

# Assessment of spatial changes in green areas in the spa town of Sopot since the 19<sup>th</sup> century

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## Abstract

This paper presents changes observed in the green areas in the city of Sopot. Analyses of Sopot archival materials, both cartographic and graphic, provided grounds for an assessment of changes and transformations in that respect starting from the 19<sup>th</sup> century. These analyses covered all the spa town protection zones A, B and C. This study also focuses on the aspect related with the primary function served by the spa town within the city. The city was also investigated in terms of the considerable cultural value frequently associated with green areas, since Sopot is an architectural gem of historical value. The analysis emphasised the positive effect of green areas on the health resort character of the city. Green areas in the spa town of Sopot were analysed applying the comparative method. For this purpose maps and city maps were investigated. Additionally, the study is also based on archival graphic materials collected from the dawnysopot.pl website, as well as recent field studies (Świczekowska, 2017).

**Keywords:** spa park Sopot, spa town Sopot, spatial planning in spa towns

## 1. Introduction

The outstanding attractiveness of Sopot, both as a resort and a spa town, is related not only with its location, but also the urban tissue including the urban landscape filled with green spaces. Nature in Sopot in combination with sophisticated architecture, such as e.g. Art Nouveau residential tenements and gentrified apartment buildings, contribute to a unique atmosphere and a prestigious character of Sopot. It is the urban domain and a magnet attracting health resort patients and tourists alike, who choose this Polish city from among all other resorts worldwide and then return to it repeatedly for rest, leisure and enjoyment as well as health reasons.

Sopot is a county town located in northern Poland on the Baltic coast (Fig. 1). Together with Gdańsk situated at a distance of 15 km and Gdynia at a distance of only 8 km it constitutes Trójmiasto, the Tricity agglomeration (ZPZR, 2012). Thanks to its location in this agglomeration Sopot has very good national and international railway connections. The international Gdańsk Lech Wałęsa Airport is also located nearby (ZPZR, 2012). Additionally, being a coastal city it also has convenient ferry connections with Scandinavia (Golba, Gościńska, 2001).

In 2019 Sopot is one of the six Polish seaside spa towns and the only one of them under the direct impact of the Tricity agglomeration (comprising Gdańsk, Gdynia and Sopot). A similar impact of a metropolitan area is observed in Poland only in Konstancin Jeziorna (a lowland spa town near Warszawa) and Swoszowice (a lowland spa town near Kraków). Additionally, Sopot has one of the highest green area indexes per capita in Poland. Thus it is evident that despite continuous urbanisation pressure of Tricity, the established Tricity Landscape Park well serves its function. Sopot is a relatively small resort, covering only 17.3 km<sup>2</sup> at the south-western coast of the Bay of Gdańsk. It is situated at the boundary of the Kaszuby Lake District (Pojezierze Kaszubskie) and the Kaszuby Littoral Region (Pobrzeże Kaszubskie, German Kaschubische Küste). The Vistula Spit (Mierzeja Wiślana) and the Vistula River Mouth (Żuławy Wiślane, a Ramsar Wetland) are also located in that region (ZPZR, 2012).

## 2. A brief history of the spa town

This part of the paper presents a brief overview of the Sopot spa town history. In 1819 an affluent merchant, Carl Christoph Wagner, established the first seaside bathing beach (ZPZR, 2012). Only 4 years later the professional Bath facilities (Fig. 1) using sea water in cold and warm baths were opened by a physician Jean Georg Haffner. Thus the beginnings of Sopot as a health resort date back to 1823 and doctor Haffner is referred to as the founding father of Sopot (Świeczkowska, 2017, after: Operat Uzdrowiskowy, 2007).

This lithograph is a beautiful representation of the extensive green areas in Sopot in the 19<sup>th</sup> century. Forested moraine hills may be seen in the background. The building development is dense rather than scattered, with an avenue leading towards the sea. Over the long stretch of a natural beach we may see large green areas. This view may be compared to a cartographic image (Fig. 3) from the same period.

**Fig. 1.** The First Spa House, a lithograph from 1839 (source: [www.dawnysopot.pl](http://www.dawnysopot.pl))





**Fig. 2.** A panorama of Sopot, a lithograph from ca. 1890 (source: [www.dawnysopot.pl](http://www.dawnysopot.pl))



**Fig. 3.** The Second Spa House, a photograph from ca. 1890 (source: [www.dawnysopot.pl](http://www.dawnysopot.pl))



**Fig. 4.** The Third Spa House – view from the lighthouse, a photograph from ca. 1910 (source: [www.dawnysopot.pl](http://www.dawnysopot.pl))

In 1842 Sopot had already 937 inhabitants, while the number of health resort visitors reached approx. 1000 annually. The 1850's were marked by the enlargement of the sanatorium to include new facilities (Fig. 3), the Second Spa House ([www.sopoty.pl](http://www.sopoty.pl)) (Świeczkowska, 2017).

In the 1870's the Gdańsk–Słupsk–Koszalin (Danzig–Kolberg) rail road was opened, contributing greatly to the dynamic development of the region (Operat Uzdrowiskowy, 2007). Since 1870, when Sopot became a part of that railway

line its growth and development were boosted thanks to its greater accessibility (Poczobut, 2016). The end of the 19<sup>th</sup> century was marked not only by the extension of the old Spa House, but also the construction of a new spa house (Świeczkowska, 2017).

Sopot was granted city rights on 8 October 1901. In 1910 the construction of the Third Spa House was started (Fig. 4) (ZPZR, 2012; Świeczkowska, 2017). In 1979 Sopot was classified as an urban complex of historical value, thanks to which it is covered by the historic preservation regulations. In 1997 the medicinal salt spring intake, Zdrój Świętego Wojciecha, was opened (ZPZR, 2012; Świeczkowska, 2017). On the 19<sup>th</sup> February 1999 Sopot was registered as a spa town on the power of the Regulation of the Minister of Health and Welfare.

The Table below presents dynamic changes in the population size of Sopot from the 18<sup>th</sup> to the 20<sup>th</sup> century (Świeczkowska, 2017; ZPZR, 2012).

**Table 1.** Changes in the population size of Sopot from the 18<sup>th</sup> to the 20<sup>th</sup> century – a study by Świeczkowska 2017 (source: ZPZR, 2012)

Date	Number of inhabitants / health resort patients
1714	13 houses, an inn, a garden with guest houses, seat of the village head, 5 fishermen's huts
1772	301 people
1842	937 inhabitants / approx. 1000 health resort patients annually
1900	over 12 000 inhabitants
27 July 1914	approx. 17 500 inhabitants / over 20 000 health resort patients annually
Mid-20 <sup>th</sup> century	over 37 000 inhabitants

It needs to be stressed here that in such towns the actual population density is much greater due to the numerous health resort patients and tourists. We need to remember that the number of tourists exceeds considerably the number of inhabitants.



