Changes in Forest Area of Coastal Communes of Baltic Sea as a Result of the Impact of Tourist and Recreational Loads

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ABSTRACT

The seaside area is one of the most forested in the country. At the same time, the forests in the coastal zone are exposed to a strong anthropogenic pressure due to a high concentration of tourism development and tourism. The aim of the study was to analyze the changes in the forest area availability of the coastal tourist municipalities of the Baltic Sea Coast in connection with the changes in the area of tourism development and tourism in this area. The analysis was conducted in dynamic terms, taking into account the years 2000–2016. In this study, all the communes that directly border the Baltic Sea were taken into account as seaside communes. The statistical data of the Local Data Bank of the Central Statistical Office were used as the source material for the implementation of the research problem addressing: the changes in the area of total forests in all coastal communes of the Baltic Sea Coast in 2000–2016, the changes in the area and population of communes, and selected data on the tourist function of the coastal communes including the data on the number of facilities and beds as well as the number of tourists visiting the coastal communes of the Baltic Sea Coast between 2000–2016. In the coastal communes, in the years 2000–2016, the forest cover index increased from 23.3 to 24.1%. Since 2000, the forest area per 1 inhabitant increased from 1741 m² to 2149 m². The increase in the forest area and average forest area per capita occurred mainly in the rural communes, large communes with the highest forest cover indicators, in the urban communes while in the communes with a strongly developed tourism function, there was an opposite tendency. The increase in the tourism load on the forest areas and decrease in the availability of forests for tourists in the municipalities and communes with the largest tourist investment (Kołobrzeg, Międzyzdroje, Władysławowo) is observed. The anthropogenic pressure and the availability of forest decreases in communes with lower population and the marginal role of tourism in their socio-economic development (Choczewo, Trzebiatów, Smołdzino, Kamień Pomorski).

Keywords: seaside communities, forest areas, tourist use, forest indicator

INTRODUCTION

The area of forests in Poland amounts to 9,214.9 thousand ha [GUS, 2016], which corresponds to the forest cover (share in the land area of the country) at the level of 29.5% [Sulewski 2018]. The average forest area in the European Union ranges from 32.8% to 37.9%. Compared to the national average and European average, the coastal area in northern Poland is characterized by a high degree of afforestation (Pomorskie Voivodeship – 36.3%, Zachodnio-pomorskie Voivodeship – 35.4%). The forests in the immediate shore zone of the Baltic Sea play a crucial role as they stabilize and strengthen the shoreline [Kluczyński and Kreft 2003]. The spatial distribution of the forest sites is very well reflected by the spatial distribution of the dominant species. The dominant species are pine, beech and birch [Piotrowska 2003]. However, due to high seasonal tourist traffic resulting from the high attractiveness of the area, they are

exposed to high anthropogenic pressure [Parzych 2001]. The change in forest area is most often associated with the development of both tourist infrastructure as well as the tourist and recreational function of forests. Taking into consideration the subject of this study, the works on the changes in the forest cover in Poland [Nyrek 1997, Ciesielska and Ciesielski 2017, Polna 2017, Falencka-Jabłońska 2017], specific types of landscape [Grzywacz 2002, Polna 2017] or selected regions [Szymura et al. 2010, Kunz 2012, Gorajska 2014] seem particularly important. The issues related to deforestation and afforestation [Fonder 2002, Sulewski 2018] as well as the spatial and organizational aspects of shaping the country's forest cover are also of great significance [Łonkiewicz 1994, Fonder 2002]. The issue pertaining to the impact of various anthropogenic factors on the forest ecosystems was addressed, among others, by Pasek and Zalewska [2011], Parzych et al. [2012], Parzych and Jonczak [2013] and Parzych [2014]. To date, however, there has been a lack of studies regarding the subject of the changes in the forest area in connection with tourist traffic and the development of tourist facilities as well as the changes in the tourist and recreational load of the forests in coastal areas. Therefore, research was undertaken to assess the changes in the forest area in relation to population and the number of tourists, the number of accommodation facilities and their capacity as well as the changes in the tourist and recreational load of forests in the communities of the Baltic Coast.

MATERIALS AND METHODS

Stand characteristic

The Polish Baltic coast covers 528 km of coastline. The studied area is located within the borders of the Zachodniopomorskie and Pomorskie Voivodships. In physical and geographical terms, the coast is a part of the macro-region of the Southern Baltic Coasts (Szczecinskie, Koszaliński and Gdańskie) extending from the Bay of Kiel to the Vistula Lagoon). They cover an area of about 19,000 km² and were shaped under the influence of the Scandinavian Ice Sheet and subsequent abrasive and accumulative activities of the sea as well as aeolian and fluvioglacial processes. For the purposes of this study, it was assumed that the coastal communes comprise the communes of the Baltic Coast, bordering directly with the Baltic Sea shoreline. In terms of administration, the studied area comprises 36 communes: 15 in Zachodniopomorskie Voivodeship (Świnoujście, Międzyzdroje, Dziwnów (community: urban and rural), Rewal, Trzebiatów, Kołobrzeg (community: urban and rural), Ustronie Morskie, Mielno (community: urban and rural), Będzino, Darłowo (community: urban and rural) and Postomino), and 21 in Pomorskie Voivodeship (Ustka (community: urban and rural), Smołdzino, Łeba, Wicko, Choczewo, Krokowa, Władysławowo (community: urban and rural), Jastarnia (community: urban and rural), Hel, Puck (community: urban and rural), Kosakowo, Gdynia, Sopot, Gdańsk, Stegna, Sztutowo and Krynica Morska). The source material for the implementation of the research problem was statistical data of the Local Data Bank of the Central Statistical Office (GUS) regarding the changes in the forest area, total area and population, the number of accommodation facilities and the number of tourists visiting the coastal communes. The analysis was carried out in dynamic terms, taking into account the years 2000–2016.

