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1. GEOGRAPHICAL LOCATION AND REGIONAL DIVERSITY OF POLAND

1.1. Geographical location of Poland in Europe

The Republic of Poland is a Central European country located on the Baltic Sea. The extreme points of its land area are as follows (Figure 1.1):

- the Northernmost Point – 54°50´N (the cliff of Kępa Swarzewska in Władysławowo, to the west of Cape Rozewie, Pomeranian Voivodship);
- the Southernmost Point – 49°00´N (Opołonek peak in the Bieszczady Mountains, near Użocka Pass and Wołosate village, Subcarpathian Voivodship);
- the Westernmost Point – 14°07´E (a meander of the Odra River near Osinów Dolny, West Pomeranian Voivodship);
- the Easternmost Point – 24°09´E (a meander of the Bug River near Zosin and Strzyżów, Lublin Voivodship).

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Figure 1.1. Absolute geographical location of Poland

Source: own elaboration

The total area of Poland is 322 575 km^2. Its land territory covers 311 888 km^2, internal marine waters – 2005 km^2, and territorial sea – 8682 km^2. The administrative area is 312 679 km^2, and encompasses the area within administrative borders of voivodships, apart from land territory also some internal marine waters (Vistula Lagoon, Szczecin Lagoon, areas of port waters). The length of border is 3511 km, including 3071 km of land borders, and 440 km of sea borders. Poland borders on Russia (210 km), Lithuania (104 km),

Belarus (418 km), Ukraine (535 km), Slovakia (541 km), Czech Republic (796 km) and Germany (467 km). During over 1000 years of Polish history, its area, relative location in Europe and the course of borders underwent frequent changes. In the last century, the most important changes occurred as a result of World War II. They consisted in shifting the borders westwards by 197 km and reducing the territory by 77 thousand km^2.

The longitudinal extent of Poland south to north is 5°50′, i.e. 649 km, and latitudinal one, measured along the 52nd parallel reaches 10°02′, i.e. 689 km.

A consequence of longitudinal extent are differences of the solar angle of incidence, which means varied sun exposure and thus, differences in average temperatures. Another important effect are different lengths of day and night. The maximum difference is over 1 hour. In the summer the day is longer in the north of the country, where it lasts maximally 17 hours and 17 minutes – then in the south – 16 hours 9 minutes. In winter the day is longer in the south of Poland (8 hours 9 minutes on 22nd December) than at the northern end of Poland, where it lasts 7 hours and 5 minutes at that time. It influences the variations of average temperatures, the functioning of biosphere and causes various consequences for economy, particularly in agriculture.

An outcome of the latitudinal extent is a difference in solar time of up to 40 minutes between the extreme western and eastern points of the country. Poland's official time is the Central European Time (CET – UTC + 1:00). It is the solar time of the meridian 15°E. In the summer, the Eastern European Time (UTC + 2:00) is observed in Poland – calculated on the basis of the meridian 30°E.

The geometrical centre of Poland was determined to be located in Piątek, a village in the Łęczyca County, about 30 km to the north of Łódź. Its coordinates are: φ = 52°04'09''N, λ = 19°28'50''E. Poland also includes the conventional geometrical centre of Europe, which proves the central location of this country in Europe. Most often, it is assumed that this point is located in Suchowola

near Białystok. It must be noted, however, that depending on the criteria used, the point could also be found in one of the neighbouring countries.

1.2. The leading features of the natural environment of Poland

Features of the natural environment often include the fact that Poland is located transitionally and on important natural boundaries. As for its relative location, the characteristic feature is Poland's location in the transition zone between compact and vast area of Eastern Europe and the heavily dissected Western Europe. It is also a transitional location between the Carpathian and Sudetes arch and the Baltic Sea, dominated by lowland areas of the Central European Plain (92% of the area of Poland lies below 300 m above sea level isohypse). As regards geological structure, Poland is considered as the boundary zone between the three main European structural units (provinces): the Precambrian East European Platform, Palaeozoic platforms and orogens of the Western Europe as well as Mesozoic-Cenozoic orogenic belts of the Alpine system. From the hydrological point of view, the location of Poland is quite explicitly assigned to the Baltic Sea catchment area, which covers 99.7% of the area of the country (Figure 1.2). The climatic location is also characteristic: in the warm temperate zone, in the transitional area between the maritime and continental climates. As far as biosphere is concerned, a number of boundary zones of the occurrence of many species of plants and animals are observed here.