**Fig. 5.** The Northern Bath House, a photograph from ca. 1910; the building walls are partly covered with climbing vegetation. The lawn was well-tended, while young trees were planted to form a parkway providing shade to strollers (source: Świeczkowska, 2017, after: www.dawnysopot.pl)



**Fig. 6.** Grand Hotel in Sopot, a photograph from ca. 1925. The most famous hotel in Sopot could always boast well-tended green spaces. View from the side of a sandy beach (source: www.dawnysopot.pl)



**Fig. 7.** Grand Hotel in Sopot in 2016 (source: Świeczkowska, 2017)

### 3. Nature value

The city of Sopot is located between two unique nature forms. On the north-western side it is bordered by the Bay of Gdańsk, which coast is protected within the framework of the Natura 2000 programme – the Special Protection Area under the Birds Directive the Bay of Puck (Zatoka Pucka) (Regulation of the Minister of the Environment of 21.07.2004 on special protection areas under the Birds Directive Natura 2000 (Dz.U. 2004 nr 229 poz. 2313). On the south-western side the city borders with the Tricity Landscape Park (Trójmiejski Park Krajobrazowy). Sopot is situated in 11 catchments of small streams draining to the sea (SUiKZP, 2010; Świeczkowska, 2017).

Bathing is allowed over the entire length of the shore, as adequate water purity is maintained thanks to long-term environmental protection programmes. Swimming and water sports are prohibited only in the immediate vicinity of the pier and mouths of the streams (Golba, Gościńska, 2001).

From the west the city lies at the margin of the Gdańsk moraine upland (Wysoczyzna Gdańska), characterised by highly varied relief forms. The Sopot Scarp (Skarpa Sopotcka) reaching an altitude of maximum 30 m a.s.l. divides the city into two parts: the upper Sopot Górny west of the scarp and the lower Sopot Dolny east of it (ZPZR, 2012). Górny Sopot is a plain ranging in altitude from 11 m a.s.l. up to 62 m a.s.l. In contrast, Dolny Sopot is a flat land platform bordering with the sandy beach and a belt of dunes (ZPZR, 2012).

Among large-scale nature conservation forms the most important role is played by the Tricity Landscape Park (Trójmiejski Park Krajobrazowy), in which one of the nature conservation objectives is to guarantee the positive impact of forests on the climate in the Gdańsk agglomeration (CRFOP, 2019). Moreover, Sopot comprises also Natura 2000 special protection areas under the Habitat Directive of the Orłów Cliffs (Klify i Rafy Kamienne Orłowa) and under the Birds Directive the Bay of Puck (Meller, 2019; CRFOP, 2019). The spa town of Sopot has one nature reserve, Zajęcze Wzgórze (a forest phytocenosis), and as many as five ecological sites, i.e. 1. Wąwozy grodowe, 2. Jar Swelini, 3. Kokoryczkowe zbocze, 4. Cisowe zbocze and 5. Konwaliowe wzgórza (Meller, 2019; CRFOP, 2019).

The Tricity Landscape Park belonging to Sopot is a perfect location for various active leisure and recreation forms. A 190-year old pine is growing in its buffer zone. The Zajęcze Wzgórze nature reserve is located in the eastern part of the park. The nature reserve was established in 1983 and covers 11.8 ha. It is crossed by the green tourist trail, Szlak Skarszewski. The nature reserve, resembling a primeval forest, is unique on the European scale. It is thanks to

the accumulation of dead wood in standing or uprooted dead trees covered by moss and overgrown by fungi. This provides a perfect habitat for some very rare species of digger wasps, being the only such site in Poland (Świeczkowska, 2017, after: Operat Uzdrowiskowy, 2007).

#### 4. Valuable stand in the spa town of Sopot

In 2019 as many as 55 monument trees and 2 granite erratics were registered as nature monuments in the Sopot health resort (CRFOP, 2019). It needs to be stressed that a review of nature monument charts in the Central Register of Nature Conservation Forms (CRFOP, 2019) provides a greater number (by including a cluster of 14 Douglas firs and pairs of trees). In turn, Świeczkowska (2017) showed data on 51 monument trees (UM Sopot 2017 – the register of nature monuments in the city of Sopot). Moreover, Sopot has street and park stands of historical value, of which many are legally protected, such as 1 avenue lined with trees (Świeczkowska, 2017).

When considering the 2019 list of specific species of monument trees an interesting finding is connected with the large number of coniferous species. Such a high number of conifers, as a rule more sensitive to urban conditions, growing in this city indicates advantageous soil, climate and air conditions. The dimensions reached by these trees as well as their species diversity are given in Table 2.

In the streets of Sopot we may find species rarely found in urban environments, such as Eastern hemlock, Nootka cypress, Douglas fir, ginkgo, Japanese cedar, giant arborvitae and Chinese thuja. The oldest preserved specimen is a common oak tree named Jerzy, found in a parsonage estate. It is over 330 years old (Świeczkowska, 2017).

The Sopot stands and individual trees are a great asset and symbol of this city, particularly when we consider trees growing in streets, constituting a perfect element to complement historical residential houses. Streets are lined by trees aged over 100 years. However, due to their age these trees require costly, regular tending measures. Nevertheless, it is worthwhile to do whatever is required to preserve and maintain those tree plantings. This provides green urban interior and emphasises the passing seasons in the city (Świeczkowska, 2017).



**Figs. 8, 9.** Tree-lined streets in combination with numerous historical residential houses provide the city with the characteristics of a health resort. We may see the clearly too small soil volume for the formation of the root mass, which may result in deterioration of the tree health condition. According to some authors the area of free surface (untreated ground) should be 9–16 m<sup>2</sup> per 1 tree (Szczepanowska, 2001). Typically only black locust may thrive under such conditions (source: Świeczkowska, 2017)

**Table 2.** Nature monuments in the spa town of Sopot – data from the Central Register of Nature Conservation Forms of 06.2019 (source: CRFOP, 2019, <http://crfop.gdos.gov.pl/CRFOP/search.jsf> The monument trees are ordered as in the register)