Data analysis

On the basis of the collected data, the forest cover indicators, forest area indicators per capita, per 1 accommodation facility, per 1 bed place and per 1 tourist as well as forest tourism and recreation load indices in 2000–2016 were calculated. The results were presented using cartograms. The interrelationships between the changes in the forest area against the background of the population changes, development and tourism intensity were expressed using *Spearman's correlation coefficients* ($p < 0.05$). Using the *Principal Components Analysis (PCA)* method, two main factors (F1 – tourist factor, F2 – area factor) explaining in total 75% of the variance, were identified. By using the hierarchical cluster analysis (*Ward's method*), the diminishing similarity between the changes in forest area in 36 examined communes directly neighbouring the Baltic Sea shoreline and the changes in tourist traffic in 2000–2016 were presented. The *STATISTICA 13.1* software package was used for the calculations.

RESULTS

Spatial diversity of forest accessibility against the background of demographic data and the data related to tourist traffic and tourist facility development

The coastal communes are characterized by a significant diversity of the forest cover. High afforestation rate occurs in the communes: Hel – 72.0%, Łeba – 54.1%, Sopot – 52.0%, Jastarnia – 49.2%, Ustka – 45.0 and Gdynia – 44.0%. Low afforestation rate is observed in the following communes: Władysławowo – 0.07%, Darłowo – 2.8%, Kołobrzeg – 3.9% and Dziwnów – 4.6%. In the years 2000–2016, a decrease in forest cover indices was noticed in 7 communes, the most significant in Międzyzdroje (46.8%) and Kołobrzeg (31.7%). In total, in 2000, there were 93 490 ha of forests in the coastal communes and in 2016 – 98877 ha (Table 1).

In the years 2000–2016, an increase in the number of accommodation facilities was recorded, from 1504 in 2000 to 2714 in 2016 (Tab. 1). In addition, there was a slight decrease in the

population and an increase in the number of bed places from 188 763 in 2000 to 189 745 in 2016 and the number of tourists from 1 970 866 in 2000 to 3 418 646 in 2016. In the studied period, the area of the coastal communes increased from 398 005 to 405 028 ha.

The average forest area per capita in the coastal communes in 2016 was 2149 m^2, and in 2000 – 1741 m^2 (an increase by 23.4%). Compared to other communes, clearly higher values of the indicator were observed in the communes: (rural: Międzyzdroje – 44 075 m^2, Smołdzino – 19 313, Choczewo – 14264, Krynica Morska – 12 766 and Wicko – 11 829 m^2), while significantly lower ones were recorded in the urban communes of Władysławowo – 9.91 m^2, Kołobrzeg – 21.9, Kamień Pomorski – 34.9 and Darłowo – 40.7 (Fig. 1A). In the years 2000–2016, an increase in the value of the indicator was recorded in 17 communes (among others, in Dziwnów – 1,449 m^2, Smołdzino – 933 m^2, Krynica Morska – 501 m^2), while in the remaining ones a decrease was noticed (e.i. Ustka – 1088 m^2, Wicko – 501 m^2, Puck – 488 m^2). On average, in 2000 there were 11.94 inhabitants per 1 ha of forests and in 2016

Table 1. Dynamics of forest area changes against the background of changes in area, population and selected measures of tourism development and traffic.

Year	Forest's area [ha]	Population's number	Number of accomodation objects	Number of accommodation places	Number of tourist	Number of tourist's night stays	Total surface [ha]
2000	93490	1049704	1504	188763	1416333	13413140	398005
2001	93706	1048482	1373	172155	1398802	12301406	397727
2002	93960	1048211	1302	170003	1396727	12173557	397727
2003	94242	1047703	1308	173831	1400377	12855478	398005
2004	95461	1050257	1339	176355	1407877	13195509	401796
2005	95246	1048414	1266	170930	1400054	13380349	401796
2006	95297	1046529	1280	173012	1400374	13611325	403517
2007	95157	1044624	1299	174813	1400063	14433557	403128
2008	95301	1044156	1284	172815	1397880	14817507	403114
2009	95602	1044699	1278	168825	1394916	14296781	403115
2010	95465	1057591	1227	162592	1401264	13633584	401106
2011	95680	1057780	1235	164633	1403921	14341487	401106
2012	95872	1057450	1966	185849	1425801	15784082	401106
2013	96244	1057724	2189	187315	1428492	16256147	401106
2014	96376	1057686	2230	189745	1431185	17312382	401106
2015	97393	1041823	2576	no data	no data	16256147	405028
2016	97877	1042560	2714	no data	no data	17312382	405028
Min	93490	1041823	1227	162592	1394916	12173557	397727
Max	97877	1057780	2714	189745	1431186	17312382	405028
Mean	95434	1049729	1610	175442	1406938	14433813	401383
SD	1176	5755	509	8596	12296	1627128	2378
CV, %	1.2	0.5	31.6	4.9	0.9	11.3	0.6