A more detailed presentation of individual aspects of location sheds more light on the diversity of this transitionality.

Land relief in Poland is characterised by significant variety, despite an averagely low elevation above sea level. High mountains of Alpine type, medium-height and low mountains, uplands of different to the great abundance of landscapes. As regards the area, the

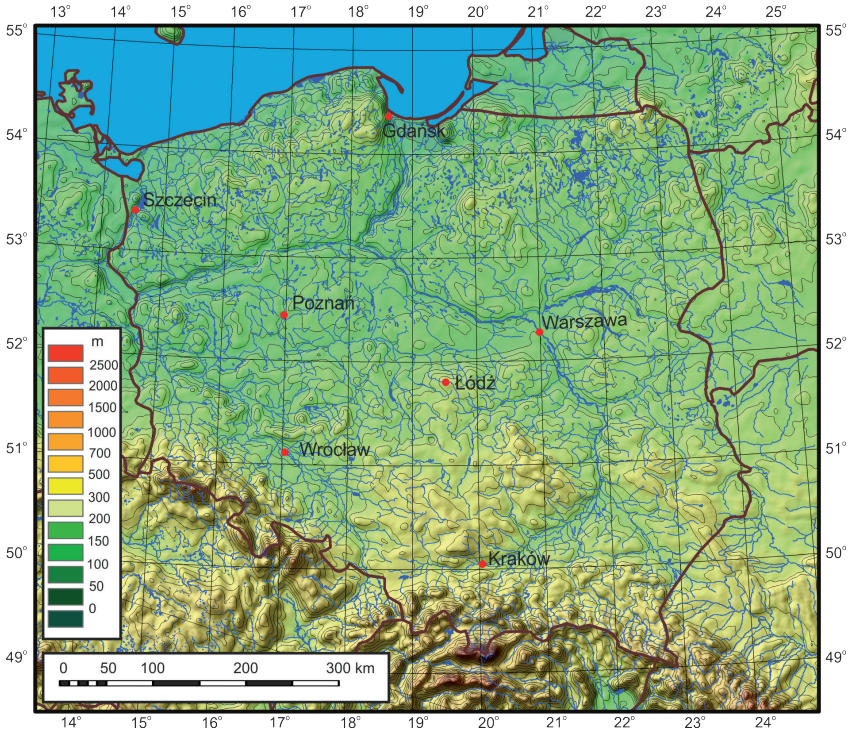

Figure 1.2. Relief of Poland

Source: own elaboration based on Digital Elevation Model SRTM-3

prevailing type are lowlands, that is areas of up to 300 m above sea level. They cover nearly 92% of the area of the country. The rest – about 8% – is covered by uplands and mountains. A superficial analysis might suggest monotonous relief, but the real richness of landscape is determined by differences in relative elevation, which often are considerable even in small areas. The largest denivelation in the country exceeds 2500 m. The highest point is Rysy (2499 m), located in the Tatra Mountains, the lowest – a depression in Raczki Elbląskie in Żuławy (1.8 m below sea level). The average height above sea level is 173 m. It is lower than the average for Europe by

about 120 m. The majority of the area of Poland is inclined towards the north and the north-west (Galon ed. 1972, Klimaszewski ed. 1972, Starkel et al. 2008).

Main relief forms are aligned in latitudinal belts. From the south one can distinguish as follows: the Carpathians – young mountains of the Alpine system, sub-Carpathian basins, old orogens and uplands, the older moraine landscape, the younger moraine landscape and coastal lowlands of the Baltic Sea. Land relief is often assigned the role of a key factor deciding about geodiversity. For this reason, in many physico-geographical classifications, elements of relief are considered as the main delimitation indicator of spatial units of different classes. Interesting examples of a contemporary account of geodiversity were presented by Z. Zwoliński (i.a. 2008).

Poland lies in the warm temperate climate zone in the area where oceanic features interweave with continental ones. The main characteristic feature of the Polish climate is the climatic transitionality. It is confirmed by: frequent exchanges of air masses (especially maritime-polar and continental-polar ones), high variability of weather types during the year, changeable sequence of weather types in successive years, increasing annual temperature amplitude from the west to the east, as well as increasing share of thermal convection precipitation towards the east.

