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The evolution of the Lipinka Valley brownfield site as a multi-layered testimony to local identity

Abstract

This article presents research carried out in the Lipinka Valley area in Świętochłowice, southern Poland, which was used to establish one of the statutory forms of nature protection in this area - the nature and landscape complex. As a result of analyses of historical sources and literature data, anthropogenic changes to the environment were identified, including changes to the local morphology and hydrography of the area, as well as to the physical and chemical characteristics of soils and surface waters. Analyses of the flora and fauna of the area have shown the formation of a unique mosaic of ecosystems here. The post-industrial, wartime and natural landscapes are closely linked here, contributing to the common identity dimension of the site. This article aims to bring out the relationship between these landscapes by showing how they are interdependent, how they complement each other, and how their unique characteristics promote the conservation of life and biodiversity. The aspect of the identity of the landscape also appears here, but not only as a set of its features perceived by man, but also as an evolutionarily evolving structure that is independent of the conscious will of man.

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1 Introduction

Human activities associated with the development of mining and metallurgy lead to changes in landforms, superficial deposits, water relations, animate nature, and above-normal pollution of soils, water and air. Examples of degraded environments can be cited from countless areas subjected to strong human impact on all continents, except Antarctica (Hutchinson & Whitby, 1977; Harnischmacher & Zepp, 2013; Rocha-Nicoleitea et al., 2017; Beck et al., 2020; Luo et al., 2023; Diallo et al., 2024). Anthropogenically transformed areas can also be found in Poland (Central Europe), especially in its southern part, in Upper Silesia, where mining and metallurgy of iron ores and silver and lead ores developed from the Middle Ages onwards, and large-scale exploitation of hard coal, zinc and lead ores, stowing sands and rock raw materials and metallurgy of ferrous and non-ferrous metals, mainly zinc, developed from the 19th century onwards. These activities contributed not only to great changes in the relief (Lamparska, 2003; Nita, 2013; Dulias, 2016; Machowski et al., 2016; Solarski et al., 2022; Dulias, 2024), but also to the transformation and pollution of other elements of the natural environment (Rostański, 1996, 1997, 2006; Cabała & Teper, 2007; Cohn et al., 2001, Leśniok, 2011; Chmura & Molenda, 2012; Jędrzejczyk-Korycińska & Rostański, A., 2015; Rzętała, 2015; Wójcik, 2017). Today, many areas of Upper Silesia, especially in the Katowice conurbation, are dominated by anthropogenic landscapes, sometimes concealed by lush nature that transforms degraded areas through processes of colonisation and natural succession. Often these landscapes have a very attractive form, with labyrinths of hills, steep slopes, valleys and water bodies in subsidence troughs, pits and sinkholes. As a result of many years of research in the area by specialists in various fields, the extraordinary richness and diversity of the natural and landscape of the post-mining and post-industrial areas have been revealed (e.g. Cabała & Sypień, 1987; Tokarska-Guzik, 1996; Tokarska-Guzik & Rostański A., 2001; Rostański A., 1996, 2000, 2006, 2023; Woźniak et al., 2003; Dulias, 2008; Świtała-Trybek & Świtała-Mastalerz, 2018, Dobrowolska et al., 2021).

Testimony to the local identity is thus not only provided by workers' settlements and the remains of industrial facilities. Equally clear testimony is provided by a vegetation cover adapted to the mounds of waste rock and the remains of silver, zinc and lead ores, as well as indicating the obliterated traces of former settlements (Rostański, K.M., 2021). All these testimonies are present in the Lipinka Valley area of Świętochłowice, located in the central part of the Katowice conurbation and which is the subject of this article. They are further permeated by the uneasy history of competition between Poland and Germany for this area. The aim of the paper is therefore to show the interdependence between the different qualities of a post-industrial area and the often surprising synergy of these qualities. Areas with an industrial past are characterised by a uniquely rich relief, a complex and multi-layered development structure and a unique mosaic of plant communities that could not have emerged elsewhere, where exploitation of deposits and anthropogenic embankments are not so significant. Given the variety of elements that make up local identity, an analysis of their variability was carried out in relation to the distinguishing features for the identity phenomenon proposed by Leszek Kołakowski (Kolakowski, 2003). The nature of other definitions of the identity phenomenon can be mentioned here. In a social context, identity usually has a personal, social and cultural dimension. Personal identity refers to unique values, beliefs, personality and experiences. Social identity describes an individual's relationship to social groups, which is defined by ethnicity, gender, nationality, religion and social class. Cultural identity is determined by language, traditions, customs, values and symbols. It is dynamically changeable, subject to constant and varied influences (Shao et al., 2020). Thanks to Kołakowski's definition, it became possible, on the one hand, to make the analyses more detailed and, on the other hand, to have a new take on the problem of identity, where nature and the processes taking place in it occupy an active place comparable to human activities in the area. In this way, nature is treated as a living organism, independent of humans. However, in literature and legal documents, nature is still only considered as matter that is assessed and shaped by humans. We are still unable to recognise all the processes that occur in nature. However, it is still more complex than we think. This should compel us to give nature as much freedom as possible so that it can develop optimally, which is, after all, in our best interest.

2 Study material and methods

2.1 Study region

The study area is located in the central part of the Silesian Upland (Richling et al., 2021), on the Chorzów Hills and Siemianowice Upland, which are part of the Bytom Plateau (Gilewska, 1972), Upper Silesia (southern Poland). The area comprises the Lipinka Valley natural and landscape complex in Świętochłowice. It lies between the districts of this city - Chropaczów and Lipiny - and to the west Godula, a district of Ruda Śląska. In geological terms, the study area is located in the Upper Silesian Foredeep composed of Upper Carboniferous sandstones and siltstones with coal seams (Kotas, 1982). At the surface, Quaternary deposits from the period of the South Polish glaciation (San I) are present, mainly glacial till (Lewandowski, 2015). Sandy and sandy-gravelly fluvioglacial deposits of considerable thickness are associated with the period of the Middle Polish (Odra) glaciation. They constitute the dominant type of surface deposits of the area. In the bottom of the Lipinka valley, Holocene fluvial and marshy deposits with a thickness ranging from several tens of centimetres to a maximum of 2.5-3 m occur. The youngest surface deposits are mining and metallurgical waste. Ores processed in local smelters were imported from mines outside the study area, from Piekary Śląskie, and do not occur in the bedrock of the study area.

The study area is located in a temperate climate zone. The average annual precipitation based on data from the precipitation station in Lipiny is about 760 mm, with a maximum of precipitation in July and a minimum in February. The average annual air temperature is in the range of 7-8°C. The warmest month is July with an average air temperature of around 19°C and the coldest month is February with an average temperature of around -2.5°C (Kruczała, 2000).

The air quality in the study area during the period of operation of the 'Guidotto' zinc smelter and other Świętochłowice and surrounding industrial plants was catastrophically bad. Particulate and gaseous air pollution exceeded all permissible standards. Since the 1990s, emissions of pollutants in the city and the entire region have decreased significantly, but permissible concentration standards are still exceeded, especially for particulate matter, and in the cold season there is a smog phenomenon (Leśniok, 2011).

Within the study area, the soils have either been buried by metallurgical or mining waste or inundated by water bodies. Along the western boundaries of the area a small area is occupied by black earths (Mapa glebowo-rolnicza..., 1991). Locally there are patches of luvisols and podzolic soils, and in the bottom of the Lipinka valley there are marshy soils.

The study area is part of the Oder River basin - it is located in the catchment area of the Lipinka, which is a left tributary of the Bytomka. An area 40,9 ha covers the bottom of the Lipinka stream valley in its middle course, along the length of the 1250 m. There are several water bodies in the valley. Their bottom deposits are contaminated with metals. The waters of the water bodies in the Lipinka valley are also polluted by components characteristic of mine waters - boron, sodium, potassium, lithium and sulphates (Fig.3; Tab.2).

2.2. History of the study area

Within the study area lies the zinc heap 'Kopyto' of the now defunct zinc smelter 'Guidotto'. To the northeast of the zinc heap is the coal heap of the 'Schlesien-Silesia' mine, and to the west is an area wooded in the mid-20th century. Further west and south, arable fields extend. The area of cultivated fields at the interface with the Godula district (Ruda Śląska) is being transformed into a development of single-family housing. The Lipinka stream flows through the area from the south. In its valley there are several water reservoirs, including the Ajska, and further north there are two floodplains with reeds into which domestic sewage is discharged. Along the course of the stream, dykes were repeatedly built to dam up the water, as can be seen on old maps, and in the field their traces have been preserved to the present day. A World War II defence line with