SD – standard deviation, CV – coefficient of variation [%]
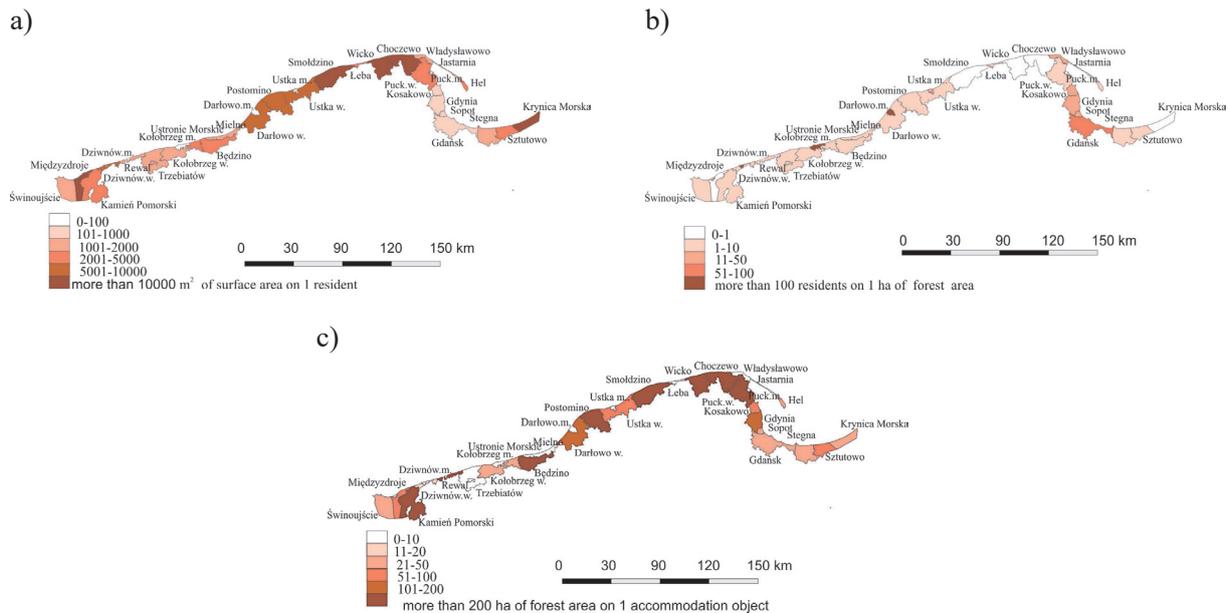
a)

b)

c)

Figure 1. Spatial distribution of selected indicators of the analysis of changes in the forest area of the coastal communes: A – population per 1 ha of forest area, B – area of forests per m² per inhabitant, C – forest area per 1 bed.

11.8 (Fig. 1B). In 2016, the indicator values changed from 455 inhabitants per 1 ha of forest in the urban communes of Kołobrzeg, Kamień Pomorski – 285 people and Darłowo – 245 people to 0.22 in the rural commune of Międzyzdroje, 0.5 in the commune of Smołdzino, 0.7 in the commune of Choczewo. In 17 communes, the indicator value increased (among others in the urban communes of Kołobrzeg, from 301 in 2000 to 455 people in 2016, Międzyzdroje from 42 to 77 people), in the other it decreased (i.a. in the commune of Kamień Pomorski – from 650 to 285 people, in the commune of Smołdzino from 280 to 250 people and in Jastarnia – from 14.6 to 9.6 people). On average, there were 62.16 ha of forests per 1 accommodation facility in 2000, and 36.06 ha in 2016 (a drop by 23.4%, Fig. 1C). The indicator values definitely higher than the average were observed in the rural communes of Władysławowo – 1654.6 ha, Smołdzino – 1654.6 ha, Kamień Pomorski – 1036 ha, Puck – 717.9 ha, while significantly lower in the urban communes of Władysławowo 0.033 ha, Dziwnów – 0.65 ha, Kołobrzeg – 0.84 ha and Darłowo – 0.84 ha. A significant increase in the forest area per 1 accommodation facility in the years 2000–2016 was recorded in the rural communes: Władysławowo – 1012.7 ha, Kosakowo – 832 ha and Choczewo – 125.4 ha while noticeable decreases were found in the urban communes of Międzyzdroje – 732.5 ha, Krynica Morska – 700.1 ha and Władysławowo – 200 ha).