Nature monuments in the spa town of sopot in 06.2019 Based on crfop the central register of nature conservation forms					
No.	Common name	Latin name	Diameter breast height	Height	Remarks
1.	White poplar	<i>Populus alba</i>	183 cm	28 m	
2.	European beech	<i>Fagus sylvatica</i>	172 cm	31 m	
3.	Common oak	<i>Quercus robur</i>	140 cm	30 m	
4.	Common oak	<i>Quercus robur</i>	115 cm	23 m	
5.	Douglas fir	<i>Pseudotsuga menziesii</i>	113 cm 72–98 cm	52 m 48–53 m	A cluster of 14 Douglas firs
6.	Northern red oak	<i>Quercus rubra</i>	130 cm	22 m	
7.	European beech	<i>Fagus sylvatica</i>	113 cm	26 m	
8.	Common oak	<i>Quercus robur</i>	167 cm	26 m	
9.	Giant arborvitae	<i>Thuja plicata</i>	89 cm	28 m	
10.	Giant arborvitae	<i>Thuja plicata</i>	83 cm	29 m	
11.	Austrian pine	<i>Pinus nigra</i>	92 cm	21 m	
12.	White pine	<i>Pinus strobus</i>	74 cm	20 m	
13.	White poplar	<i>Populus alba</i>	175 cm	29 m	
14.	Scots pine	<i>Pinus sylvestris</i>	96 cm	8 m	Aged approx. 185 years, broken and dead tree – destroyed monument tree
15.	Japanese cedar	<i>Cryptomeria japonica</i>	39 cm	16 m	
16.	Eastern hemlock	<i>Tsuga canadensis</i>	21 cm	3 m	
17.	European beech	<i>Fagus sylvatica</i>	122 cm	29 m	
18.	Horse chestnut	<i>Aesculus hippocastanum</i>	113 cm	23 m	
19.	Ginkgo	<i>Ginkgo biloba</i>	71 cm	21 m	
20.	Chinese thuja	<i>Thuja orientalis</i>	47 cm	15 m	
21.	European beech	<i>Fagus sylvatica</i>	146 cm	28 m	
22.	European larch	<i>Larix decidua</i>	96 cm	20 m	
23.	European beech	<i>Fagus sylvatica</i>	104 cm	38 m	
24.	European beech	<i>Fagus sylvatica</i>	118 cm	40 m	
25.	European beech	<i>Fagus sylvatica</i>	118 cm	24 m	
26.	European white elm	<i>Ulmus laevis</i>	99 cm	27 m	
27.	Scots pine European beech	<i>Pinus sylvestris</i> <i>Fagus sylvatica</i>	121 cm	29 m	Conjoined trees
28.	Scots pine	<i>Pinus sylvestris</i>	100 cm	31 m	
29.	European larch	<i>Larix decidua</i>	102 cm	36 m	
30.	Scots pine	<i>Pinus sylvestris</i>	106 cm	34 m	
31.	Common oak	<i>Quercus robur</i>	108 cm	27 m	
32.	Common oak	<i>Quercus robur</i>	119 cm	36 m	
33.	Common oak	<i>Quercus robur</i>	109 cm	36 m	
34.	Douglas fir	<i>Pseudotsuga menziesii</i>	112 cm	40 m	
35.	European larch	<i>Larix decidua</i>	100 cm	33 m	
36.	Scots pine	<i>Pinus sylvestris</i>	106 cm	33 m	
37.	Nootka cypress	<i>Cupressus nootkatensis</i>	57 cm	13 m	
38.	European beech	<i>Fagus sylvatica</i>	307 cm	25 m	
39.	Scots pine	<i>Pinus sylvestris</i>	320 cm	23 m	
40.	European white elm	<i>Ulmus laevis</i>	108 cm	No data	

41.	European larch	Larix decidua	334 cm	25 m	Estimated age of both trees – 160 years
42.	European larch	Larix decidua	332 cm		
43.	Granite erratic				
44.	Granite erratic				

## 5. Changes in green areas in the city of Sopot since the 19<sup>th</sup> century

Analysed data are based on a study by Świeczkowska from 2017. Using figures to that study (Figs. 13, 15, 16) the areas of green spaces in Sopot were calculated. The data are presented in the Table below.

**Table 3.** Land management in the city of Sopot between the 19<sup>th</sup> and 21<sup>st</sup> centuries.  
Based on Figs. 13, 15, 16 (source: Świeczkowska, 2017)

	19 <sup>th</sup> century [km <sup>2</sup> ]	20 <sup>th</sup> century [km <sup>2</sup> ]	21 <sup>st</sup> century [km <sup>2</sup> ]
Forest	13.36	9.32	10.41
Parks, urban green and others	0.9	4.31	1.17
Cemetery	–	0.11	0.16
Other area	1.28	–	–
Developed area	0.63	3.03	5.04
Beach	1.13	0.3	0.19
Sports grounds, playgrounds, etc.	–	0.01	0.07
Standing waters	–	0.02	0.01
Hippodrome	–	0.2	0.25
Total	17.3	17.3	17.3

The analyses identified such areas in Sopot as forest, parks, urban green and other green spaces, cemeteries, developed area, beach, sports grounds, playgrounds, standing waters, the Hippodrome and other areas, otherwise unclassified. The division into these area types is supported by the accuracy of maps. In the Table we may observe the changing size of these areas over the centuries. The percentage shares of individual areas in each of the investigated centuries are given in the Table below (Świeczkowska, 2017).

**Table 4.** Shares of individual green area types in Sopot over centuries. Based on Figs. 13, 15, 16  
(source: Świeczkowska, 2017)

	19 <sup>th</sup> century [%]	20 <sup>th</sup> century [%]	21 <sup>st</sup> century [%]
Forest	77.2	53.9	60.2
Parks, urban green and others	5.2	24.9	6.8
Cemetery	–	0.6	0.9
Other area	7.4	–	–
Developed area	3.6	17.5	29.1
Beach	6.5	1.7	1.1
Sports grounds, playgrounds, etc.	–	0.1	0.4
Standing waters	–	0.1	0.1
Hippodrome	–	1.2	1.4
Total	100	100	100



Forests cover the greatest part of the city. Their area decreased from over 13 km<sup>2</sup> in the 19<sup>th</sup> century to only 9.3 km<sup>2</sup> in the 20<sup>th</sup> century. This was a consequence of urbanisation and a rapid increase in developed area. The decreasing forested area was also influenced by the allocation of land to other green spaces.

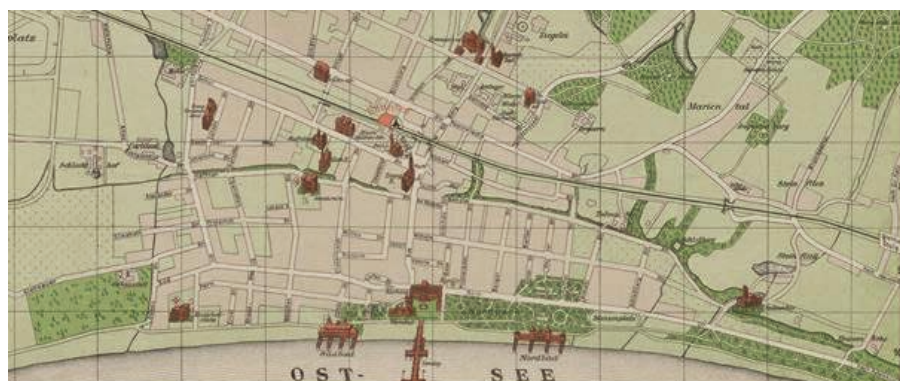
Fig. 17 presents the area of forests, which vanished in the period from the 19<sup>th</sup> and 20<sup>th</sup> centuries. It is 4.04 km<sup>2</sup>, which accounts for over 23% city area. It may be stated that this area is shrinking first of all in the vicinity of developed areas (Świeczkowska, 2017).