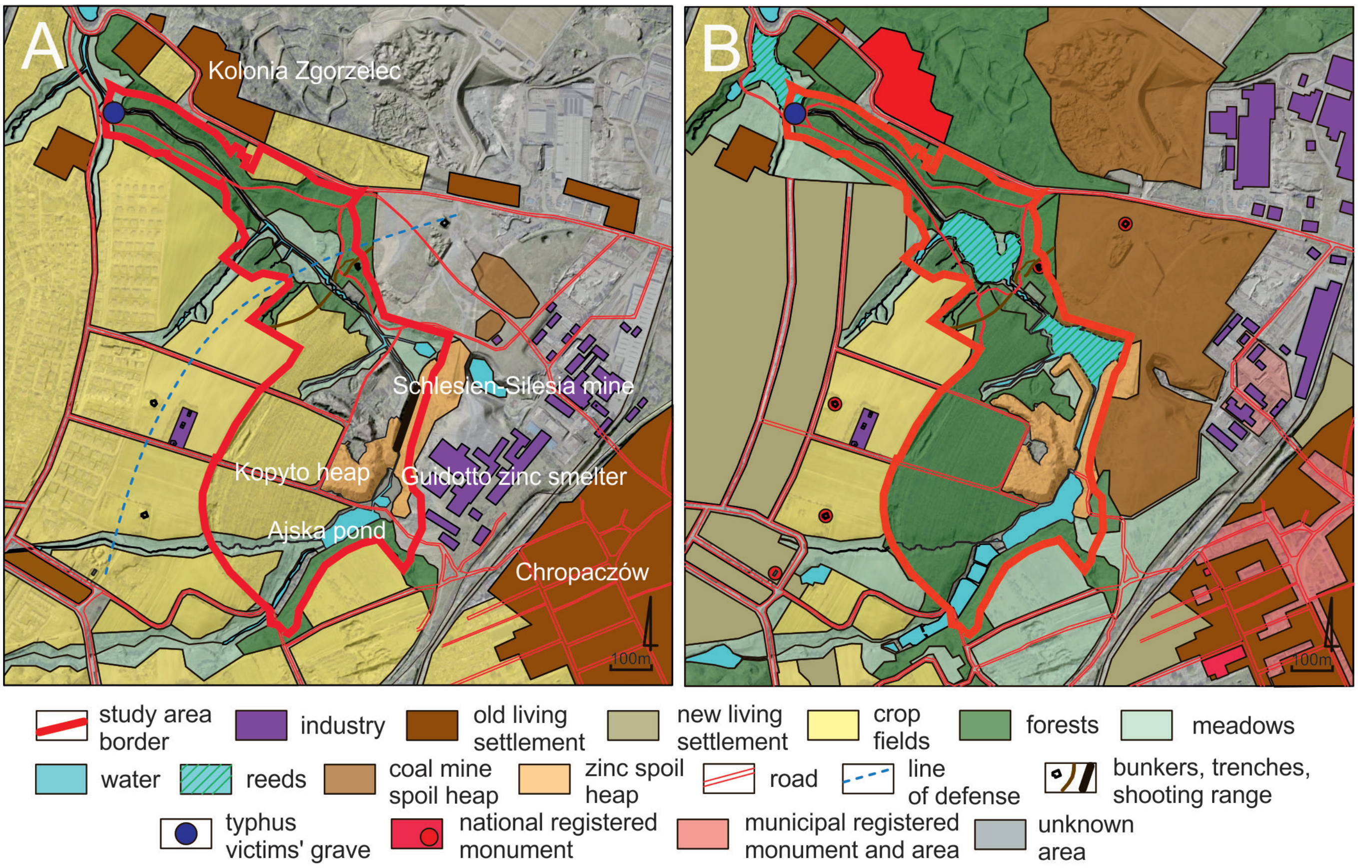

Figure 1. A - Study area in 1939. (based on: Mapa Szczegółowa Polski 1:25 000 ..., 1939); B - Study area in 2025. (based on field analyses and LIDAR map)

bunkers of various types passes through the site. The condition in 1939 is shown in Fig.1A, where the Kopyto heap is not yet fully mounded and there are no ponds with rushes to the north of it. The woodland to the west of the heap was planted around this time. Ploughed land for tree planting are still visible on contemporary LIDAR maps (LIDAR map). The present state in 2025 (Fig.1B) shows a change in the area of the ponds, associated with the progressive lowering of the land surface due to mining damage, a change in the area of the woodland and a change in the extent of the smelter and mine spoil heaps, and increasing anthropopressure, mainly from housing settlements that are developing on the side of the Godula district.

The above-mentioned traces of former industrial activity and their historical context are related to the fact that the research area is located in the very center of the Upper Silesian Industrial Region (GOP) – the largest industrial area in Poland and one of the largest in Europe. Rich deposits of mineral resources – hard coal, zinc and lead ores, silver, iron, and rock resources – contributed to the industrial development of this region. Until the end of the 18th century, metallurgy here was based on bloomery furnaces and wood-fired furnaces. The acceleration of development can be dated to the turn of the 18th and 19th centuries. This was the moment when Poland lost its independence. The aforementioned area, rich in raw materials, was then divided between Prussia, Russia, and Austria-Hungary. This lasted until the 1920s. The regaining of independence by the Polish state was accompanied by the consolidation of the lands occupied by Prussia and Austria-Hungary as a result of the Silesian uprisings of 1919, 1920, and 1921 into a single Silesian province. After World War II, the entire Upper Silesian Industrial Region was administratively incorporated into a single province.

The dynamic development of industry in Upper Silesia was initially linked to the introduction of modern steam technology. The first steam engine, which was used to drain the silver mine in Bobrowniki near Tarnowskie Góry, was launched on April 4, 1788. (Fuchs, 2002). The next step towards advanced industrialization was the use of coke. The first successful attempts date back to 1778, but it was not until 1796 that the first coke-fired blast furnace was launched at the steelworks in Gliwice (Kwaśny, 2002).

In addition to natural and technological factors, the development of Upper Silesia's industry was also influenced by the economic policies of the countries ruling the area, the state border favorable to the export of goods, and the large local labor force. The acceleration of economic development in the part of Silesia occupied by Prussia was facilitated by the laws of 1810 and 1811, which abolished the monopoly of craft guilds in the Prussian state (Kwak 1983). Rapid industrialization, linked to the development of mining, metallurgy, and railways, took place in the second half of the 19th century (during the industrial revolution) and after World War II in the years 1945–1989 (during the socialist economy).

A characteristic feature of the Upper Silesian Industrial Region (GOP) is the high spatial concentration of numerous mines and industrial plants, mainly representing traditional industries (apart from mining and metallurgy, also the machine, electrical engineering, transport, metal, and chemical industries). Economic development was accompanied by intensive urbanization of the area, which led to the formation of the Katowice conurbation. Individual cities form a compact fabric with usually unclear boundaries. In the second half of the 20th century, the GOP area accounted for over 70% of Polish hard coal production, 35% of pig iron production, and 45% of rolled products (Tkocz, 1998). After 1989, as a result of economic transformation and industrial restructuring, the number of industrial plants and the number of people employed in industry decreased significantly. A serious problem of unemployment arose. At the beginning of the 21st century, services became the dominant sector of employment for the inhabitants of this area, so the name GOP now has mainly historical significance.

The initial stage of the research included studies of geographical and natural literature, analysis of historical sources and archival cartographic studies from: 1792, 1827, 1880, 1881, 1889, 1902, 1908, 1913, 1933, 1939, 1958, 1974, 1993 and contemporary orthophotos. The old maps were obtained from the collections of the Archives of the National Library in Warsaw, Silesian Library, Jagiellonian Digital Library, Military Geographical Institute (WIG) and The Staatsbibliothek in Berlin. On the basis of these studies, the features of the environment and changes in its elements as a result of anthropopression, from the beginning of the 19th century to the present, were established (Illustrierter Führer, 1904; Alberg, 1936; Dębicki, 1927; Dobis, 1938). In addition, the history of the economic development of the study area and its surroundings, in particular coal mining and zinc metallurgy, was recognised (Illustrierter Führer, 1904; Krantz, 1911; Piernikarczyk, 1936).

2.3. Data collection

The field research was carried out between March and September 2020. This included the inventory and mapping of animate and inanimate nature elements in the Lipinka valley and its immediate surroundings. The type and extent of anthropogenic deposits against the background of the geology and geomorphology of the area were recognised. The flora of vascular plants and the features of their composition were determined by direct surveys, using commonly known keys for their determination (e.g. Mirek et al., 2002) and web applications (e.g. atlas-roslin.pl, 2024), with some data obtained from previous research (e.g. Michalska & Rostański, 2003). The scientific nomenclature of the plants used was after *Flowering plants and pterodophytes of Poland a checklist* (Mirek et al., 2020), and their degree of protection was indicated (Rozporządzenie Ministra Środowiska, 2014; Parusel & Urbisz, 2012).

The presence of fish species was determined by observations of the water depths and interviews with anglers. Other vertebrates were determined on site by direct observation using binoculars. In other cases, they were based on tracks, faeces, feeding, dead specimens and other traces left by animals, using appropriate guides (Chmielewski, 1984; Bouchner 1992). Invertebrate animals were in most cases collected and identified in the Zoology Department of the University of Silesia using specialised keys. Systematic nomenclature of animals was adopted from the series 'Fauna Polski' (Polish Fauna) (Bogdanowicz et al., 2004, 2007, 2008, 2014). The degree of protection of animal species was determined on the basis of EEC Council Directives (Directives 79/409/EWG, 92/43/EWG, Rozporządzenie Ministra Środowiska..., 2016). A discussion of the results was carried out with reference to, among other things, the state of affairs 25 years ago (Waga, 1995).

2.4. Conceptual background

This work draws attention to the fact that landscape is something alive. Regardless of the extent of human activity, or even its absence, landscape is subject to change and always has its own characteristics and identity. The philosophical concept of identity, formulated by Leszek Kołakowski (2003), proposes

Table 1. Definitions of aspects shaping social identity according to Leszek Kołakowski (2003), which were related to landscape identity analyses.

Identity aspects	**Aspects definition**
Substance	something that defines the body, it gives the body uniqueness and individuality
Memory	keeps up the feeling of continuity
Anticipation	the expression of hopes, fears, uncertainty of the future, intentions
Body	physically existing elements
Beginning	an approximate moment situated in time of the establishment act