From the hydrological point of view, the area of Poland occupies a characteristic position between the Main European Watershed and the Baltic Sea. The drainage divide runs along the southern border of the country, which is why as much as 99.7% of the area of Poland belongs to the catchment area of the Baltic Sea. Only 0.2% belongs to the catchment area of the North Sea and 0.1% to the catchment area of the Black Sea. The hydrographical network is characterised by considerable extensiveness of main river basins, a relatively high density of the drainage system and low elevation of drainage divides. The river basins are usually asymmetrical**.** This is due to the general inclination of the Polish Lowland towards the north-west and the configuration of postglacial forms (e.g. bottoms of spillway valleys are usually inclined westwards). This asymmetry,

particularly in the case of big rivers, is expressed in the right-bank parts of river basins being approximately 2.5 times larger than the left-bank sides (for the Odra basin the ratio is 70:30, for the Vistula River – 73:27). The predominant direction of river flow – from the south-east to the north-west, is compatible with the general inclination of land surface. The present layout of main river valleys in the area of mountains and uplands of Southern Poland originated in the Palaeogene and Neogene, and in the area of the Polish Lowland – in the Quaternary, with increasingly younger valleys found further northwards. Local variations from the general direction of river valleys depend on postglacial landforms – latitudinal sections utilise spillways, whereas longitudinal ones (narrower, gorge-like) run in tunnel valleys and intramorraine depressions. Most valleys, especially in the Lowland, are disproportionately large in relation to the rivers they host. This results from their complex genesis, in which the key role was played by glacial processes and the impact of periglacial climate. Spatially, various geometrical configurations of the drainage system occur: radial (examples include rivers of the Kielce-Sandomierz Upland and Łódź region), concentric (rivers of the Mazovian Lowland), dendritic (Biebrza), rectangular (rivers of the Eastern Beskids and part of the Świętokrzyskie Mountains) and parallel (rivers of the Coastal Lowlands, Sudetes, West Carpathians).

Soil cover of Poland is dominated by soils dependent in their development mainly on the geological structure, relief, hydrographical conditions and – to a large extent – on the agricultural activity of human beings. Structurally, zonal soils prevail with brown soils and lessive soils, which constitute more than a half of the territory (52%), and podzolic soils (26%). Hydrogenic soils also make up a considerable share (muck and peat soils) – about 8%, as well as fen soils (5%).

The location of Poland between natural boundaries in the north and south and artificial ones in the west and east opens the area up for latitudinal migration of plants. An additional facilitation are the east to west sections of spillways and major river valleys. As a re-

sult the flora in Poland includes 60% of species common for the neighbouring countries, and 40% of species have their geographic range limits in this area. Most often it is the northern limit (for 17% of species). It is only in part of the mountains that the flora is more unique, which is related to higher geomorphologic and geological diversity. Species which occur only in Poland constitute about 0.5%, which allows for the endemism of Poland to be classified as very low (Olaczek 2008).

From the zoogeographical point of view, the territory of Poland belongs to the European region (Palaearctic ecozone, Arctogea region), which lies in the biome of deciduous forests. Several tens of thousands of species live here, of which the most well-known group of vertebrates includes 600 species. Among them, native species of fauna constitute slightly over 1%.

The natural environment of Poland is an important element of the natural heritage of Europe. In Central Europe, when the degree of anthropopressure is analysed, a tendency to decrease is observed from west to east. This regularity is also clear when we only take the area of Poland into account. The occurring changes result mainly from the effects of settlement and human activity. It is more noticeable in the lowlands than the mountain and upland areas.

Among forests of the Polish Lowlands, one can point to forests that are nearly primal, with the most spectacular examples found in Eastern Poland, e.g. within the Białowieża Forest. The share of these nearly primal forests is also observed in Pomerania and Greater Poland, but it is more rare and occurs in smaller fragments. A similar spatial regularity concerns rivers and their valleys. Most features of naturalness occur in the rivers of Northern and Eastern Poland, except for bigger cities. The valleys of Biebrza, Narew, Bug, San, Pilica, and rivers in the Coastal Lowlands include concentrations of exceptional natural value. Fortunately, these assets are being noticed, which is proved by the establishment of 4 national parks, whose priority is to protect the valley systems: the Warta River Mouth National Park, Drawa National Park, Narew National Park and Biebrza

National Park. In the Odra basin, the length of sections with limited freedom of natural ecohydrological processes is increasing. On the other hand, in countries to the west of Poland, rivers which flow in natural channels are rare, except for some mountain and upland areas. In the mountains and uplands of Southern Poland, ecosystems display more features of naturalness. It is, however, similar to the other parts of Europe. Thus, the role of conservation of lowland areas in Poland, especially in comparison with lowland areas of Western Europe, is very important.