The analysis of changes in the forest area in relation to the changes in the intensity of accommodation facility development indicates that in 2000 there were 127 m² of forests and in 2016 – 114.30 m² per 1 bed place. In 2016, a much higher forest area per 1 bed place than the average was recorded in the communes of: Smołdzino – 565 691 m², Kamień Pomorski – 450 489 m², Puck – 225 056 m², while much lower values were observed in the urban communes of Władysławowo – 8.31 m², Kołobrzeg – 66.8 m², Dziwnów – 101.59 m², Międzyzdroje – 106.08 m² and Darłowo – 110.95 m² (Fig. 2A). An increase was recorded in 17 communes (among others, in the communes of: Kosakowo from 75 to 149 m², Międzyzdroje from 59 to 94 m², Mielno from 19 to 26 m²), while the remaining communes observed a decrease of the indicator value (i.a. in the municipality of Kamień Pomorski – from 30 to 20 m², Łeba – from 17 to 11 m² and Ustka – from 16 to 11.3 m²).

Diversity of accommodation facility development density in the forest areas of the coastal communes

An analysis of the changes in the density of the accommodation facilities development in relation to the forest area indicates that in 2000 there were 2.01 bed places per 1 ha of forests in the studied area, in 2016 – 2.24; considerably above the average were the values in the communes of

Władysławowo – 1202, Kołobrzeg – 149, Dziwnów – 98, Międzyzdroje – 94, while in the communes of Smołdzino – 0.01, Kamień Pomorski (rural commune) – 0.02, Choczewo – 0.05 the values were considerably below the average. In 19 communes, in the years 2000–2016, an increase was recorded (among others in the urban commune of Kołobrzeg, from 75 to 149, in the urban commune of Międzyzdroje, from 59 to 94 and in Mielno, from 18 to 26) while in the remaining communes the indicator value was decreasing (i.a. in the municipality of Kamień Pomorski, from 30 to 20, in Ustka from 16 to 11, in Łeba, from 17 to 11). On average, in 2000, there were 21.08 tourists per 1 ha of forests, in 2016 – 34.92 (increase by 65.4%). There was a high tourist traffic load in the following communes: Kołobrzeg – 4,161 tourists per 1 ha of forests, Międzyzdroje – 2110, Darłowo – 896 and Dziwnów – 698; it was significantly lower in rural communes: Międzyzdroje – 0.01, Kamień Pomorski – 0.056, Smołdzino – 0.09 (Fig. 2B). In the years 2000–2016, an increase was recorded in 21 communes (particularly significant in the urban communes of Kołobrzeg – from 1275 to 4161, Międzyzdroje – from 827 to 2110, Darłowo – from 374 to 896, Sopot – from 125 to 278 and Gdańsk – from 68 to 153), in the remaining ones (among others: Jastarnia – from 210 to 170 people, Międzyzdroje (rural commune) – from 120 to 101 people, Kamień Pomorski – from 79 to 59 people) the values decreased.

In 2016, in the rural communes of Międzyzdroje, Kamien Pomorski and Smołdzino, there were 958 202 m², 177 115 m², 106 223 m² of the forest area per 1 tourist, respectively. The lowest forest area per 1 tourist was recorded in the urban communes of Kołobrzeg, Międzyzdroje and Darłowo,: 2.4 m², 4.73 m² and 11.1m², respectively (Fig. 2C).

In 19 communes, in the period 2000–2016, an increase in the forest area per 1 tourist (in rural communes: Międzyzdroje from 27 419 m² to 985 202 m², Kamień Pomorski from 97 816 m² to 177 115 m², Smołdzino from 51 932 m² to 106 924 m²), was recorded, in the remaining communes (including Postomino: from 2807 m² to 1528 m², Darłowo – from 1901 to 1392 and Sztutowo from 1681 to 936 m²), the rate decreased.

The relationship between the density of forest area and the number of tourists in the coastal communes