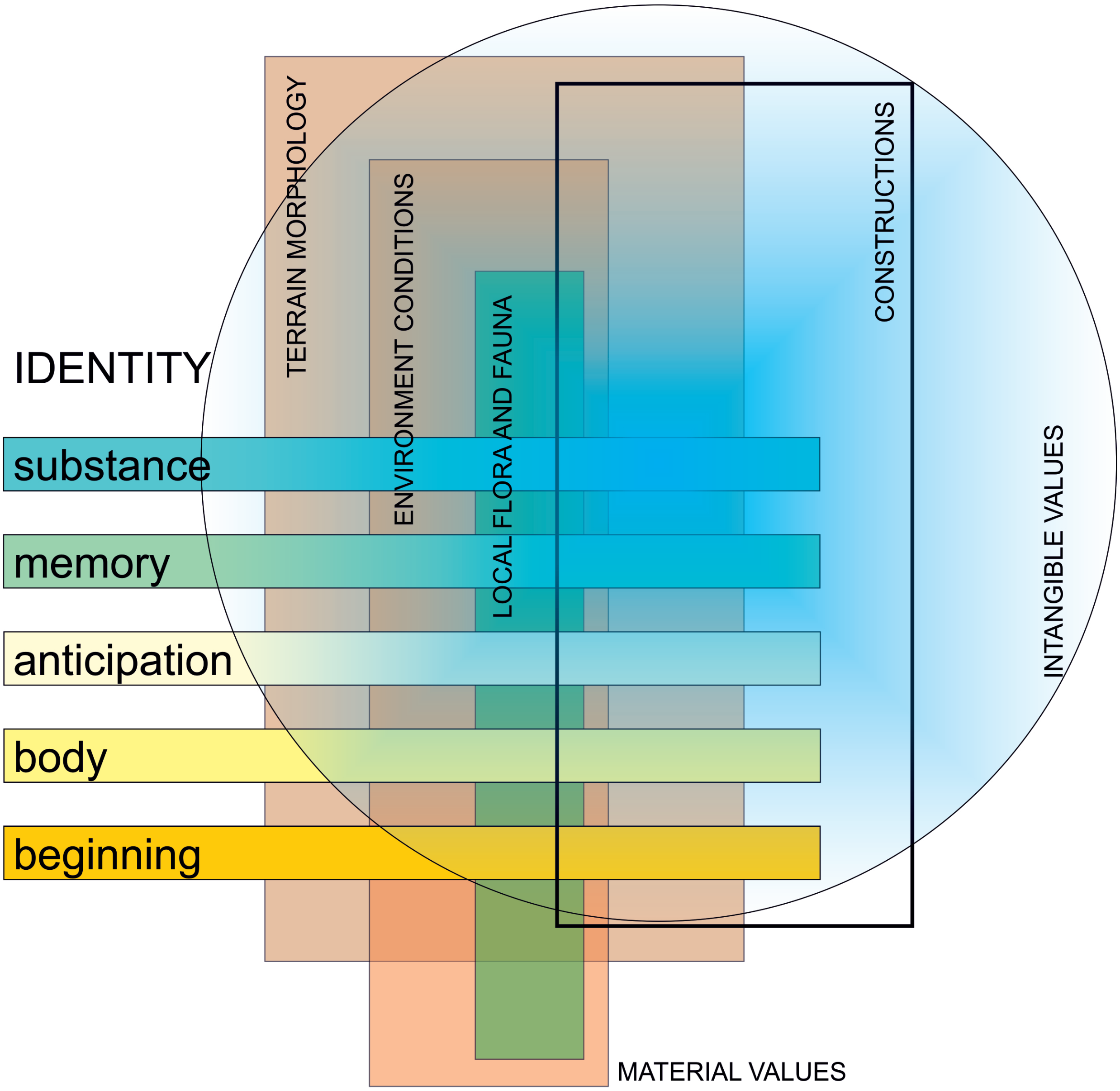

Figure 2. Landscape identity diagram

a distinction between five aspects of identity: substance, memory, anticipation, body, and beginning (Table1). This definition, created for a community or human being, allows the landscape to be treated as a living organism. This approach highlights the role of natural processes, their variability subject to the influence of climate change, the evolution of vegetation cover, but also anthropogenic factors such as changes in environmental pollution and landform.

The distinctive features of the Lipinka Valley landscape that build its identity were taken to be: local flora and fauna, environmental features, terrain morphology, constructions and intangible values (e.g. the impact of events over time on human consciousness and the behaviour of animals and plants).

The aspects of the concept of identity intersect with the distinctive features of the landscape (Figure 2). The term 'local flora and fauna' is a simplification to describe all living organisms without their systematic division into domains (Woese et al. 1990). Local flora and fauna are related to environmental conditions in a complete way. The habitats of living organisms and the organisms themselves adapt according to a limited range of conditions. The morphology of the site influences the condition of the habitats, and this is associated with different attractiveness for different species. Constructions are most distinct to humans because they are the closest environment to them. They may stand out and may appear separate from their surroundings, but this is not common. They usually provide a particular habitat inhabited by certain species e.g. birds, algae or fungi. Intangible qualities reflect feelings, habits, preferences not only of humans, but also of animals. In relation to plants, one can speak of something similar in terms of preferences. The impact of landscape differentiators on identity components is discussed in the Results. The differentiation of the components is permanent, the distinguishing features were presented as geometrical forms with a certain transparency, because their contents are constantly changing.

The analyses consisted of looking for relationships between identity components and landscape distinguishing features.

3 Results

3.1 Environment under anthropogenic pressure

The soils of the described area are highly contaminated (Table 2). Near the Kopyto heap, >0.16% sulphur was found in them, the source of which is probably pyrite accompanying the coal-bearing rocks and fuel used in the zinc smelter. Above all, however, the surrounding soils are heavily contaminated with arsenic, cadmium, lead and zinc. In the vicinity of the heap, the contamination of soils in the near-surface layer (0-0.3 m) is as follows: silver - 34 mg/kg, arsenic - 5 288 mg/kg, lead - 16 110 mg/kg, zinc - 36 930 mg/kg (Pasieczna, 2016).

The source of pollution of the Lipinka stream's waters is the weathering and rain-washed Kopyto heap and the waters of the water bodies through which it flows, in which high contents of arsenic (21 μg/dm^3) and metals were found: 8.89 μg/dm^3 cadmium, 4.13 μg/dm^3 copper, 1.84 μg/dm^3 antimony, 2-5 mg/dm^3 zinc, and up to 10 μg/dm^3 selenium and 0.80 μg/dm^3 thallium. Municipal wastewater from Chropaczow is also discharged into the stream. From the analyses of the degree of pollution, it can be seen that the pollutants in the soils and waters of the creek clearly decrease with the distance from the Kopyto dump (Figure 3). In the field, the strongest influence here is

Table 2. Pollution of sediments and waters of Ajska reservoir (Pasieczna, 2016, Rozporządzenie, 2016).

No.	Pollution factor	Pollution quantity	Standard for recreational areas 0-0.25m ppt	Standard for industrial areas 0-0.25 m ppt
	Sediments			
1	Ag	45 mg/kg		
2	As	1 320 mg/kg	25 mg/kg	100 mg/kg
3	Cd	170 mg/kg	2 mg/kg	15 mg/kg
4	Cu	314 mg/kg	200 mg/kg	600 mg/kg
5	Pb	12 100 mg/kg	200 mg/kg	600 mg/kg
6	Zn	45 360 mg/kg	500 mg/kg	2 000 mg/kg
7	Mn	2 400 mg/kg		
8	Ni	70 mg/kg	150 mg/kg	500 mg/kg
	Waters			
9	sulfates	15 114 mg/dm^3		
10	Ca	215.4 mg/dm3		
11	Mg	240.7 mg/dm^3		
12	pH	9.1		

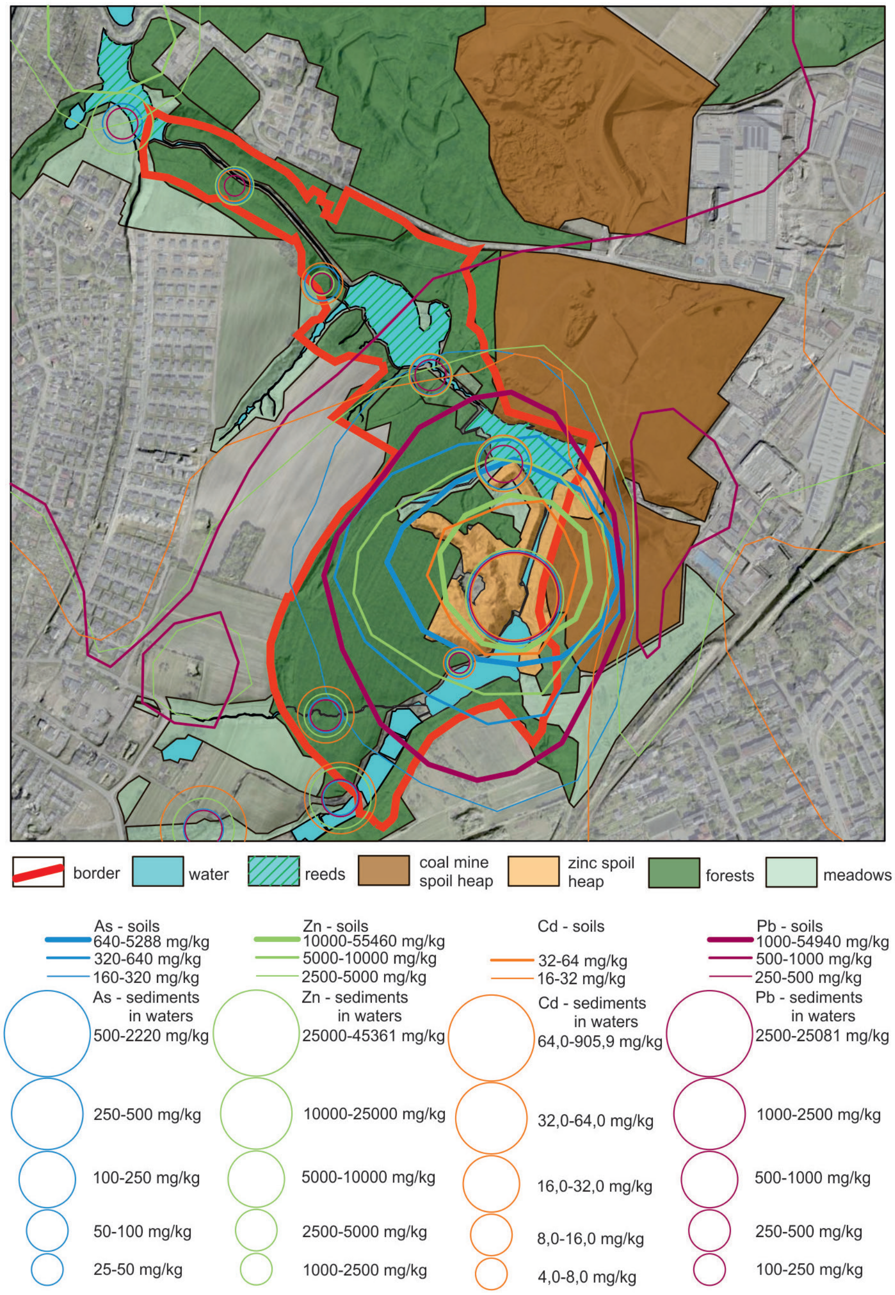

Figure 3. The degree of soil and river sediment contamination. (based on: Pasieczna, 2016).

the dust from the smelter heap and coal mine spoil heap.

The features of the stream's deposits are influenced by the filtering role of reed beds and water column vegetation. The occurrence of certain species of flora and fauna in the study area testifies to its exceptional self-purification properties. The Lipinka stream, which leads its waters out of the heavily polluted 'Ajska' reservoir (Figure 4), after flowing and spilling within two reedbeds, as well as a several-dozen-metre section of a narrow channel with a fast-flowing stream of water, achieves purity that allows the existence of pure water species in it, and this despite the discharge of domestic sewage into it. Its self-purification potential is evidenced by the fact that just after the first riffle, stones, plants and parts of the bottom are completely covered with gray sludge, and about 100 meters further on, the sludge disappears, and the water in the stream becomes clear. Clear water species include, among others, caddisflies (*Trichoptera*), which are abundant here, and birds associated with the water environment - kingfishers, observed in the lower reaches of the Lipinka stream. As can be seen, nature here, despite many unfavorable factors, has great potential for self-regulation and restoration of biodiversity.