1.3. Regional natural diversity of Poland – regional divisions

More than 100 years of interest in the issue of regionalisation in the Polish geographic literature has mostly been focused on using the method of leading factor in various concepts of unit division. Frequently, it is not only one factor, e.g. relief, sometimes it is relief accompanied with geological structure. Climate and vegetation are usually considered as auxiliary factors. Sometimes, it is stressed that regions are often defined on the basis of easily noticeable elements of nature (Ostaszewska 2002, Richling 2005).

Regional diversity of the natural environment in Poland, was first accounted for in the regional divisions of the beginning of the 20th century, and more advanced proposals appeared between the First and Second World Wars. One of them was the division by S. Lencewicz of 1937. The author died in the war, but just after the war this idea was developed by J. Kondracki, who gradually introduced more and more new elements. For example, in 1965 he presented a new concept of division (physico-geographical regionalisation), based on the decimal system. This division was later systematically improved, until the posthumous edition (Kondracki 2001, Figure 1.3).

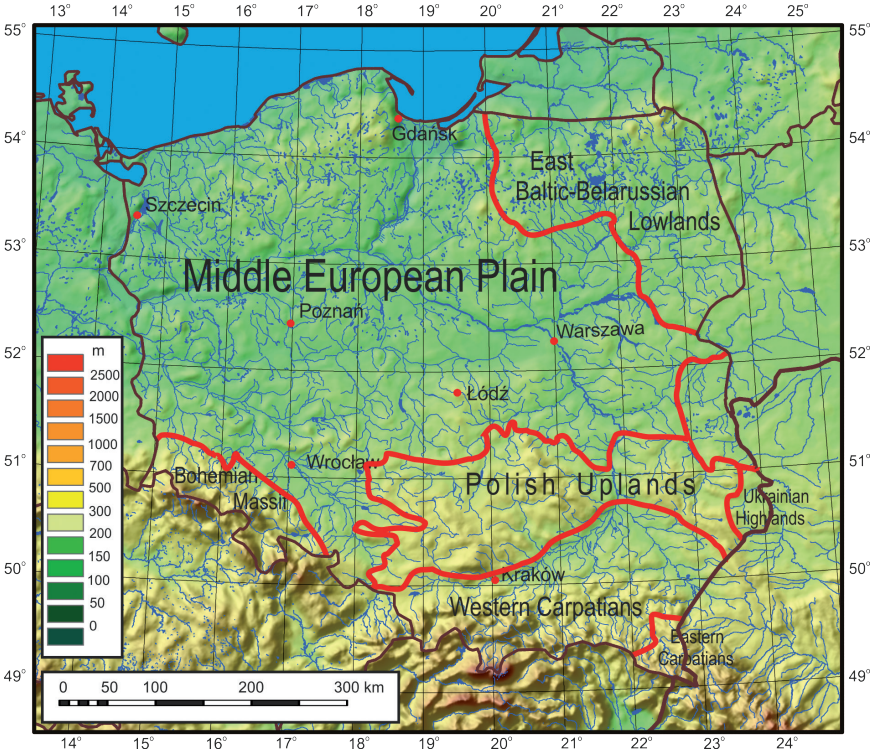

Figure 1.3. Division of Poland into main units (natural provinces)

31 – Middle European Plain (Niż Środkowoeuropejski), 33 – Bohemian Massif (Masyw Czeski), 34 – Polish Uplands (Wyżyny Polskie), 51 – Western Carpathians (Karpaty Zachodnie), 52 – Eastern Carpathians (Karpaty Wschodnie), 84 – East Baltic-Belarussian Lowlands (Niziny Wschodniobałtycko-Białoruskie), 85 – Ukrainian Highlands (Wyżyny Ukraińskie)

Source: J. Kondracki (2001)

In the period after World War II, divisions of selected regions originated, related to advances of detailed research on these areas. Among the most interesting concepts is the study of delimitating

the Łódź region ("kraina podłódzka") by J. Dylik (1948). The author assumed morphographic analysis as the basis for regional division. The point of departure was a morphometric analysis performed on the basis of a 1:25 000 topographical map in basic fields of 4 km^2, where slope inclinations and relative heights were measured. The division was supplemented with field measurements. As an effect, 45 secondary subregions were delimited, belonging to 6 morphographic types (Figure 1.4). They are: hills, hillocks, low hillocks, plains, valleys and basins and dunes.