The trend is different if we compare the 19<sup>th</sup> and the 21<sup>st</sup> centuries, as the forested area increased from 9.3 km<sup>2</sup> to 10.4 km<sup>2</sup> (Fig. 18). This is equivalent to an increase by 1.1 km<sup>2</sup>, which amounts to 6.4% city area. However, this concerns not only the increase in forested area, but it is related also to losses. Changes in forested area in Sopot between the 20<sup>th</sup> and 21<sup>st</sup> centuries are given in Fig. 18 (Świeczkowska, 2017). We can see that the area of forests changes mainly at the boundary with developed areas. An increase in forested areas is also connected with afforestation of areas previously covered by other vegetation. This is evident in the northern part of the city.

An interesting phenomenon is related with changes in the area of all parks, urban greens and other green spaces. In the 19<sup>th</sup> century they covered only 0.9 km<sup>2</sup>, while they increased 5-fold in the 20<sup>th</sup> century. This increase is connected with clearing of forests and changes in allocation of these areas to undeveloped areas. In the 21<sup>st</sup> century these areas cover only 1.17 km<sup>2</sup>. They also include street greens, green spaces in housing districts, urban greens and parks (Świeczkowska, 2017).

The two main city parks, i.e. Park Północny and Park Południowy im. Kaczyńskich, may already be seen in a city map from the 19<sup>th</sup> century. However, due to the insufficient accuracy of the map it is not possible to determine the shape of the parks. Only in the city map from 1920 we may see the detailed outline of green areas. The area of sports grounds and playgrounds also increased. This is connected with the increasingly popular active leisure and recreation, as well as healthy, environmentally friendly lifestyle. The beach area, particularly its vegetation, is also of considerable nature value. It is protected within the framework of the Natura 2000 programme (Świeczkowska, 2017).

In the city map from the 20<sup>th</sup> century we may see that both parks were maintained in their original boundaries. Their area remained practically the same, because they are surrounded by dense urban development, acting as the limiting boundary. In the city map of 1920 we may also see abundant street plantings, green squares and urban green (Świeczkowska, 2017).



**Fig. 10.** A city map of Sopot from 1920 (source: www.mapywig.org)

## 6. A comparison of green areas in Sopot with other Polish spa towns

Despite its location within the Tricity agglomeration (formerly Gdański Obszar Metropolitalny, at present Obszar Metropolitalny Gdańsk–Gdynia–Sopot), Sopot has one of the highest indexes of green areas per capita both in Poland and among Polish spa towns. In 2017 Świeczkowska calculated that 1075.5 ha in the city are covered by vegetation, which is equivalent to 280 m<sup>2</sup> green spaces per capita. This figure exceeds considerably the national average.

Sopot is a leader among the 9 compared Polish spa towns in terms of its green areas. They include mainly forests; however, in this respect the only exceptions are Inowrocław and Kołobrzeg, where forests constitute a small percentage of green areas. Instead, in those spa towns green areas are mainly composed of parks, green squares and green spaces in housing districts. It may be concluded from this comparison that with their indexes of over 50% Duszniki-Zdrój (61.0%) and Muszyna (59.8%) rank immediately after Sopot. In contrast, Inowrocław is the spa town with the lowest share of green areas (8.1%) (Świeczkowska, 2017).

**Table 5.** Shares of urban green areas in Polish spa towns in 2015 (source: Świeczkowska, 2017, after: GUS, 2016)

Name of spa town	Spa town area [ha]	Parks, green squares, green areas in housing districts [ha]	Street green [ha]	Cemetery [ha]	Forests [ha]	Total [ha]	Share of green areas %
Augustów	8090	54.1	4.2	11.9	2966.0	3036.1	37.5
Ciechocinek	1526	75.8	4.8	7.4	74.0	162.0	10.6
Duszniki-Zdrój	2228	23.8	1.7	1.5	1331.9	1358.9	61.0
Inowrocław	3042	187.7	30.2	19.5	9.7	247.1	8.1
Kołobrzeg	2567	212.8	21.6	19.7	102.2	356.3	13.9
Kudowa-Zdrój	3390	25.1	4.0	4.5	1623.0	1656.5	48.9
Muszyna	2443	31.5	0.3	1.8	1427.4	1461.0	59.8
Sopot	1728	111.1	16.7	18.2	929.5	1075.5	62.2
Świnoujście	19723	122.3	84.6	20.1	4387.8	4614.8	23.4

## 7. Advantages connected with the spa town status

The primary development potential of Sopot is connected with its spa town status. While it results in certain limitations, it obviously guarantees prestige and a unique character of the city or town. An elegant spa town attracts numerous tourists and spa town patients, who expect premium accommodation facilities (Świeczkowska, 2017).

The cited authors analysed the property market in Sopot and showed its marked diversification (Belej, Andrzejewska, 2016). They reported the accommodation services at approx. 1500 beds in 20 hotel facilities, predominantly three- and four-star hotels (with no one-star facilities there) (Belej, Andrzejewska, 2016). Those authors stated that prices of hotel rooms vary greatly and several hotels offer prices markedly different from the national average (including five-star facilities) (Belej, Andrzejewska, 2016).

In view of the constantly changing numbers of tourists the author (Świeczkowska, 2017) reported that as many as 1,083,548 individuals purchased tickets to the pier in 2016 from 30.04.2016 to 25.09.2016. This means that during the 5 months (!) of 2016, only in the spring and summer, over 1 million people strolled on the pier in Sopot (Świeczkowska, 2017).

August 2016 was the month with the highest number of sold tickets, amounting to as many as 320,163. This is almost 10 times higher than the number of the city inhabitants in 2016 (Świczowska, 2017). Several benefits result from the spa town natural conditions.

Thanks to the benefits resulting from the location and availability of maritime transport, the three port cities nearby also provide potential for ferry trips to foreign resorts.

In 2016 Poczobut published results on revitalisation and gentrification in Sopot (Poczobut, 2016). That author mentioned a very high rank of the city before 1939, showing its prestige and unique character. That author cited specific EU funds, which promoted changes, e.g. public spaces in Sopot are adapted to the needs of people with disabilities. Thanks to the implemented revitalisation programmes the city preserved the historical and cultural value of Sopot.

As it results from the Environmental Protection Programme for the county city of Sopot for the years 2011–2014 including the perspective for the years 2015–2020, objective 3 concerns the preservation of nature and landscape value underlying the image of Sopot as a brand – understanding that the natural environment needs to be protected and maintained so that it may remain the primary asset of Sopot, the Sopot County runs a sustainable policy, focused on nature conservation, protection of forests and revitalisation of parks. Both in its actions promoting city development and revitalisation the County (Urząd Miasta Sopotu, 2011).

Each year the authorities in Sopot allocate considerable funds to preservation and reconstruction works in green areas and to improvement of landscape value of Sopot. One of the objectives is to ensure such management of the environs of suburban forests, mainly municipal forests, to channel pedestrian and bicycle traffic thanks to the establishment of foot paths, cycling paths, construction of street furniture and provision of environmental education (e.g. information boards at educational trails) (Urząd Miasta Sopotu, 2011).