The relationships between the changes in the forest area, total area of the communes, population and selected measures of tourist function were expressed with Spearman's correlation coefficients and by means of *Principal Component Analysis* (*PCA*). The changes in the forest area were highly correlated with the changes in the number of
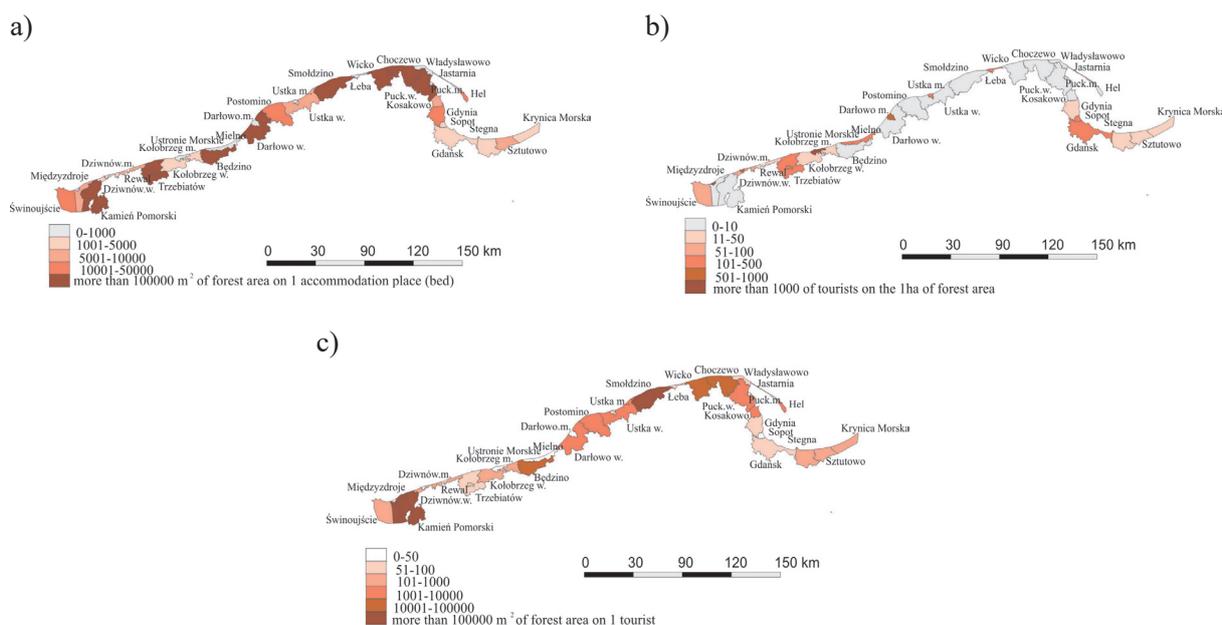

Figure 2. Spatial distribution of selected indicators for the analysis of changes in the forest area of coastal commune: A – forest area per 1 accommodation facility, B – forest area per tourist, C – number of tourists per 1 ha of forest area.

accommodation services provided and the population (r=0.79 and r=0.61 at p<0.05, relatively). Statistically significant correlations were shown between the number of tourists and the population (r=0.77), the number of accommodation facilities (r=0.57) and the number of bed places (r=0.68). However, no statistically significant correlation was found between the changes in the forest area and other variables describing the area, population and other measures of the tourist function (Table 2).

In the *Principal Component Analysis*, two main factors were identified (Tab. 3). The first factor (F1 – tourist) explained 44% of the variance and indicated the relationship between the number of bed places, the number of tourists and the number of accommodation services provided. These variables were characterized by high, negative factor loading values. The second factor (F2 – area) explained 31% of the variance and was created by high, positive factor loading values: forest area and the total area of communes.

In order to determine the spatial differences in the scope of the interrelationship of the changes in the forest area and the area in total, population and tourist function measures in the coastal communes, a hierarchical cluster analysis using the Ward's method was performed (Fig. 3). Three clusters (A, B, C) were separated. The first cluster (A) consisted of two smaller sub-clusters. The first group (A1) consisted of the communes of: Łeba, Jastarnia, the rural communes: Trzebiatów, Dziwnów, Mielno, Ustronie Morskie, Kołobrzeg and Władysławowo. The second (A2) group included the communes of Krynica Morska, Międzyzdroje, urban communes of Krynica Morska, Międzyzdroje, rural communes: Dziwnów, Darłowo, Ustka, Kamień

Pomorski, Sopot, Świnoujście and the rural commune of Kołobrzeg. The (B) cluster also consists of two sub-clusters. The first of them (B1) includes the communes of: Stegna, Sztutowo, Hel, Rewal, Postomino, and the rural communes of Ustka and Darłowo. The second group (B2) is constituted by the communes of Gdańsk, Gdynia and Puck. Smaller clusters can be also found in the (C) cluster. The first (C1) consists of the communes of Wicko, Choczewo, Kosakowo and Puck. The second sub-cluster (C2) included the following communes: Smołdzino, Będzino, and the rural communes of Władysławowo, Kamień Pomorski and Międzyzdroje (Fig. 3).

DISCUSSION

Spatial diversity of forest accessibility against the background of demographic data and the data related to tourist traffic and tourist facility development

In the years 2002–2014, the forest cover rates in Poland increased from 28.5 to 29.5% [Ciesielska and Ciesielski 2017, Falencka-Jabłońska 2017], in connection with the implementation of the National Programme for the Augmentation of Forest Cover (KPZL) [Sulewski 2018]. Until 2004, the increase in the forest cover concerned mainly the state-owned lands and in subsequent years the forests on private lands [Kaliszewski 2012, Jabłoński 2015, Ciesielski and Ciesielska 2017]. In Pomerania, the increase in forest cover has been recorded continuously since the beginning of the 20th century [Kunz 2012]. In the

Table 2. Spearman's correlation coefficients of (p<0.05) of the forest areas in coastal communes in 2000–2016 and area of communes, population and selected measures of tourism development and tourism