In the context of environmental conditions (Table 3), the ‘Substance’ aspect describes the general character of the place, the way it is perceived by people, but also its ecosystem value and attractiveness for animals and plants. It is a place with a high degree of pollution, but also with a high potential for self-purification and regulation. Post-industrial waste creates special habitat conditions that benefit species that are less sensitive to its chemical properties. This makes the area of the smelter heap clearly stand out from the rest of the area. The ‘Memory’ aspect functions here in different ways. On the one hand, it reveals the power of nature to achieve the state of equilibrium that prevailed here before the zinc mine and smelter were in operation, which is associated with the riparian and oak-hornbeam communities found here. On the smelter heap, initial vegetation with phytoremediation capabilities has persisted for several decades. This aspect also describes anthropogenic changes in the shaping of the Lipinka stream bed and the surrounding heaps. It also relates to human behaviour towards forestry, farming, fishing, children’s play and recreation. The ‘Anticipation’ aspect contains possible scenarios for the continued dismantling of the waste rock heap, the protection and neutralisation of the smelter heap, the increase in habitat fertility resulting from the arrival of the humus layer and the increase in recreational attractiveness. The ‘Body’ aspect is the material elements of the spatial structure, unique in its aesthetics, vegetation, scent, bird voices. For the sense of local identity, the ‘Beginning’ aspect is important. Before the 19th century, the conditions in the Lipinka valley were due to natural erosion and plant succession. Later, anthropogenic influence dominated much of the area and bound together the living environment and artificial forms, which contrast with each other in a moving way.

Table 3. Landscape identity aspects in the context of ‘Environmental conditions under anthropogenic pressure’.

Identity aspects	Environmental conditions under anthropogenic pressure features
Substance	• land pollution • remediation ability • potential for ecosystem services
Memory	• phytoremediation • changes in the composition of vegetation and the development of riparian and oak-hornbeam communities
Anticipation	• liquidation of mining dumps • remediation of zinc smelter dump and water of Lipinka stream • increase in soil fertility • increase in the number of users of the recreation area
Body	• a network of walking paths that take advantage of the interesting morphology of the terrain • air quality • gradually developing green cover
Beginning	• beyond the beginning of 19th century

3.2. Buildings related to industrial and military activities

The exploitation of zinc ore in Upper Silesia was started in 1704 by Georg Gische on the basis of a privilege from the Austrian Emperor Leopold (Dobis, 1938). At that time, calamine was used in metallurgy, which when roasted together with copper yielded brass. Pure zinc could not be obtained at that time - the first smelting furnace was built in 1800 in Wesoła, south of Katowice (Dębicki, 1927). In Chropaczów, in the vicinity of the study area, the company ‘Georg von Giesche Erben’ founded the first coal mine ‘König Saul Grube’ in 1825 (Piernikarczyk, 1936; Popiołek, 1965; Popiołek, 1984). Next to it, the zinc smelter ‘Dawidhütte’ was established in 1826. To the east of the study area Guido Henckel von Donnersmarck opened the zinc smelter ‘Guidotto’ in 1887, where zinc blende was roasted. In the 19th century, zinc production, especially in its early stages, resulted in many deaths from metal vapour poisoning and starvation. A reminder of this is the typhus victims’ grave in the northern part of the site.

To the south-east of the Lipinka Valley, in the Lipiny district, the ‘Silesiahütte’ non-ferrous metal smelter was located at the end of the 19th century (Illustrier..., 1904, p. 70). There were also coal mines in the vicinity of the study area - ‘Mathilde’ in Lipiny and ‘Schlesien’ in Chropaczów (Jaros, 1984).

During the First World War, zinc production declined due to the conscription of half of the workers employed in the smelters into the army (Dębicki, 1927). After the war, zinc production increased again. It was then that the waste from the production of the ‘Guidotto’ smelter began to be stored in the Lipinka

Figure 4. Kopyto heap and Ajska pond. (Photo: Rostański K.M.).

valley near the 'Ajska' reservoir, creating the largest heap in the study area called 'Kopyto' (English 'hoof'). In the 1920s, Upper Silesia was the third largest producer of zinc in the world after the USA and Belgium (Dębicki, 1927).

In addition to coal and zinc production, the 'Guidotto' smelter and the 'Schlesien-Silesia' mine also produced sulphuric acid, a by-product of zinc production from blende (Illustrier..., 1904). In 1857 both plants were taken over by the Silesian Joint Stock Society for Mining and Zinc Smelting (Schlesische AG für Bergbau und Zinkhüttenbetrieb), which was set up by von Donnersmarck. No trace now remains of the 'Guidotto' ironworks, whose liquidation is shown on a map of 1958, but some of the buildings of the 'Schlesien-Silesia' mine, whose coal was used by the 'Silesiahütte' zinc smelter from Lipiny, have survived, together with its tall chimney, but with a different function. What remains today of the industrial activity is a heap of metallurgical waste, which, due to its toxicity, has mostly not been overgrown with vegetation after almost 80 years. The spoil heap at the 'Silesia' mine, was demolished for construction aggregate; the only traces of it are the leveled area with the waste rock.

In the described area there are also remnants of a defence line from the year 1939, from the period of the Second World War - these are objects of the Warring Area 'Śląsk'. Within the study area is a heavy battle bunker with an armoured dome from the year 1938 (Figure 5), while in its vicinity there are further bunkers forming the defence line (Biskup, 2002; Pietrucha, 2006). One was an ammunition store of particular construction, and is now submerged to the roof by ground water. The bottom of the Lipinka stream after leaving the Ajska reservoir was routed in a straight line and enclosed with several-metre-high escarpments made of zinc production waste. A military shooting range was placed in the ravine thus created (Mapa Szczegółowa Polski..., 1939). Reconstruction teams of military history enthusiasts periodically recreate the trenches crossing the study area near the aforementioned battle shelter.

Figure 5. Heavy battle bunker of the Warring Area 'Śląsk'. (Photo: Rostański K.M.).

Table 4. Landscape identity aspects in the context of 'Constructions'.

Identity aspects	Construction features
Substance	• anthropogenically transformed area • grave of typhus victims • a heap of dangerous pollutants with greenery around • remains of fish farming ponds
Memory	• the development and decline of zinc production in Upper Silesia • World War II • redevelopment of the area
Anticipation	• construction of a housing estate on the border • construction of recreational infrastructure • construction of educational infrastructure
Body	• post-industrial facilities • military defence line • water dykes on the stream • wood artificially planted
Beginning	• 1825 first coal mine • 1887 first zinc smelter

The unique features of the Lipinka valley landscape are evidenced by the structures located here since the 1920s (Table 4), which are gradually being absorbed by the greenery. 'Substance' corresponding to them is an area of green space with the remains of the mine and its coal extraction process, the toxic remains of metallurgical activities, the grave of 19th century typhoid victims, a World War II defence line and the remains of fish farm ponds. 'Memory' associated with this is the story of the development of local industry, which on the one hand gave earnings to the ancestors of the present inhabitants of Chropaczów and Lipiny, and on the other hand was the cause of their premature death. In the time before the Second World War, it was a border area with bunkers to stop the enemy army. 'Anticipation' is an aspect supporting the continuation of local values. The largest of the bunker complex stands in the study area, which is an attraction for young people and could potentially be a wintering ground for bats. It is listed in the national register of monuments, as are four bunkers adjacent to the site, the church and cross in Chropaczów, and the buildings of the Kolonia Zgorzelec housing estate north of the site. The municipal register of monuments includes the remaining buildings of the 'Schlesien-Silesia' mine and selected tenement houses in Chropaczów. The protection of monuments is an expression of concern for the preservation of traces of history for future generations, which strengthen local identity. All of the above-mentioned buildings are shown in Figure 1B. Educational and recreational infrastructure is gradually being developed. It is important to know about the toxicity of the heap to prevent poisoning by lead and other heavy metals or arsenic. 'Body' is the Lipinka stream valley with natural greenery, post-industrial heaps and forest which is one of the ways to rehabilitate the area. The 'Beginning' aspect anchors the distinctive features of the landscape to the history of industrial development in the area.

3.3. Changes to the landscape of the Lipinka valley

The landscape of the area described has changed considerably in the last two hundred years. At the beginning of the 19th century, the area on the left bank of the Lipinka stream was covered with forest, while the right bank had an agricultural character with the first elements of a mining landscape - the shafts of small coal mines and the 'Dawidhütte' zinc smelter (Mappa szczegulna…, 1792; Urmesstischblatt..., 1827). The valley had a natural character and no water bodies were present. By the end of the 19th century, however, there was no trace left of this forest complex, and Chropaczów and Lipiny had expanded considerably on the right bank, while numerous roads and railways were built to serve the needs of the coal mines and zinc works. Among other things, a road was built across the Lipinka stream, leading from the north towards the western bank of the present 'Kopyto' spoil heap (Morgenroth-Lipine..., 1880). A dyke was placed parallel to it, which probably served to regulate the water level in the stream to keep the road passable.

Dikes damming up the water can be seen all along the course of the stream, presumably to provide conditions for fish growth and fishing opportunities. In the valley of the right tributary of the Lipinka, first one and then another reservoir was created (Morgenroth-Lipine..., 1880; Topograpchische Karte..., 1889). The hollow of this first reservoir still exists today. At that time, the landscape had an agricultural and industrial character. At that time, absolute heights ranged from altitude of 286 m in the south-western part of the area to altitude of 267 m in the north-western part, the lowest point of the Lipinka valley (Messtischblatt, 1881). The maximum relative heights were 19 m. The flat bottom of the Lipinka valley was bounded by distinct natural edges with heights increasing with the course of the valley up to 5-6 m. The average slope of the valley floor was 11.2‰. In the landscape of the valley itself, the Ajska reservoir appeared at the end of the 19th century, formed in a subsidence trough (BEUTHEN Spezialkarte, 1894).

Since the beginning of the 20th century, the landscape of the study area has changed very dynamically, as documented by topographic maps from 1902-1939. On the right bank of the Lipinka valley, industrial and residential buildings and transport infrastructure occupy an increasing area (Floetzkarte des Oberschlesischen…, 1902). In the 1930s, the Kopyto slag heap significantly increases in size (Mapa taktyczna…, 1933), and by the beginning of the Second World War it is already so large that it completely obscures the Lipinka valley in one section (Mapa szczegółowa Polski…, 1939). Slag waste was hauled to the heap via the former causeway separating the Ajska reservoir and the previously mentioned 'northern road'. The close proximity of the smelter heap, coal mining spoil heaps, transport infrastructure, industrial and residential buildings and military facilities (battle shelters) gave the landscape a typically anthropogenic character that persisted for the next half century (Mapa topograficzna, 1974, 1994).

