth is not offset by a positive migration balance
Type F - negative natural growth with a minus but no larger (in absolute value) migration balance
Type G - negative natural growth with a minus, but not less (in absolute value) migration balance
Type H – negative migration balance is not compensated by a positive natural growth
(7) *Chicago Area Transportation Study.* Final Report 2, Chicago 1960.
(8) Zipser, T., Sławski, J., *Models of urbanization processes*. Warsaw 1988.
(9) Zipser, T., *The networks as derivatives of concentration process*. Wrocław 1990.
(10) Dobrowolski, M., Proposals for modification of the methods of development of spatial planning general plans, in: Spatial planning – overview of methods and research techniques. In: E. Bagiński editor, Wrocław 1994.
(11) Modelling data are based on official data of The Central Statistic Department and the data

from the Regional Office for Spatial Planning of Zachodniopomorskie Voivodship in Szczecin.
(12) The study of the case of A6 highway
(13) (Szczecin – Berlin) and the expressway S3,
(14) Urząd Marszałkowski Województwa Zachodniopomorskiego, Szczecin 2010.
(15) Potrzeby i perspektywy polityki demograficznej na obszarze województwa zachodniopomorskiego. Available at: http://eregion.wzp.pl/sites/default/files/raport_potrzeby_i_perspektywy_polityki_demograficznej_na_obszarze_wojewodztwa_zachodniopomorskiego.pdf, DoA: 20 January 2016.

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