One of the priorities is to provide protection and revitalisation of urban green areas as well as areas of nature and landscape value, including inventory of green spaces, increasing the number of objects covered by legal protection and revitalisation of green spaces (Urząd Miasta Sopotu, 2011). These documents focused also on forests. Among other things, measures were specified to ensure forest's availability for leisure and recreation, management of suburban forest fringes – primarily municipal forests (footpaths and cycling trails, street furniture, information boards, other forms of environmental education) and limited commercial utilisation of forests (Urząd Miasta Sopotu, 2011). That document also safeguarded improvement of the “green” image of the city (revitalisation of inner yards, construction of new playgrounds and recreational facilities for adults, preservation and tending measures for urban green, reinforcement of vegetation cover in remnants of dunes and immediate environs of beaches (Urząd Miasta Sopotu, 2011). As we can see, the list of specific measures with a beneficial and tangible impact on the urban green in Sopot is long. Mere numbers and facts speak for themselves. The city of Sopot in that document emphasised material effects of these measures concerning nature and landscape, e.g. maintenance of the grid of the natural systems in the city, improved air quality (limitation of suspended matter distribution) and upgrading the esthetic quality of the city (Urząd Miasta Sopotu, 2011).

## 8. Concluding remarks

The tradition of Sopot as a health resort is almost 200 years old. Since the very beginning the town has been striving to reinforce its prestige and renowned image, in the process gaining a vast number of enthusiasts among tourists and health resort patients. In 2016 within only five months in the spring and summer (30.04.2016–25.09.2016) over a million people (1083548 based on the number of sold tickets) strolled on the Sopot pier (Świczowska, 2017). For many

decades permanent housing development has been mixed with guesthouse and hotel facilities. In 1901 Sopot was granted city rights.

In the early 20<sup>th</sup> century the town had 17 500 inhabitants, while the number of health resort patients reached over 20 000. One hundred years ago the population increased by 20 000, while an outstanding increase was observed in the number of health resort patients – it was as high as 100-fold (Świeczkowska, 2017). The housing development started along Bohaterów Monte Cassino street. These changes may be observed in Figs. 13 and 15-18 to this paper. In contrast, the therapeutic function has been developing in a strip parallel to seashore in the area of the pier and along the beach. The city has a high percentage share of green areas as required in the Act on Health resort Treatment (2005). The share of green areas in zone A amounts to 85.9% and exceeds the required limit of 65%. In protection zone B of the Sopot spa town it is 82.7%, again much more than the 50% required. Jointly the three spa town protection zones in Sopot cover 1723 ha, of which zone A comprises 140 ha, zone B – 1089 ha and zone C – 494 ha, respectively (Bernat, Meller, 2018).

The popularity of Sopot stems not only from its health resort traditions, but also therapeutic properties of that town. They are connected with the deposits of natural medicinal waters and a therapeutic climate. Sopot has a beneficial microclimate thanks to its location on the seaside, the vicinity of the terminal moraine, its relief forms and expansive green areas (Świeczkowska, 2017). In the spa town the most important nature values are associated with the natural therapeutic assets, i.e. the climate, mineral waters and peloid, among other things. Moreover, as in other spa towns, also here a very important role is played by legally protected areas either within or in its immediate vicinity (Węctawowicz Bilka, 2008). They provide a superior quality natural environment and guarantee its nature and landscape value (Węctawowicz Bilka, 2008)

**Nature value.** Around 26 monument trees are growing in the Sopot forest (which accounts for almost ½ of the 55 registered monument trees). In Sopot the monument trees represent 17 species. In terms of the individual tree species – both deciduous and coniferous – many specimens are truly valuable. Douglas fir is the species represented in Sopot by the highest number of monument specimens (15 trees). Apart from that, other species are also valuable and characterised by high soil requirements. For example, there are 9 European beech trees, 6 common oaks (of which one is the oldest nature monument in Sopot), 6 Scots pines, 5 European larches, 2 giant arborvitae specimens and 2 European white elms. In turn, the following species are represented in Sopot by single nature monument specimens: Japanese cedar, Chinese thuja, white pine, Austrian pine, Eastern hemlock, Nootka cypress and ginkgo (which despite having broad leaves morphologically it is a gymnosperm species). Among single specimens of broadleaf monument trees Sopot in 2019 has a Northern red oak, a horse chestnut as well as two European white elms. Thus we can see that the population of coniferous species in Sopot is thriving, with trees reaching monumental dimensions. Many of the tree species have high soil and habitat requirements, they are valuable and long-lived! Such nature resources are a tremendous asset for Sopot as a spa town. It definitely needs to be publicised. The city might consider distributing mycorrhizal inoculants to treat tree root systems in order to enhance tree health, improve photosynthetic efficiency and even tree growth rate, which could be easily observed with the naked eye.

For centuries the considerable share of green areas in the city was mainly connected with forests. This valuable area, practically unaffected by anthropopressure, has been covered by legal protection within the established landscape park. In the 19<sup>th</sup> century forests occupied almost 80% of the town area. Despite the changing area of the forest and the increasing pressure to allocate land for building development at present forest accounts for as much as 60% city area (Świeczkowska, 2017). Analysis of cartographic materials facilitated calculations of green areas in Sopot over centuries. It may be concluded that despite changes taking place in the green areas the city may still boast a very

high percentage share of green spaces. In 2017 a total of 1075.5 ha city area were covered by vegetation. Knowing the spa town permanent population it shows that it is equivalent to over 280 m<sup>2</sup> green spaces per capita. It is an excellent result on the national scale. Thus it is evident that Sopot has a huge potential for urban green area (Świeczkowska, 2017).

The spa town character of the city is the primary asset worth promoting on the national and international scale. For this reason it is of great importance to maintain these expansive green areas, since they guarantee observation of air quality standards. The advantageous effect of vegetation on air quality is well known. We also need to mention here the effect of green spaces on limitation of noise pollution as well as reduction of wind impact. This is also promoted by the land relief in the city. Thanks to its location on the seaside Sopot satisfies all needs of spa town patients for treatment, relaxation, recreation and culture. Some of the notable attractions include a walk along the beach, a sea cruise or a stroll over the longest wooden pier in Europe. They are some of the city attractions which may accompany thalassotherapy, i.e. a form of therapy using the maritime climate, sea water, breeze, clay, algae, sand, seaweeds, peloid and other substances originating from the sea (Kasprzak, Mańkowska, 2008). The beautiful, vast and sandy beaches provide excellent conditions for heliotherapy, a form of light therapy (Kasprzak, Mańkowska, 2008). Irrespective of the season and weather Sopot provides a rich and varied offer of spa town and health resort services.