The lowering of the land surface as a result of mining subsidence and the increase in absolute heights as a result of the formation of a heap several metres high has contributed to the great variety of the landscape. The highest point is now the culmination of the Kopyto heap, at around altitude of 290 m, and the lowest point is the Lipinka valley bottom at the north-western study boundary, which has been lowered by 8 m in relation to its original position, i.e. altitude of 259 m. The average slope of the valley floor has decreased to 8.8‰, but varies greatly along its course - from 24‰ in the unleveled upper section to 2‰ in the lower section.

Figure 6. The Lipinka stream flowing out of the Ajska pond amid slag left over from zinc production. (Photo: Rostański K.M.).

Table 5. Landscape identity aspects in the context of terrain morphology.

Identity aspects	Terrain morphology features
Substance	• natural landscape partly anthropogenically transformed
Memory	• Lipinka stream bed • subsidence of the terrain due to mining damage • deposition of industrial waste
Anticipation	• securing the contaminated dump • further naturalisation of habitats • accumulation of organic matter and increase in soil fertility
Body	• post-industrial landscape • rural landscape • natural landscape • military landscape
Beginning	• beyond the beginning of 19th century

The dikes in the Lipinka valley, still visible on the 1902 map (Floetzkarte des Oberschlesischen..., 1902), have been cleared and at present the stream bed over 180 m beyond the Ajska reservoir is bounded by almost 10 m high banks built almost exclusively of anthropogenic material. The valley here has the character of a sharp gully, which resembles a river gorge morphologically although not in its generation. At first, the waters of the Lipinka flow swiftly over rapids a few tens of centimetres high, and then the watercourse begins to form small meanders or splits into two arms.

The heap has steep slopes, almost vertical in several places, while the top is level. The variously coloured waste material is subjected not only to physical and chemical weathering processes, but also to geomorphological processes - water erosion, deflation and mass movements - the stripping and sliding of larger waste packages. For the above reasons, the slopes of the heap are morphologically varied with erosion grooves and outwash cones at the base. In places there are more peculiar forms, resembling rock ‘monadnocks’, as well as larger packages of stripped waste material. Natural relief features include several ravines descending into the Lipinka valley.

The special identity of the landscape associated with the study area is evidenced by the interesting pattern of natural ravines, bringing rainwater into the Lipinka stream. These have been subject to erosion for centuries. The stream itself has changed over time since the early 19th century. Land subsidence associated with the collapse of coal pits caused the creation of reservoirs and also indirectly of rushes. Historical maps show dikes damming up the water between 1880 and 1939. Today there are only traces of them. Already at that time it was apparent that the terrain near 'Kopyto' heap had subsided so much that it was necessary to deepen and straighten parts of the stream bed. The dykes also made it possible to cross the creek bed at this location until 1939. The Ajska reservoir at the foot of the 'Kopyto' heap did not appear on the map until 1913 (Geologische Karte..., 1913). The 'Guidotto' zinc smelter did not disappear from maps until after the Second World War. A spoil heap was piled up in its place, and a similar one started to be piled up also at the north-eastern boundary of the study area. The latter is now almost completely demolished. Presumably in 1939 trenches were created crossing the Lipinka stream near the bunker. Aspect 'Substance' thus consists of natural erosion processes, but above all the deposition of metallurgical and mine waste and mining damage (Table 5). 'Social memory' covers the entire period of active industrial activity, the remnants of which are still visible. Its counterpart in nature is the natural communities of riparian and oak-hornbeam forests. 'Anticipation' is associated with the gradual renaturalisation of habitats and remediation of the smelter heap (Figure 6). Landforms, the 'Body' aspect, have been influenced by industrial activities, agricultural works, warfare and erosion processes. Here, too, the beginning of industrial development ('Beginning') can be identified as a breakthrough moment for the increase in anthropogenic influences.

3.4. Flora and Fauna

The poverty, toxicity and lack of balance on spoil heaps means that the land is not exploitable for agriculture and commercial forestry and therefore not cultivatable, allowing more natural succession. These post-industrial substrates leads to particularly slow colonisation, which can lead to high levels of biological diversity because many of the more competitive species which dominate vegetation types on less stressful soils are unable to dominate there (Trueman, Tokarska-Guzik & Cohn, 2022). For this reason, there are poor initial anthropogenic communities of post-smelter heaps, with a group of metal-tolerant plants.

Due to the diversity of the area's habitats outside the dumps, the presence of watercourses and water reservoirs, and its location between industrial settlements and agricultural areas, the study area is characterised by a relatively rich and varied plant cover. There are richer anthropogenic wooded communities at the foot of the heaps and in the vicinity of agricultural areas (the LIDAR image shows skips made before planting trees) and riparian forests of a semi-natural character, in the Lipinka stream valley itself. Mention should also be made of the aquatic and arboreal vegetation that accompanies the stream and surrounds the floodplains that exist here. Currently, nearly 400 species of vascular plants have been identified here, the vast majority of which are native plant species (about 80% of species) from various ecological groups.

The native species in the flora of the area are mainly forest and herbaceous plants, meadow plants and aquatic, bog and marsh plants, found in patches of natural and semi-natural vegetation in most of the area. Among these plants, a large group is made up of geophytes and hemicryptophytes - persistent species whose presence may indicate the stability of the forest, scrub, meadow and wetland habitats of the study area.

The share of alien species - kenophytes (the so-called newcomers) in the flora composition of the studied area is not high (approx. 10 % of the flora composition), and several of them can be classified as invasive species, i.e. species that may pose a threat to the habitats of the area. These include: *Impatiens glandulifera, Impatiens parviflora, Solidago gigantea* and *Solidago canadensis, Padus serotina, Robinia pseudacacia, Quercus rubra, Reynoutria japonica, Reynoutria sachalinensis*. There is a similar proportion (about 10%) of archaeophytes (ancient pre-Columbian newcomers), which are mainly associated with agricultural activity in the area.

Figure 7. The orchid *Epipactis palustris* growing at the foot of the 'Kopyto' slag heap. (Photo: Rostański K.M.).

A particularly interesting group of plants present in the flora of the area are the metal-tolerant plants that grow in the dry places most heavily contaminated with heavy metals (e.g. blast-furnace heaps, and their immediate surroundings). These are plants of calamine grasslands, such as *Arabidopsis arenosa, Silene vulgaris, Leontodon hispidus, Pimpinella saxifraga, Linum catharticum, Thymus pulegioides, Agrostis capillaris, Carex spicata, Carlina vulgaris, Chamaenerion palustre, Daucus carota, Euphorbia cyparissias, Festuca ovina, Gypsophila fastigiata, Hieracium pilosella, H. piloselloides, Lotus corniculatus, Matricaria maritima subsp. inodora, Poa compressa, Ranunculus serpens subsp. nemorosus, Rumex acetosella, Solidago virgaurea, Viola tricolor*.

*Deschampsia caespitosa, Molinia caerulea, Arabidopsis halleri, Dianthus deltoides, Puccinellia dystan*s and the strictly protected orchid *Epipactis palustris* can be found in slightly wetter areas with high metal contamination. The occurrence of metal-tolerant plants illustrates the anthropogenic changes that have taken place here over a number of recent decades.

In the flora of the Lipinka valley area, the presence of plants protected by law, endangered and valuable for the regional flora has been confirmed. The orchid *Epipactis palustris* is a strictly protected species (Figure 7). Its population of a few dozen specimens persists in the area of humid places in the surroundings of the tin heaps, in the central part of the area (cf. Michalska and Rostański 2003). The species under partial protection under current law (Rozporządzenie Ministra Środowiska, 2014) are: orchids - *Epipactis helleborine* - fairly common throughout the study area, *Epipactis atrorubens* and *Listera ovata* - are much rarer here and occur in wooded areas. The wintergreen *Pyrola rotundifolia* and the smaller *P. minor* - form quite rare small populations here on the edges of wooded areas. Partially protected species of interest also include centuria: the common

Centaurium erythrea and the overbearing *C.pulchellum* - these are only found in one place, in the central, lowered part of the 'Kopyto' heap. The LC category of taxa of least concern here includes woodland species such as *Convalaria majalis* and *Polygonatum verticillatum*; meadow plants: *Viscaria vulgaris, Genista germanica*, or *Rhinanthus alectorolophus*; and the yellow water lily *Nuphar lute*a established in the area's ponds (Parusel & Urbisz, 2012).

The current state of the vascular plant flora indicates the existence within the study area of remnants of the native natural flora (associated with forests and aquatic habitats) and incoming ruderal plant species, alien invasive species (the result of increased anthropopression over the decades), and specialised metal-tolerant species, closely associated with the remains of the metallurgical industry. The list of vascular plants from the 'Ajska' study area is mentioned in the supplementary material, divided into ecological groups of vascular plants (Ellenberg, 2009). The most common plants in communities transformed by humans have been omitted from the list.

The invertebrate fauna of the Lipinka valley is typical of the forest and synanthropic environments found in Upper Silesia and is represented by a significant proportion of taxa common in Poland. *Hemiptera* are relatively abundant in the forested areas, representing both predatory forms and typical sucking phytophages. Due to their abundance, they are a very important component of ecosystems and occupy an important place in the food chain of organisms. The study area showed numerous representatives of *Coleoptera* beetles from the families: *Scarabeidae, Cerambycidae, Carabidae, Chrysomelidae, Coccinelidae, Elateridae, Pyrochroidae and Silphidae*. The *Hymenoptera* are represented in the described area, among others, by social insects such as *Bombus*, some bees, ants and several species of wasps with their largest representative, *Vespa carbo*. Ground-nesting bees include, for example, *Osmia*, *Andrena*, *Colletes* and some *Megachiles*. In the more exposed areas, several common butterfly species can be observed: *Apatura iris, Anthocharis cardamines, Pieris brassicae, Gonepteryx rhamni, Vanessa atalanta, Nymphalis antiopa* and butterflies of the butterfly family (*Lycaniadae*). *Cossus cossus* caterpillars feed in the wood of old willows, poplars and other deciduous trees.

Table 6. Landscape identity aspects in the context of local flora and fauna.