Specification	Forest's surface	Population's Number	Number of accomodation objects	Number of accommodation places	Number of tourists	Number of tourist's night stays	Total surface [ha]
Forest's surface	1.00	**0.61**	0.26	0.28	0.50	**0.79**	0.43
Population's number	**0.61**	1.00	0.41	0.31	**0.77**	0.27	-0.17
Number of accomodation objects	0.26	0.41	1.00	**0.89**	**0.57**	0.22	-0.15
Number of accommodation places	0.28	0.31	**0.89**	1.00	**0.68**	0.37	0.14
Number of tourists	0.50	**0.77**	**0.57**	**0.68**	1.00	0.49	-0.18
Number of tourist's night stays	**0.79**	0.27	0.22	0.37	0.49	1.00	0.40
Total surface [ha]	0.43	-0.17	-0.15	0.14	-0.18	0.40	1.00

Note: statistical significant values are bold

Table 3. Results of principal component analysis (PCA) dependence of forest area and population and selected variables characterizing the development and tourist traffic in the coastal communes.

Variable	Factor 1	Factor 2
Forest's surface	0.25	**0.86**
Population's number	-0.57	0.58
Total surface	0.15	**0.89**
Number of accomodation objects	-0.66	-0.40
Number of accommodation places	**-0.88**	-0.14
Number of tourists	**-0.86**	0.36
Number of tourist's nigtstays	**-0.83**	0.13
Output value	3.05	2.19
Participation, %	44	31
	75	

Note: factor loading levels higher than 0.7 are in bold

period 2000–2016, an increase in the forest cover rates was noted in most of the coastal communes of the Baltic Coast (from 23.4 to 24.4%). In the communes with declines in forest cover, these were most often due to the changes in the area of communes (increase in the total area by the lands of lower afforestation rate). An example would be the communes of Kołobrzeg and Międzyzdroje, where the forest area remained unchanged while the forest cover rates decreased significantly.

Diversity of accommodation facility development density in the forest areas of the coastal communes

In the years 2002–2014 there was an increase in the average forest area per capita, from 1741 m² to 2149 m² per capita. It mainly concerns the large rural communes, the reverse trend occurred in urban communes (Kołobrzeg, Międzyzdroje, Sopot, Gdańsk) and other intensively developed ones. In the urban communes most intensively used for tourist purposes (Kołobrzeg, Ustka, Łeba, Władysławowo, Gdańsk, Mielno), with intensive development of the accommodation base, there was a significant decrease in the forest area per 1 accommodation facility. This is associated with a drop in the accessibility of forests for tourists and an increase in the tourist anthropogenic pressure in the forest areas. There is a group of communes (Wicko, Smołdzino, Kamień Pomorski, Trzebiatów, Choczewo), where the forest area per 1 facility and per 1 bed place has increased. It is connected with the afforestation of agricultural land or wasteland owned by the

Agricultural Property Agency of the State Treasury, originating from liquidated state farms (PGR) [Polna 2017]. The changes in the forest cover indices in some communes are also caused by the changes in the total area and the administrative system [Ciesielski and Ciesielska 2017]. An example is the Władysławowo commune, where the changes result from the separation of the new urban commune of Władysławowo from the area of the previously existing one, with the largest number of accommodation facilities on the coast. The lowest values of the forest area indices per 1 bed place and the highest drops in the values of these indices are characteristic for the communes most intensively used in terms of tourism (Władysławowo Kołobrzeg, Dziwnów, Międzyzdroje and Darłowo). This is due to the dynamic development of the accommodation base. In these communes, the level of potential tourist and recreational anthropogenic pressure on forest areas is much higher. As Pasek and Zalewska [2011] note on the basis of research in the Oliwa Forests, the growth of the tourist pressure in forests leads to limiting their health and recreational value [Pasek and Zalewska 2011]. Lower tourist anthropogenic pressure is a feature of the forest areas of the peripheral communes of the studied area, with a much less developed tourist function (Choczewo, Wicko, Trzebiatów, Kamień Pomorski) and the communes in the outskirts of protected areas (rural communes: Kamień Pomorski, Międzyzdroje, Smołdzino).

The relationship between the density of forest area and the number of tourists in the coastal communes