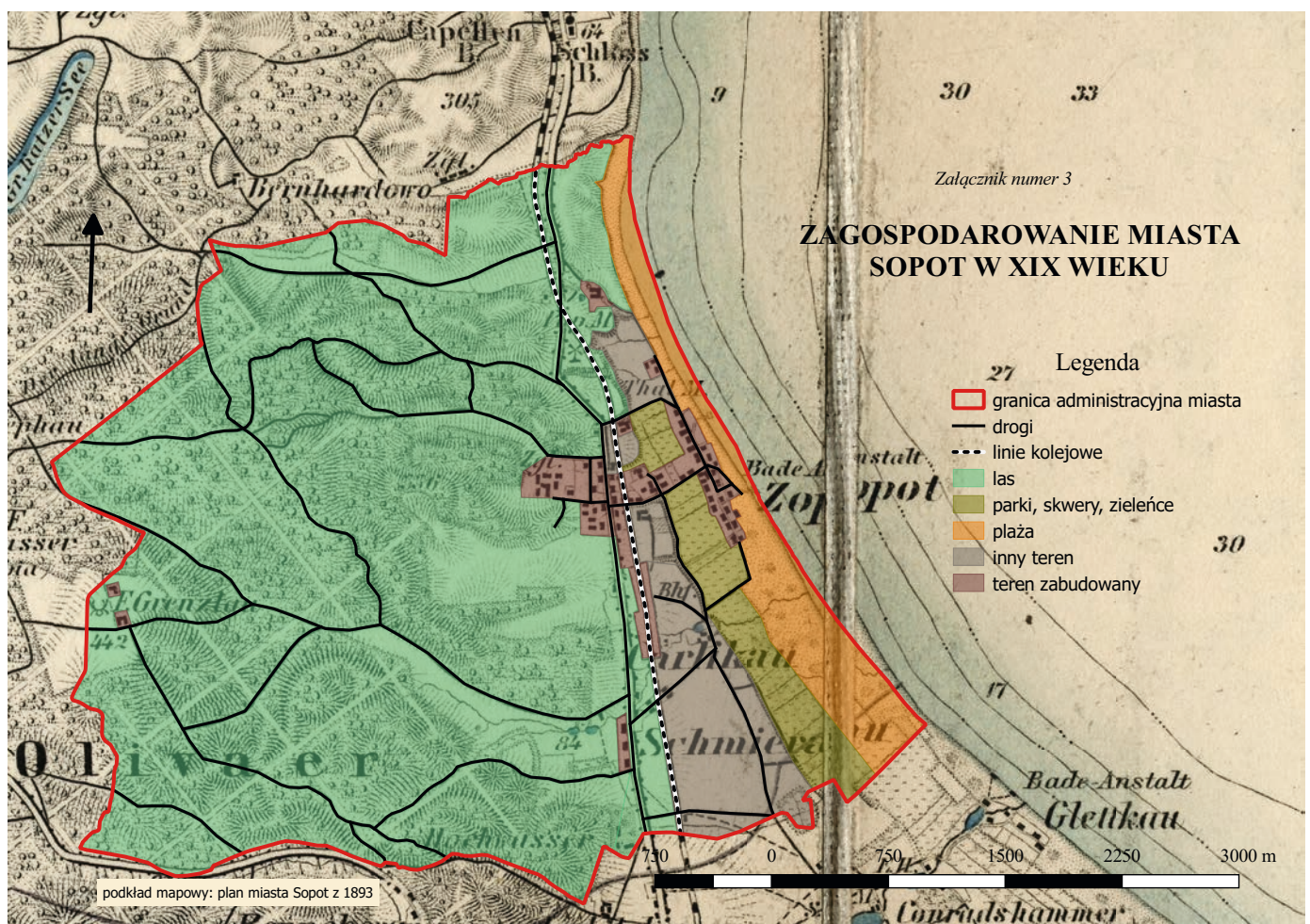
The local authorities are responsible for the preservation of the high share of green areas in the city. The local government has tools to maintain the advantageous situation. Since its beginnings Sopot has been one of the most attractive health resorts in Poland. It has the highest share of green areas among the compared spa towns. It is not a typical spa town, as it combines elements of a green spa town with a seaside resort with the urban tissue of considerable historical value. Nevertheless, the primary asset of Sopot is connected with its green areas, analysed in this paper. All the collected graphic materials, both archival and contemporary, rightly confirm the thesis that the city of Sopot is a green spa town located on the seaside and having a therapeutic microclimate.



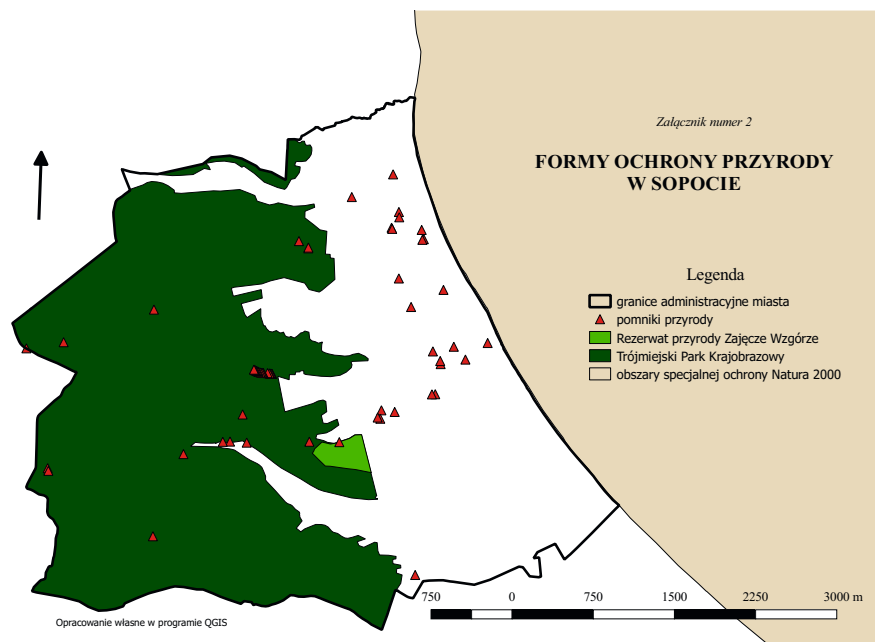
**Fig. 11.** Architecture of the Sopot villas and residences. Designers, investors and users in the years 1870–1945. Exhibition prepared by the Sopot Museum. Objects presented at the exhibition at the Sopot Museum and objects presented at the outdoor exhibition as in the picture (source: Świeczkowska, 2017)