Identity aspects	Local flora and fauna features
Substance	• resistance to human impact with the colonization of post-industrial dumps and remediation of pollution
Memory	• protected species • metallophytes • species of uncontaminated habitats • changes in vegetation composition
Anticipation	• invasive species • habitat species • adaptation of plant communities to changing conditions • resistance to human impact
Body	• separated habitats associated with spoil heaps and the natural stream valley habitat species
Beginning	• 1825 first coal mine and 1887 first zinc smelter with their production waste changing the local species composition

There are very few amphibians in the Lipinka valley area. In the forested part, outside the area of the heaps, the toad *Bufo bufo*, the green frogs *Rana esculenta complex* and the newt *Lissotriton vulgaris* are occasionally encountered. The lizard *Lacerta agilis* was encountered on open, sunny roads and at the edge of the forest, and the grass snake *Natrix natrix* in the rushes. Mammals are represented by the wild boar *Sus scrofa* and roe deer *Capreolus capreolus*, which roam here (Figure 8). The fox *Vulpes vulpes*, the marten *Martes foina*, the squirrel *Sciurus vulgaris*, the hedgehog *Erinaceus roumanicus*, the shrew *Sorex araneus*, the mole *Talpa europe*a and the buzzards *Apodemus flavicollis* and *Apodemus agrarius* nest here. The rat *Rattus norvegicus*, which is an alien species that robs bird nests, also appears here. Hares *Lepus europeus* are rare and have been observed in the surrounding fields and forest edges. Bats have also been observed here, but their species composition has not been established.

The avifauna is the richest, as nearly 50 bird species have been observed here. Of the less common ones, we can mention *Buteo buteo, Accipiter gentilis, Strix aluco, Dryocopus martius, Picus canus, Troglodytes troglodytes, Schoeniclus schoeniclus* and the kingfisher *Alcedo atthis*.

Insects - *Zygoptera, Anisoptera, Ephemeroptera, Megaloptera, Trichoptera, Diptera, Coleoptera* and

Figure 8. Deer wandering along the edge of the forest. (Photo: Rostański K.M.).

various winged bugs *Heteroptera* - develop in the water of the Lipinka stream and its periodic tributaries. Leeches of various species, including *Haemopis sanguisuga*, were observed in the lower part of the Lipinka stream.

The most polluted reservoir 'Ajska' is used by anglers. It lies at the foot of the slope of the smelter heap, from which material carrying a significant load of pollutants (including heavy metals and arsenic) is washed away with every rain. People still seem to be unaware of the dangers of pond pollution. Several fish species have been recorded here, of which *Rutilus rutilus, Scardinius erythrophthalmus, Tinca tinca, Cyprinus carpio, Carassius gibelio* and *Esox lucius* are common.

The site confirmed the occurrence of 387 species of vascular plants and 75 species of insects, 24 species of invertebrates and 70 species of vertebrates, including many species of plants and animals protected and valuable for local and regional biodiversity, which against the background of the Upper Silesian conurbation is a testimony to the high natural value of the site.

In this context, the ecosystem processes of the Lipinka stream valley, which resist anthropopression, have been identified as 'Substance' (Tab.6). The greatest impact on the local habitat structure was the deposition of smelter waste on the 'Kopyto' heap. Coal mine spoil heap was deposited on the north-eastern periphery of the site, a relatively small area. The ecosystem was based on the existing gene pool here, equivalent to the 'Memory' component, but was modified by the planting of poplar and mixed woodland to the west of the 'Kopyto' heap. Apart from the intervening woodland composition, the rest of the vegetation appears to have spread in free succession, spontaneously adapting the plant communities to changing conditions and benefiting in this respect from genetic material brought here from outside the site, corresponding to the 'Anticipation' component. Some species appeared to be invasive, alien. Distinct habitats associated with waste heaps and the natural habitats of the Lipinka stream valley were identified as 'Body'. The metallophyte species inhabiting the smelter heap are not present in the rest of the area; they must have been brought here by animals, dolomite transport and winds, mainly from the northern area of Bytom and Tarnowskie Góry, from where zinc ore was imported. The 'Beginning' aspect of the identity of the environment thus created is linked to the beginning of local industrial activity.

3.5. Intangible qualities

In the middle of the 19th century, Hugo Solger wrote about the heaps and buildings of the mines and steelworks and the workers' houses, which were surrounded by dead trees (Solger, 1860, p. 116). Lipiny with the 'Silesiahütte' smelter and the 'Guidotto' smelter in neighbouring Chropaczów had the highest mortality rate in the Prussian Empire at the end of the 19th century, a testament to the level of environmental contamination (Illustrier..., 1904). Workers suffered from lead colic and after a few years of work suffered muscle paralysis, most often of the arms. Some suffered paralysis of the hands, arms, legs and feet at the same time. The most common cause of death was respiratory disease. In 1893, 56.3% of the 2453 members of the then Silesian Zinc Smelters Sickness Fund were suffering from work-related illnesses in zinc production (Krantz, 1911). The life expectancy of zinc smelter workers at the end of the 19th century here was 46 years. Many also died of starvation and the resulting epidemics, especially children. Evidence of this can be found in the typhus victims' grave in the northern part of the study area. Efforts to ensure adequate living conditions for workers, and in particular to enable them to survive in times of economic crisis, were initiated in Upper Silesia by Karol Godula, owner of most of the zinc smelters at the beginning of the 19th century, in whose honour, in the interwar period, the village neighbouring the area under study to the west was renamed from Colonie Godullahütte to Godula. The life story of Karol Godula, the fate of his adopted daughter, the development of his fortune and his charitable activities became legendary and deeply ingrained in the local identity (Piernikarczyk, 1936).

This bleak picture of a degraded environment lasted for decades and came to be identified with the whole of Upper Silesia. Over time, however, with the gradual closure of industrial plants and the cessation of waste production, the area was gradually renaturalised through spontaneous succession. Today, the remains of industrial structures and buildings are treated by tourists as an attraction and by the local government as a problem to be solved due to pollution and increasingly dangerous rusting structures. Post-industrial sites are sometimes referred to as the 'New Sublime', by their nature of showing the transience and ephemerality of material grandeur, which, as early as the 19th century, distinguished the narrative present in 'Sublime' style parks.

The workers in the industrial plants of Upper Silesia were recruited from the surrounding countryside and further afield within the borders of several countries. Upper Silesia itself is a region located in Poland and the Czech Republic. The common, distinctive fate of the people here, linked to industry, and the language, which has preserved the local vocabulary from the 17th and 18th centuries, with later technical infiltrations of German, have meant that there are strong autonomous tendencies here.

Surrounding residents treasure the place for various reasons. Hugo Solger recalled workers' children playing on the heaps in the mid-19th century (Solger, 1860). Today, it is a popular spot for outdoor photography and walks, not least because of the expansive view of the surrounding area from the levelled top of the heap. The smelter heap itself has an attractive brownish-red colour against the green background. Unfortunately, the site is also used by anglers and motocross and off-road enthusiasts. Until the establishment of the Lipinka Valley nature and landscape complex (2021), motorbikes used to tear up the 'Kopyto' heap, their drivers playing in complete ignorance of the fact that they were inhaling toxic dust and also poisoning walkers by spraying it around. Off-Road competitions organised periodically at this location, such as the Women's Day rally (8th of March 2020), devastated the beds of the surrounding creeks, as partially sinking cars into the silt of the creek and pulling them out with winches was considered a great sporting experience. In the process, the site of the orchid *Epipactis palustris*, was

Table 7. Landscape identity aspects in the context of intangible values.

Identity aspects	Intangible values features
Substance	• Silesian national identity • relations in local ecosystem • the area is perceived as a wild place surrounded by urbanized areas
Memory	• awareness of the history and the threats that exist there • memory of the plagues of cholera and typhus • variability of conditions causing changes in the attractiveness of the area for animal and plant species
Anticipation	• adaptation to the changing needs of local residents • increased attractiveness of the area for animals and plants associated with the gradual naturalization of habitats
Body	• industry workers and their descendants • fishermen • nature lovers • inhabitants • animal and plant species
Beginning	• beginning of 19^{th} century

devastated, with the population declining from more than 120 specimens to a dozen in 2020. Walking in the area was sometimes dangerous, as motorcyclists did not slow down when passing walkers.

The study area is far from residential buildings and not easy to penetrate, so it sometimes attracts poachers during the week. On a number of occasions, the municipal police have been informed of birds being shot 'for fun' with long-barreled airguns. During a penetration of the site in 2020, a mallard duck was found shot and the remains of several small birds.

The 'Substance' aspect of this place is connected with the Silesian language, awareness of industrial and national history, but also a certain distinctiveness from Poland and Germany (Table 7). There is also a sense of freedom felt in the wildly overgrown areas, giving residents a taste of contact with nature, but also making the area attractive to animals. The attractiveness of this forest enclave, the singing of the birds and its beneficial effects on air quality obliterate the harsh industrial past, although metal-tolerant plants are common here indicating, not least to botanists, the places most affected by pollution. The aspect of 'Memory' is clearly associated with the industrial past and activities of Karol Godula. In the consciousness of Silesian families, often divided nationally, this former borderland has left a significant mark. The memory of the fate of ancestors who worked in industry, of epidemics caused by environmental pollution and periods of famine, also remains. The soil conditions in the area are remarkably stable, maintaining the species composition of the vegetation despite the former clearing of trees for fuel and the continuing levels of pollution. One can admire the environment's great ability to rebuild the composition of its flora and fauna. For the 19^{th} and 20^{th} centuries, the Lipinka stream valley area was the only place for Sunday walks. Today 'Anticipation' in this area is linked to the idea of 'New Sublime' and maintaining post-industrial areas as part of local identity with a broader meaning. The residents' attachment to the region causes constant construction pressure in this area despite persistently high levels of land pollution. The area, undergoing naturalisation, is conducive to the development of fauna. Despite its location in a heavily urbanised area, roe deer, hares, foxes and many species of birds can be found here. The Lipinka stream is becoming increasingly clean as it flows. Nature is increasingly taking over this place. The 'Body' aspect also refers to the local community and the nature found here. The constant influx of new residents, but the clear dominance of the Silesian dialect in public spaces, proves the durability of social relations and the continuity of many generations of residents in this place. Pigeon breeding, once so popular, is now giving way to fishing. The Ajska pond attracts many anglers despite the contamination of its waters. However, awareness of the degree of environmental degradation requires continuous educational activities. The wildness of post-industrial sites with spontaneous vegetation attracts many nature lovers and local residents who walk, watch birds, but unfortunately also attracts motocross riders and off-road vehicle drivers. Since the area has been protected and awareness of the toxic qualities of the smelter heap has spread, the Off-Road problem has almost completely disappeared and the site has become safe. It was not the bans but awareness of their origin that proved important. The great diversity of natural and anthropogenic habitats promotes biodiversity, and the place seems attractive not only to people but also to animals, which bring seeds of new plants here. Previously, the area was mainly covered by forests and farmland, but from the beginning of the 19th century, industry began to dominate. This changed the place forever, introducing pollution into the environment that cannot be removed. In the minds of the inhabitants, the industrial revolution is a widely recognised turning point in time and can be identified with the aspect of "Beginning".