An interesting regionalisation concept for the entire territory of Poland was presented in 1973 by A. Dylikowa in an 816-page handbook *Geografia Polski. Krainy geograficzne*. It must be stressed that the work is valued until today by geographers and other naturalists, because it is a great example of presenting an integral image of Poland, while accounting for differences between individual regions (lands). Besides huge illuminating value, the handbook also includes varied examples of emphasised links between human and the surrounding environments, taken from different parts of Poland. The geographical lands were distinguished on the basis of a number of specific natural features. Among other things, a vast area around Łódź, called "Wyżyna Łódzka" (the Łódź Upland), was distinguished. The author stressed that this land combines a variety of natural environment features, characteristic of both uplands and lowlands. The idea of including this land among uplands is being abandoned, although there are a few advocates of such a viewpoint (Turkowska 2006, et al.).

Wyżyna Łódzka distinguished by A. Dylikowa (1973) showed a number of unique features. It was an example of an area where the watershed zone did not divide but rather joined the adjacent areas. The role of the watershed zone changed with time. As long as it was a highly afforested area (the so-called Łódź Forest) on the borderline between Greater Poland and Mazovia, it did not have such a role. However, after a thriving industrial centre had been formed there and the aglomeration developed, this central area began to function as a centre of economic life, and with time also scientific and cultural activities.

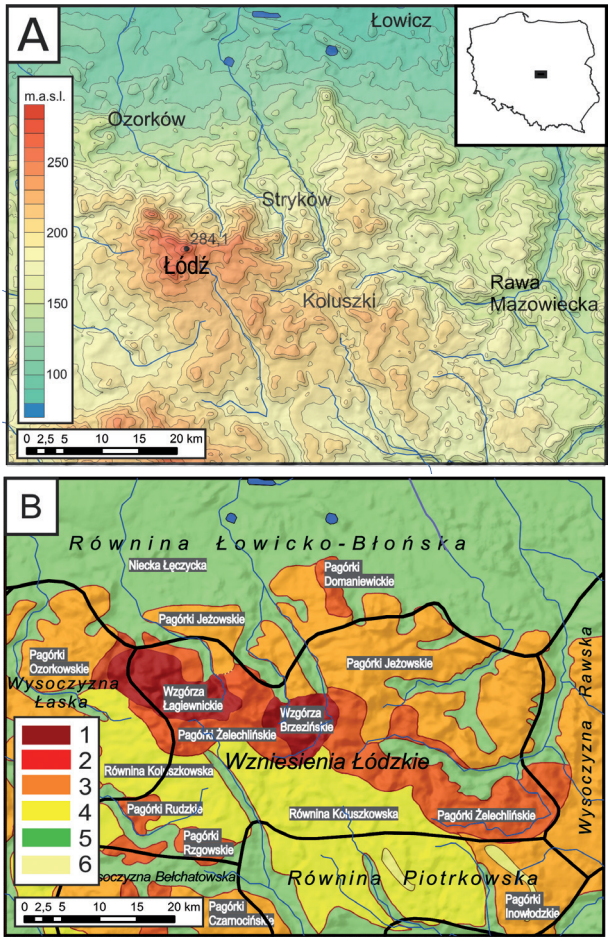

Figure 1.4. A. Relief of the vicinity of Łódź. B. An example of comparison between two regionalisations of the vicinity of Łódź: division according to a morphographic criterion (Dylik 1948) and division according to physico-geographical criteria (Kondracki 2001) Regions by J. Dylik (1948): 1 – hills, 2 – hillocks, 3 – low hillocks, 4 – plains, 5 – valleys and basins, 6 – dunes; black line – boundaries of mesoregions by J. Kondracki (2001)

Source: elaboration based on J. Dylik (1948), J. Kondracki (2001)

Despite the advantages of the natural division introduced by A. Dylikowa (1973, 1974), the aforementioned decimal division by J. Kondracki (1965, 2001), developed for many years, gained considerable popularity. This division (physico-geographical regionalisation) refers to divisions used in the neighbouring countries. In Poland, two natural areas were identified (out of 4 identified in Europe), belonging to Western and Eastern Europe. In Western Europe 5 provinces were delimited: the Middle European Plain, the Bohemian Massif, the Polish Uplands, the Western Carpathians and the Eastern Carpathians, whereas in Eastern Europe there are 2 provinces: East Baltic-Belarussian Lowlands and Ukrainian Uplands (Figure 1.3). The provinces were divided into 17 subprovinces, 56 macroregions and 318 mesoregions. Further division into microregions was developed only for a few selected mesoregions.