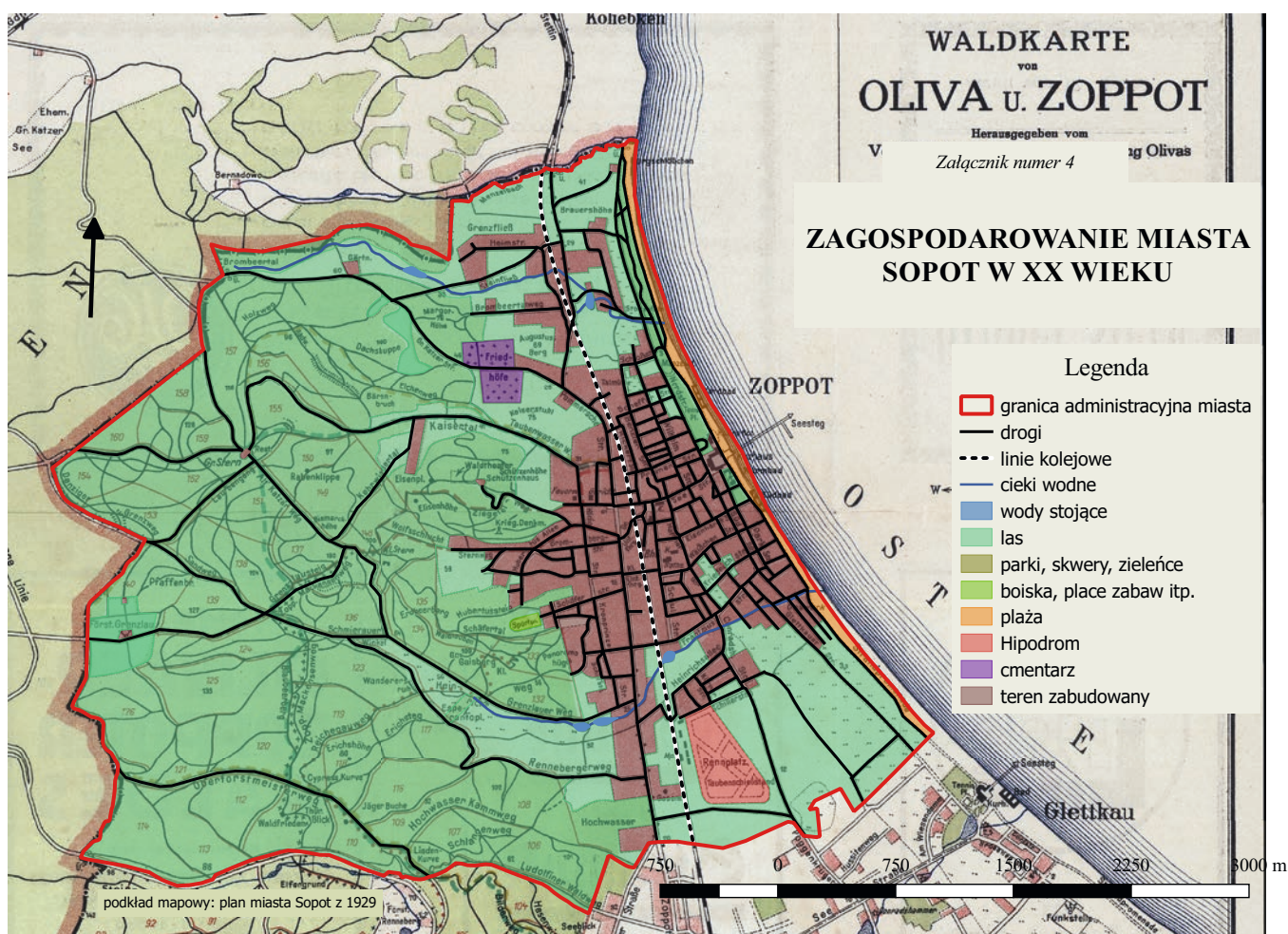
**Fig. 12.** Architecture of the Sopot villas and residences. Designers, investors and users in the years 1870–1945. Exhibition prepared by the Sopot Museum. Close-up of projections and elevations of the object from the outdoor exhibition in Sopot. On the left on the set, objects presented in the Sopot Museum are marked in blue, but at an outdoor exhibition like the one in the photo. The objects presented at the exhibition in the Sopot Museum are marked in brown (source: Świeczkowska, 2017)



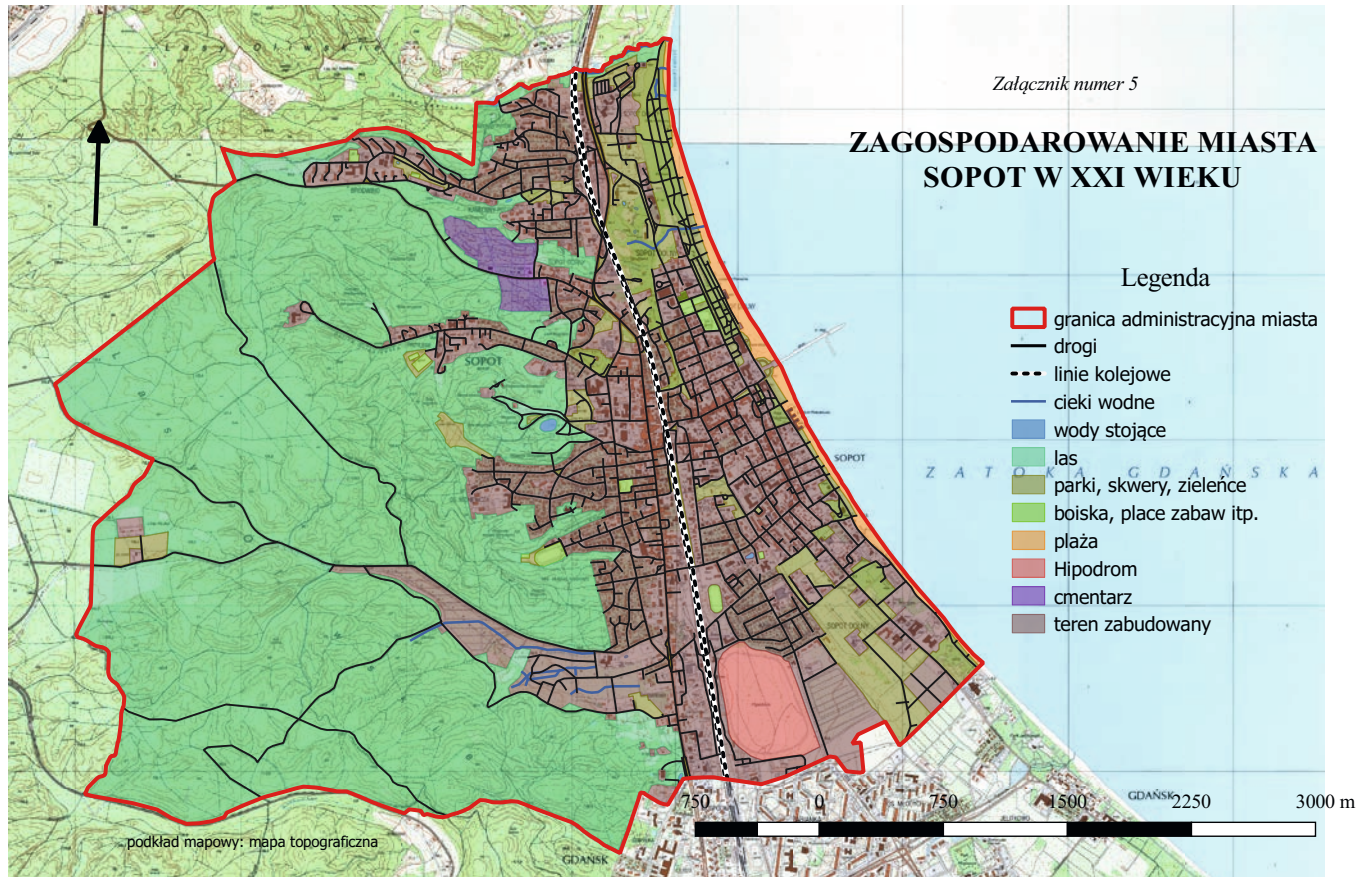
**Fig. 13.** Development of the city of Sopot in the 19<sup>th</sup> century. Background to the map from 1893. Map legend: administrative boundary of the city; roads; railway lines; forest; parks, squares, green areas; beach; another area; built-up area (source: Świeczkowska, 2017)