4 Discussion

It is recognized that the landscape is not a fixed structure (Antrop, 2005). But the concept of landscape and especially its identity, are presented in the literature as concepts defined by man and his own influence and judgment (Jackson, 1984; European Landscape Convention, 2000; Murphy, 2005; Butler & Sarlöv-Herlin, 2019; Loupa Ramos et al., 2019). It is as if the landscape does not exist without the man who evaluates it. This fact is not changed by the fact that sometimes authors accept landscapes directly untouched by man as full-fledged forms of it (Berleant, 1992). It is not noticed that the landscape has its own identity, comparable even to the social aspect of it, which develops according to the laws of nature, and we humans only describe it. To support this thesis, the paper uses Leszek Kołakowski's definition of social identity to the analysis of landscape identity. It was considered the most universal and transposable to the idea of landscape identity.

Humans perceive the world by seeking consistency with their ideas, benefits and goals. By sticking to the concept of landscape identity linked to human perception, we gradually cease to pay attention to nature's right to decide for itself what is best for it. If we place ourselves in the role of humans as an integral part of the environment and ecosystem, then our well-being depends on the effective functioning of the system. However, this requires the free functioning of natural succession and a broad gene pool associated with local conditions. These conditions have their origins in the evolution of local habitats. It is easy to point to analogies with Kołakowski's concept of identity. 'Substance' as a characteristic of the ecosystem, 'Memory' as a gene bank, 'Anticipation' as the goal of survival or evolution of the ecosystem, 'Body' as elements of the ecosystem and 'Beginning' as the moment of creation of a biotope existing in a given place and the initialisation of the evolution of the local biocenosis. This approach is more complex than previous concepts of man's place in the environment, based on greater or lesser separation from nature and analysing it from the outside. The identity of a landscape is said to stem from the uniqueness of a place. This can be understood as a unique psycho-sociological perception of a place defined in a spatial–cultural space. Its essence is the involvement of society in the preservation and further development of its spatial and existential characteristics (Stobbelaar & Pedroli, 2011). The problem, however, is that this involvement should sometimes be understood as refraining from action.

The definitions of landscape identity are dominated by the structural trend, which emphasises the description of the existing material elements of the landscape as the unique psycho-social perception of a place within a spatial, cultural space (Myczkowski, 2003; Kułak, Stobbelaar & Pedroli, 2011; Chmielewski, 2012; Loupa Ramos et al., 2019). This tends to use methods of systematically recording the unique values of the local landscape, which are captured within the boundaries of landscape interiors. This is a very static approach in which natural processes occupy a marginal place. The landscape is sometimes treated much more as a product of human activities than as an object of human perception or contemplation, particularly evident in works on urbanised landscapes (Ziyaee, 2018). This humanistic approach points to a 'sense of place' as the distinguishing feature of the landscape and the design goals pursued by humans to achieve solutions that best serve them. There are also voices against the egoistic approach of humans to their actions in the environment and thinking of the concept of identity as merely a human property of 'self-identity' (Oliver, 2022).

Kolakowski's concept of identity seems closer to the idea of landscape as a living structure, changing over time, adapting in a directional way to changing conditions. It is difficult to find sources that attempt to elevate the importance of nature's activities in the ecosystem to a full-fledged element of place identity formation, yet natural landscapes have an important place in landscape typologies. The action of nature in the ecosystem can be assessed even by such an extreme humanistic approach as that proposed by Kolakowski in defining identity. This by no means implies the personification of nature. We are still in the realm of man's perception of the landscape, but man too is part of the ecosystem and, willy-nilly, follows natural processes to stay alive. Direct analogies can be found here (Rostański, K.M., 2018). In a similar way to Kolakowski 's definition of identity, Khaledi (Kahledi, 2022) systematises heritage. He distinguishes three categories - identity, archetype and history. Identity with a collective aspect related to social relations and a contextual aspect derived from human perception. Archetype refers to the tangible and intangible elements contained in the structure under analysis. The category of history, which refers to the recorded changes in people's surroundings and the relationships that have been formed in relation to these surroundings and each other in this context. Khaledi defines landscape identity only in relation to humans, where nature is only an object of perception and not a living participant in the process of change and interaction.

Many places similar to the Lipinka valley have been included in various forms of protection and are now not only local, but also supra-regional tourist and recreational attractions (Celiński et al., 1996; Tokarska-Guzik, 1996; Rostański A., 2006, 2023, 2024). Among them is the 'Segiet' nature reserve, which protects a diverse beech forest complex (from acidic lowland beech to fertile orchid beech) with many species of protected and rare plants and species threatened with extinction in the region - a forest that spontaneously overgrew the area of former silver and lead ore mining pits. The nearby spoil heap of the former ore mine 'Fryderyk', in Tarnowskie Góry, overgrown by a calamine grassland, is a UNESCO World Heritage Site. The natural and landscape complex 'Żabie Doły' in the area of Bytom and Chorzów forms an area with numerous water reservoirs in subsidence troughs, preceded by railway embankments and heaps, and is rich in ornithology. The Pogoria I, II and III ecological sites in Dąbrowa Górnicza protect rare species of flora on the banks of water reservoirs, in former sand pits, and the 'Blachówka' documentation site protects, among other things, the geological profile of Triassic rocks in a former extensive quarry. Similar examples can be found in the Black Country region of the UK, around Olkusz in Poland and in central Slovakia. More tolerant plant species even undergo micro-evolution, extending their range of tolerance under high pollution conditions, while weaker species retreat. The plant races thus created have altered ecological characteristics and are noticeably different from the typical species (Wierzbicka & Rostański, 2002; Trueman et al., 2022).

The Lipinka Valley is an example of the intertwining of social identity and natural identity. They work synergistically and are intrinsically linked. This is not a situation where one value exists against the backdrop of the other. Either we recognise that this is one common value, or we make our world unliveable. Recognising the equivalence of these identities entails criticism of the current legal acts concerning landscape. All of them are anthropocentric. An example is the European Landscape Convention, which refers to social aspirations, guiding change, landscape planning and management. The protection referred to here is based precisely on these assumptions. An important element that has emerged here is the recognition of everyday landscapes as important for social identity and the need to preserve them. However, there is still no direct indication here for recognising natural succession processes as a legitimate force in shaping landscapes. This approach is characteristic of researchers of so-called 'fourth nature'. It is seen as an opportunity to preserve natural processes in cities (McKinney et al., 2018; Seitz et al., 2022). Interestingly, acceptance of free succession is more common among garden owners than among people without gardening experience (Straka, 2022). However, naturalists associated with the idea of 'fourth nature' note the degrading role of invasive plants, whose succession should be limited.

The adopted methodological concept describes the essential features of a landscape that coexists with humans, but also independently of them. It is a description that not only refers to the present moment, but also points to anticipated changes. It does not indicate ready-made solutions to control these changes. If it did, it would risk increasing anthropogenic pressure and limiting natural processes. We do not know all the factors shaping the evolution of a given landscape. Our actions are always imperfect. It is important to always leave nature as much room as possible for natural regulation.

Due to its natural and landscape values, the studied area was included under a form of legal protection in 2021 - as the nature and landscape complex 'Lipinka Valley'. The project to make the area accessible proposes, in addition to benches and educational path boards, the enrichment of the area with fruit-bearing trees and shrubs, such as rowans (*Sorbus*), hawthorns (*Crategus*), dogwoods (*Cornus*), bird cherry (*Prunus padus*) and others. It was also proposed that bird boxes of various species, bat boxes and pollinator houses be placed in the area. It was considered necessary to leave stumps after windbreaks as habitat for invertebrates, shelter for amphibians and small mammals and nesting sites for birds. Educational trails and benches have been included in the conservation design to attract older people and families with children to the site (Rostański K.M. et al., 2020). Currently, the site is a local recreation area and a reminder of the site's past industrial history, also linked to its military past, being a sanctuary of local biodiversity worthy of a legal form of nature protection.

5 Conclusions

The Lipinka valley is filled with elements of natural and semi-natural origin (e.g., part of the Lipinka stream bed, some ravines and spring areas), elements that are the result of early human activity (dykes on the stream, bead reservoirs, agricultural fields, a military bunker in the valley). There are anthropogenic elements, causing environmental degradation (heaps of post-mining and post-smelting waste, numerous road tracts and other elements of industrial infrastructure). Post-industrial habitats are covered with vegetation at various stages of succession (e.g., initial grasslands on the tops and summits of heaps, shrubs and anthropogenic forest west of the Kopyto heap, riparian forest filling the valley, reeds, rushes and sedges in the stream valley and overgrowing the Lipinka floodplains). An important element that binds this ecosystem is the Lipinka stream itself, flowing through the entire area. The state of water pollution changes along the course of the stream to reach a fairly good state of purity in its lower reaches, in the northern part, which indicates the high purification potential of the aquatic ecosystem. This phenomenon should be thoroughly investigated in a separate study.

Many publications and international documents talk about social identity, linked to history and natural values. The Lipinka Valley illustrates how natural and anthropogenic values can be convergent, creating a unique quality and a special kind of identity. The processes here existed before and are still ongoing, exemplifying the gradual evolutionary changes and build-up of phenomena related to the development and decline of industrial activities and their relationship with local nature. The local community, thanks to the popularisation of knowledge about the area, stops treating it as a worthless wasteland that can be invasively used and even destroyed for fun.

The evolution experienced in the study area manifests itself not only in the increasing diversification of the flora, but also in the form of microevolutionary changes within individual plant species and the emergence of races that gradually increase their tolerance to pollution.