The increase in the number of inhabitants and the intensity of tourist traffic in coastal communes is significantly correlated with the spatial development of the residential and tourist buildings as well as elements of tourism and recreation facilities development which determines the decrease in the forest area and the increase in the tourist and recreational pressure on the existing forest areas [Parzych 2001, Stępień 2005, Pasek and Zalewska 2011]. This is accompanied by the phenomena of trampling new paths, soil surface erosion caused by riding bicycles on non-designated routes, excessive noise and pollution associated with walking the dogs [Stępień 2005, Jalinik 2016]. Another problem, also related to the growing scale of tourist traffic in the forest
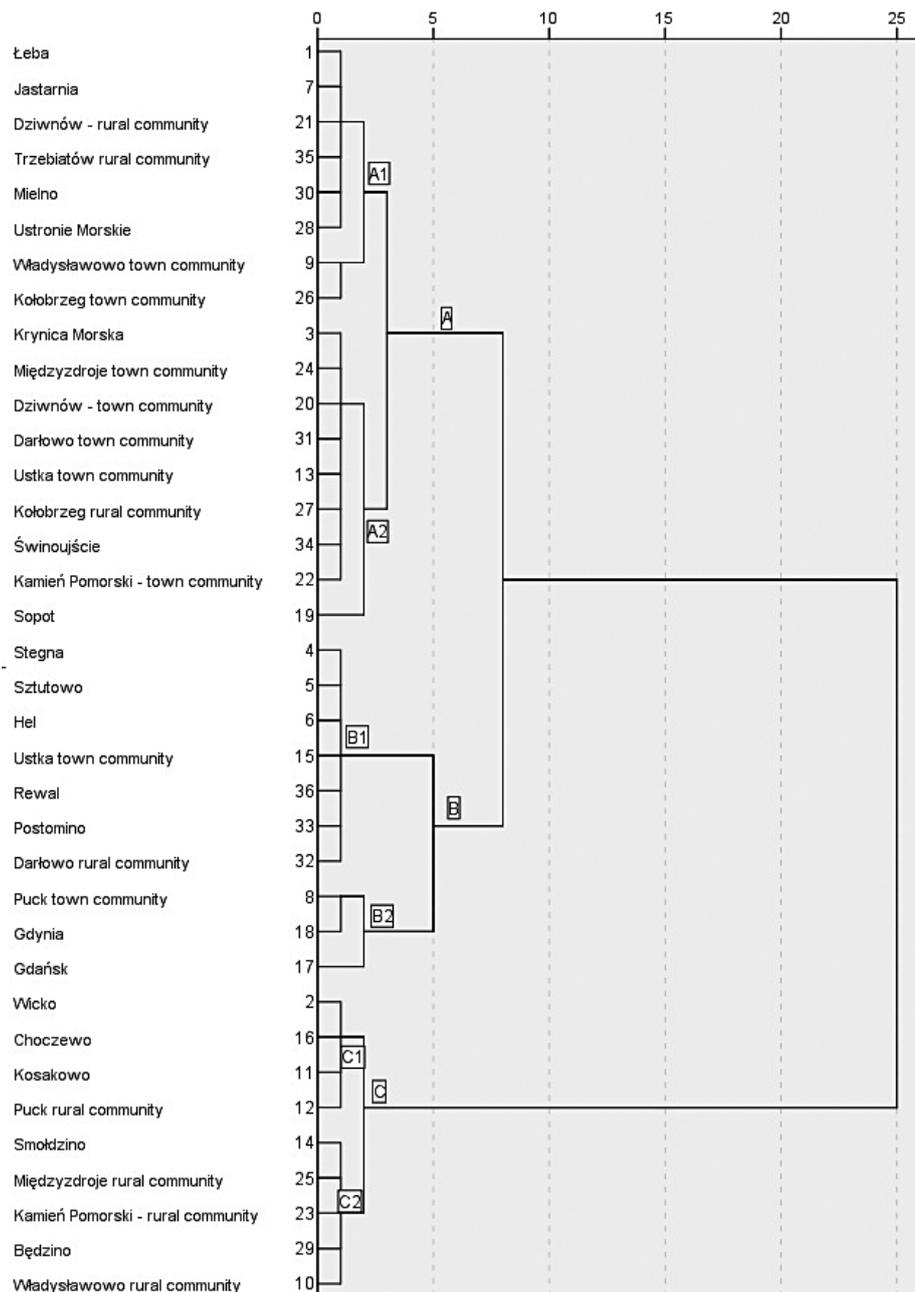
Figure 3. Spatial dependence in the distribution of the forest area changes and the area and population of communes and selected features of tourism development and tourism using the Ward's method.

areas, seems to be the entry of new forms of recreation and tourism such as jogging or various types of cycling sports, such as freestyle biking or downhill biking [Cieszewska 2008].

The high level of development of the tourist function is associated with the adoption of new areas for accommodation facilities and other tourist development elements, often at the expense of forest areas [Cieszewska 2008, Jalinik 2016]. This is confirmed by the results of the cluster analysis. The communes in the A1 cluster are grouped by similarity of high development and tourist traffic measures

with the moderate and low forest areas, while in the A2 cluster by moderately high values for the facility development and tourist traffic and lower forest cover measures. The B1 cluster included the communes showing similarity due to significantly lower values of development and tourist traffic measures with significant differences in the forest areas, whereas B2 comprised the communes with similar total area, forest cover rates and significant differences in the values of tourist function measures. The C1 cluster consists of the communes with a low number of tourists and bed places, significantly differentiated

forest cover rates as well as total areas and population while the C2 cluster comprises the communes similar in terms of total area, forest cover and lower values of tourist function measures (Fig. 3).