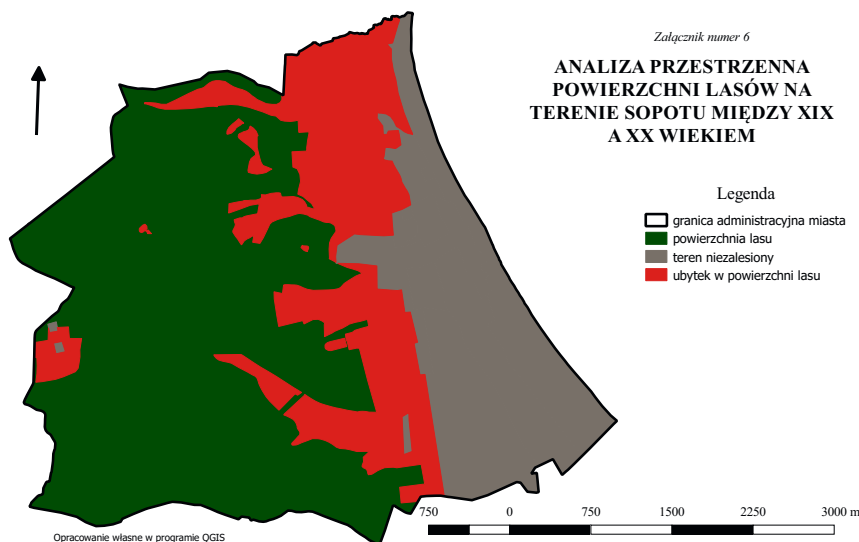
**Fig. 14.** Forms of nature protection in Sopot. Map legend: administrative boundary of the city; natural monument; The Zajęcze Wzgórze nature reserve; Tricity Landscape Park; opecial protection areas Natura 2000 (source: Świeczkowska, 2017)



**Fig. 15.** Development of the city of Sopot in the 20<sup>th</sup> century. Map background from 1929 Map legend: administrative boundary of the city; roads; railway lines; watercourses; standing waters; forest; parks, squares, green areas; playgrounds, playgrounds etc.; beach; Hippodrome; cemetery; built-up area (source: Świeczkowska, 2017)

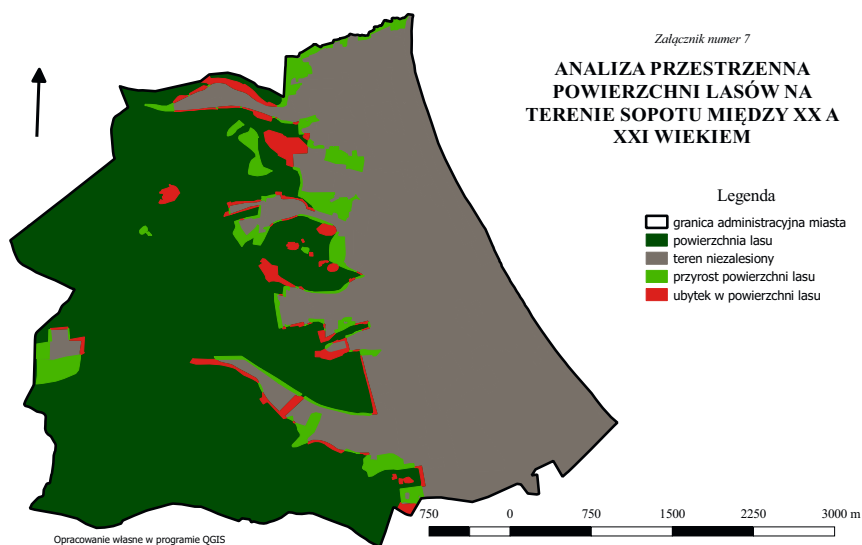


**Fig. 16.** Development of the city of Sopot in the 21<sup>st</sup> century. The topographic map. Map legend: administrative boundary of the city; roads; railway lines; watercourses; standing waters; forest; parks, squares, green areas; playgrounds, playgrounds etc.; beach; Hippodrome; cemetery; built-up area (source: Świczowska, 2017)



**Fig. 17.** General spatial analysis of the forest area in Sopot between the 19<sup>th</sup> and 20<sup>th</sup> centuries. Map legend: administrative border of the city; forest area; area without a forest; defect in the forest surface. Own study in the QGIS program (source: Świczowska, 2017)





**Fig. 18.** General spatial analysis of the forest area in Sopot between the 19<sup>th</sup> and 20<sup>th</sup> centuries – the increase and decrease in the area of green areas. Map legend: administrative border of the city; forest area; area without a forest; growth of forest areas; defect in the forest surface. Own study in the QGIS program (source: Świeczkowska, 2017)

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## Ocena zmian przestrzennych terenów zieleni w miejscowości uzdrowiskowej Sopot od XIX wieku

### Streszczenie

W pracy przedstawiono zmiany, jakie zaszły w powierzchni terenów zieleni miejskiej miasta Sopotu. Analiza materiałów archiwalnych Sopotu, zarówno kartograficznych, jak i ikonograficznych, pozwoliła na ocenę, jakie zmiany i przeobrażenia zaszły na tym obszarze od XIX wieku. Obszarem badań były wszystkie strefy ochrony uzdrowiskowej A, B oraz C. Zwrócono również uwagę na aspekt związany z główną funkcją, którą pełni uzdrowisko w mieście. Zalety miejscowości rozpatrzono także pod kątem cennych walorów kulturowych towarzyszących często terenom zieleni, gdyż miasto to jest perełką architektoniczną o zabytkowym charakterze. Ponadto podkreślono pozytywny wpływ terenów zieleni na uzdrowiskowy charakter miejscowości. Badania terenów zieleni miejskiej uzdrowiska Sopot wykonano metodą porównawczą. W tym celu wykorzystano mapy oraz plany miasta. Dodatkowo w badaniach wspomagano się archiwalnymi materiałami ikonograficznymi pozyskanymi z portalu dawnysopot.pl oraz aktualnymi badaniami terenowymi (Świeczkowska, 2017).

**Słowa kluczowe:** park zdrojowy Sopot, miejscowość uzdrowiskowa Sopot, planowanie przestrzenne w uzdrowiskach