Applying Leszek Kołakowski's approach to the analysis of local identity values has allowed for a more accurate description of its characteristics than other definitions of identity. Using this approach to analyse landscape identity and extending its scope to include natural elements allows us to treat the natural landscape as a living organism that is just as important as the anthropogenic landscape. In this view, cultural identity intertwines with natural identity in a balanced way. This enhances the value of nature that arises spontaneously. In this case, these are communities of vegetation resistant to heavy metal pollution, which are a valuable witness to the development of industry in this area. Humans tend to create ideas that are always flawed and incomplete. We dream of ideal solutions, but nature does not apply such solutions. Natural solutions are always optimal. For this to be the case, we must strive to leave it as much freedom as possible. To achieve this, some areas of each landscape must be left untouched by human activity, regardless of their naturalness. This could be treated as part of environmental policy, which should include regulations on refraining from interfering with a certain percentage of land in all types of landscapes. The only interference that should occur in such places is control of the excessive spread of invasive species. However, it should be noted that this is also part of natural processes. This concerns a limited percentage of land in order to preserve natural processes, but prevent the destruction of, for example, plant communities associated with pastures and meadows, which tend to become overgrown with forest. Sustainable development remains the key to all environmental decisions.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary material

The list of vascular plants of the “AJSKA” study area.

The ecological groups of vascular flora (1 – 7) after Ellenberg (2009); §§ - species strictly protected, § - species partly protected in Poland.

1) Forest species –(about 20% of the flora).

Trees: *Acer campestre, Acer negundo, Acer platanoides, Acer pseudoplatanus, Alnus glutinosa, Betula pendula, Carpinus betulus,Fraxinus excelsior, Larix decidua, Padus avium, Padus serotina, Picea abies, Pinus sylvestris, Populus nigra, Populus tremula, Prunus spinosa, Pyrus communis, Quercus robur, Quercus rubra, Salix alba, Salix aurita, Salix cinerea, Salix fragilis, Salix sepulcralis, Salix triandra, Sorbus aucuparia, Tilia cordata, Ulmus laevis;*

Shrubs: *Corylus avellana, Crataegus monogyna, Euonymus europaea, Frangula alnus, Ribes uva-crispa, Rosa canina, Rosa rugosa, Rubus plicatus, Viburnum opulus;*

Forest floor species: *Aegopodium podagraria, Ajuga reptans, Athyrium filix-femina, Brachypodium sylvaticum, Campanula trachelium, Carex brizoides, Carex spicata, Cerasus avium, Convallaria majalis, Deschampsia flexuosa, Dryopteris dilatata, Dryopteris filix-mas, Epipactis atrorubens§, Epipactis helleborine§, Festuca gigantea, Geranium robertianum, Geum urbanum, Glechoma hederacea, Hieracium lachenalii, Hieracium laevigatum, Hieracium murorum, Hieracium sabaudum, Humulus lupulus, Impatiens noli-tangere, Impatiens parviflora, Listera ovata§, Luzula pilosa, Lysimachia nummularia, Majanthemum bifolium, Mycelis muralis, Oxalis acetosella, Poa nemoralis, Polygonatum multiflorum, Polygonatum verticillatum, Pyrola minor§, Pyrola rotundifolia§, Scrophularia nodosa, Senecio ovatus, Vaccinium myrtillus, Viola riviniana*.

2)“Edge species”–marginal habitat plants – (c.a. 7% of the flora):

Agrimonia eupatoria, Anthoxanthum odoratum, Astragalus cicer, Astragalus glycyphyllos, Campanula rapunculoides, Carex pairae, Centaurium erythraea§, Chamaenerion angustifolium, Cornus sanguinea, Coronilla varia, Fragaria vesca, Fragaria viridis, Hypericum perforatum, Lathyrus sylvestris, Medicago falcata, Molinia arundinacea, Pteridium aquilinum, Rubus idaeus, Sambucus nigra, Trifolium medium, Verbascum lychnitis, Verbascum thapsus, Vicia sepium, Salix caprea, Solidago virgaurea, Veronica chamaedrys.

3) Meadow species – (about 20% of the flora):

Achillea millefolium, Alopecurus pratensis, Angelica sylvestris, Anthriscus sylvestris, Arrhenatherum elatius, Avenula pubescens, Bellis perennis, Bromus hordeaceus, Campanula patula, Centaurea jacea, Cerastium holosteoides, Chaerophyllum hirsutum, Cirsium oleraceum, Cirsium palustre, Crepis biennis, Crepis capillaris, Dactylis glomerata, Deschampsia caespitosa, Equisetum arvense, Equisetum palustre, Euphrasia rostkoviana, Festuca arundinacea, Festuca pratensis, Festuca rubra, Galium mollugo, Genista tinctoria, Geranium palustre, Geranium pratense, Geum rivale, Heracleum sphondylium, Holcus lanatus, Hordeum murinum, Hypericum maculatum, Juncus effusus, Knautia arvensis, Lathyrus pratensis, Leontodon autumnalis, Leontodon hispidus, Leontodon hastilis, Leucanthemum vulgare, Lolium perenne, Lotus corniculatus, Lotus uliginosus, Lychnis flos-cuculi, Lysimachia vulgaris, Medicago sativa, Molinia caerulea, Odontites serotina, Phleum pratense, Pimpinella major, Plantago lanceolata, Poa angustifolia, Poa pratensis, Poa trivialis, Prunella vulgaris, Ranunculus acris, Rhinanthus alectorolophus, Rhinanthus serotinus, Rumex acetosa, Sanguisorba officinalis, Scirpus sylvaticus, Senecio jacobaea, Stachys palustris, Stellaria graminea, Taraxacum officinale, Thymus pulegioides, Tragopogon pratensis, Trifolium dubium, Trifolium pratense, Trifolium repens, Valeriana officinalis, Vicia cracca, Viola tricolor.

4) Grassland species, including metalopytes – (about 7% of the flora):

Agrostis capillaris, Arabidopsis arenosa, Arabidopsis helleri, Arenaria serpyllifolia, Artemisia campestris, Carex ovalis, Carex spicata, Carlina vulgaris, Cerastium semidecandrum, Chamaenerion palustre, Dianthus deltoides, Erigeron acris, Euphorbia cyparissias, Genista germanica, Gypsophila fastigiata, Hieracium pilosella, Hypochoeris radicata, Jasione montana, Linum catharticum, Luzula campestris, *Medicago lupulina, Potentilla argentea, Potentilla erecta, Ranunculus nemorosus, Rumex acetosella, Scabiosa ochroleuca, Senecio viscosus, Silene vulgaris, Trifolium arvense, Trifolium campestre, Viscaria vulgaris.*

5) Ruderal species – (c.a. 21% of the flora):

Agrostis stolonifera, Alliaria petiolata, Arctium lappa, Arctium minus, Armoracia rusticana, Artemisia vulgrais, Barbarea vulgaris, Bromus inermis, Calamagrostis epigejos, Calystegia sepium, Carduus acanthoides, Carex hirta, Centaurea diffusa, Cerastium arvense, Chamomilla recutita, Chamomilla suaveolens, Chelidonium majus, Convolvulus arvensis, Conyza canadensis, Cornus alba, Daucus carota, Dipsacus sylvestris, Echium vulgare, Elymus repens, Epilobium adenocaulon, Epilobium adnatum, Epilobium hirsutum, Erigeron annuus, Eupatorium cannabinum, Festuca ovina, Galeopsis pubescens, Galium aparine, Helianthus tuberosus, Lactuca serriola, Lamium album, Leonurus cardiaca, Lepidium ruderale, Linaria vulgaris, Matricaria inodora, Medicago varia, Melandrium album, Melilotus alba, Melilotus officinalis, Oenothera biennis, Oenothera paradoxa, Oenothera rubricaulis, Picris hieracioides, Plantago major, Poa annua, Poa compressa, Polygonum aviculare, Potentilla anserina, Potentilla reptans, Prunus cerasifera, Pyrus pyraster, Puccinellia distans, Ranunculus repens, Reseda lutea, Rosa glauca, Rubus caesius, Rumex crispus, Rumex obtusifolius, Saponaria officinalis, Symphytum officinale, Tanacetum vulgare, Trifolium hybridum, Tussilago farfara, Urtica dioica, Verbascum densiflorum, Verbascum phlomoides, Ligustrum vulgare.

Ruderal species also contains invasive alien species like: *Aster novi-belgii, Bromus carinatus, Echinocystis lobata, Juncus tenuis, Reynoutria japonica, Reynoutria sachalinensis, Robinia pseudacacia, Solidago canadensis, Solidago gigantea, Syringa vulgaris.*

6) Segetal weeds – (about 17%):

Aethusa cynapium, Amaranthus retroflexus, Anthemis arvensis, Apera spica-venti, Artemisia absinthium, Atriplex nitens, Atriplex patula, Avena sativa, Berteroa incana, Brassica napus, Cannabis sativa, Capsella bursa-pastoris, Centaurea cyanus, Chaenorhinum minus, Chenopodium album, Cichorium intybus, Cirsium arvense, Digitaria ischaemum, Digitaria sanguinalis, Diplotaxis muralis, Echinochloa crus-galli, Erodium cicutarium, Erysimum cheiranthoides, Euphorbia peplus, Fallopia convolvulus, Galeopsis tetrahit, Galinsoga ciliata, Galinsoga parviflora, Geranium pusillum, Lamium purpureum, Lathyrus tuberosus, Lepidium densiflorum, Malva neglecta, Malva sylvestris, Matricaria inodora, Mentha arvensis, Myosotis arvensis, Oxalis stricta, Papaver rhoeas, Pastinaca sativa, Polygonum persicaria, Raphanus raphanistrum, Salvia verticillata, Secale cereale, Senecio vernalis, Senecio vulgaris, Setaria pumila, Setaria viridis, Sisymbrium altissimum, Sisymbrium loeselii, Sisymbrium officinale, Solanum nigrum, Sonchus arvensis, Sonchus asper, Sonchus oleraceus, Stellaria media, Thlaspi arvense, Tragopogon dubius, Veronica arvensis, Veronica hederifolia, Vicia angustifolia, Vicia hirsuta, Vicia sativa, Vicia tetrasperma, Viola arvensis.

7) Marsh and waterside species– (about 7% of the flora):

Acorus calamus, Agrostis canina, Carex canescens, Carex nigra, Epipactis palustris§§, Juncus articulatus, Alisma plantago-aquatica, Alopecurus aequalis, Bidens tripartita, Carex acutiformis, Carex distans, Carex gracilis, Carex vulpina, Centaurium pulchellum§, Eleocharis palustris, Equisetum fluviatile, Galium palustre, Glyceria maxima, Impatiens glandulifera, Iris pseudacorus, Juncus inflexus, Lemna minor, Luzula multiflora, Lycopus europaeus, Lythrum salicaria, Myosoton aquaticum, Nuphar lutea, Petasites hybridus, Phalaris arundinacea, Phragmites australis, Polygonum hydropiper, Polygonum lapathifolium, Potamogeton natans, Ranunculus sceleratus, Sparganium emersum, Typha latifolia.