CONCLUSION

In the coastal communes of the Baltic Coast, in the period 2000–2016 a significant increase in forest cover rates was observed. The most significant increase occurred in the rural communes, with large areas, sparsely populated and with domination of non-tourist socio-economic development functions. At the same time, the decrease in the forest area per one accommodation facility and 1 bed place as well as per 1 tourist resulting from the intensive development of facilities and tourist traffic in most of the coastal communes was observed. There was also an increase in the tourist load of forests and a decrease in forest area per capita and per 1 tourist in the urban communes and in the communes best developed in terms of tourism (Kołobrzeg, Międzyzdroje, Władysławowo). The lowest impact of anthropogenic pressure and the increase in the forest area per capita and per 1 tourist were demonstrated in the communes with lower population density and low development of tourist and recreational facilities (Choczewo, Trzebiatów, Smołdzino, Kamień Pomorski).

REFERENCES

1. Ciesielska K., Ciesielski M. 2017. Lesistość w Polsce w przekrojach terytorialnych. Wiadomości statystyczne, Rok LXII 5 (672): 62–78.

2. Cieszewska A. 2008. Zasady organizacji turystyki i wypoczynku na obszarach leśnych w krajach Unii Europejskiej. Studia i Materiały CEPL 10, 3(19): 179–192.

3. Falencka-Jabłońska M. 2017. Forest economy versus sustainable development. Journal of Ecological Engineering 18, 6: 30–35. DOI: 10.12911/22998993/76832

4. Fonder W. 2002. Organizacyjne i ekonomiczne aspekty zwiększania lesistości w Polsce. Post. Nauk Roln. 3: 41–50.

5. Grzywacz A. 2002. Problemy zalesień w wielofunkcyjnym rozwoju obszarów wiejskich. Post. Nauk Roln. 3: 5–18.

6. GUS (2016). Forestry 2016, Warsaw. (in Polish)

7. Hermy M., Verheyen K. 2002: Legacies of the past in the present-day forest biodiversity: a review of past land-use effects on forest plant species composition and diversity. Ecological Research 22: 361–371.

8. Jabłoński M. 2015. Forest land – causes of change and coherence of data sources. Wiadomości Statystyczne 11: 54–68. (in Polish)

9. Kaliszewski A. 2012. „National Program for Expanding of Forest Cover" following Poland's accession to the European Union. Forest Research Papers 73: 189–200.

10. Kluczyński B., Kreft A. 2003. Ilościowy oraz biologiczny stan starodrzewów sosnowych (Pinus sylvestris L.) w Słowińskim Parku Narodowym. Parki Narodowe i Rezerwaty Przyrody 22, 2: 197–226. (in Polish)

11. Jalinik M. 2016. Obszary leśne w rozwoju turystyki. Ekonomia i Środowisko 3: 313–323.

12. Kunz M. 2012. The changes in woodiness of West Pomerania During the last 400 years. Annals of Geomatics 10, 4(54): 145–155. (in Polish)

13. Łonkiewicz B. 1994. Przestrzenne modele kształtowania lesistości kraju. Człowiek i środowisko 18, 97: 97–114.

14. Nyrek K. 1997. Uwagi o przyczynach zmian zalesienia ziem polskich w latach 1772–1918. Słupskie Studia Historyczne 5: 91–98.

15. Parzych A. 2014. Heavy metals accumulation in moss Pleurozium schreberi (Brid.) Mitt. and Hylocomium splendens (Hedw.) B.S.G. in the Słowiński National Park. J. Elem. 2: 471–482. Doi: 10.5601/jelem.2014.19.2.460.

16. Parzych K. 2001. Tourism movement in Slowinski National Park in 1995–1999. Wyższa Pomorska Szkoła Turystyki i Hotelarstwa. Zeszyty Naukowe 1: 253–263. (in Polish)

17. Parzych A., Jonczak J. 2013. Content of heavy metals in needles of Scots pine (Pinus sylvestris L.) in selected of pine forest in the Slowinski National Park. Arch. Environ. Prot. 1, 39: 41–51.

18. Parzych A., Sobisz Z., Trojanowski J. 2012. Prognosis content of heavy metals in soil and herbaceous plants in selected of pine forest in the Slowinski National Park. Arch. Environ. Prot. 4, 38: 35–47.

19. Pasek M, Zalewska A. 2011. Obciążenie rekreacyjne lasów oliwskich w świetle ich chłonności naturalnej. Journal Ecological Health 15 (4): 199–202.

20. Piotrowska H. 2003. Diversity and dynamics of coastal forests and scrub in Poland. Wydawnictwo Naukowe Bogucki, Poznań-Gdańsk, 102pp.

21. Polna M. 2017. Changes in the woodiness of rural areas in Poland in the years 1995–2016. Roczniki Naukowe Stowarzyszenia Ekonomistów Rolnictwa i Agrobiznesu 19 (2): 194–199. (in Polish)

22. Stępień E. 2005. Możliwości promowania i ograniczenia rozwoju turystyki i rekreacji w lasach. Turystyka i Rekreacja 1: 39–42.

23. Sulewski P. 2018. Conditions, scope and economic effects of afforestation of marginal soils on farms in Poland. Problems of Agricultural Economics 1 (354): 149–169.

24. Szymura T.H., Dunajski A., Ruczakowska A.M. 2010. Changes of forest cover in the Karkonosze National Park area in 1747–1977 period. Opera Corcontica 47 Suppl. (1): 159–166.