An interesting division of Poland into natural and landscape regions was presented by R. Olaczek (2008, Figure 1.5). It is a division

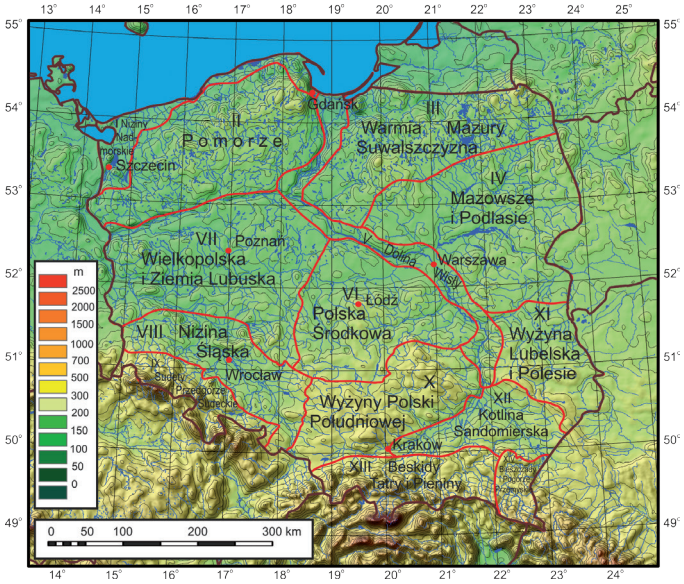

Figure 1.5. Division of Poland into natural and landscape regions

Source: R. Olaczek (2008)

into 14 regions, identified on the basis of landscape similarity and the state of preservation and conservation of nature. Within regions, R. Olaczek distinguishes smaller units, using J. Kondracki's division.

1.4. A review of natural and landscape units in Poland with special attention paid to Polska Środkowa (Central Poland)

The characteristics of regions presented below takes into consideration the division according to R. Olaczek (2008), based on landscape diversity. Only small corrections were introduced in this study in comparison to the original division. For example the name Wybrzeże Bałtyku (Baltic Coast) was changed to Niziny Nadmorskie (Coastal Lowlands), because it is an area which significantly exceeds the commonly assumed range of the coast. Individual regions were described synthetically due to restricted space, leaving Central Poland as an example of more precise characteristics.

1.4.1. Niziny Nadmorskie (Coastal Lowlands)

This region is a belt of land adjacent to the Baltic Sea, ranging from approximately 1 km of width in Gdynia to about 100 km in the valley depressions of the Odra and Vistula rivers and to the East of the Vistula Lagoon. These extensions result from features of the geological basis (Mesozoic bedrock) and the dynamics of the latest ice-sheet. The ice-sheet there reached deepest southwards in the form of the Vistula and Odra lobes. The landscape is dominated by ground moraine plateaus, often separated into smaller or bigger moraine uplands (in Polish: "kępy") by the so-called Pomeranian spillways and river valleys. Here and there these surfaces are diversified by rows of hills, hillocks and end moraine ridges. Absolute elevation usually do not exceed 100 m above sea level. The southern boundary of the region in many sections is poorly visible, and the area smoothly

transforms into the area of Pomerania Lakeland. The northern edge is very clear – it is formed by the Baltic coast with specific landscape features.

The most typical landscapes include: glacial types (flat and rolling), eolian types (hummocky and hilly), delta accumulative, marshy plains etc. The climate of this area is clearly influenced by the sea, characterised by cooler summers than in the neighbouring lakelands and milder temperatures in winters. There is a significant percentage of Atlantic species in plant communities.

1.4.2. Pomorze (Pomerania)

This area is characterised by belts of postglacial landscapes – the most visible ones in the entire Polish Lowland. The most important factor in the formation of main relief features was the relatively long-term stabilisation of ice-sheet front on the Baltic Ridge in the Pomeranian Phase of the Last Glaciation (Weichselian or Vistulian), and the subsequent uneven retreat. In the highest parts of Pomerania, there are numerous hillocks, ridges and moraine hills, reaching 150 m of relative height. Groups of marginal ice-sheet landforms run across the entire lakeland area, aligned into characteristic festoons, which reflects the extent of glacial lobes. They form a belt of unusually lively relief, in its most developed form between Kościerzyna and Kartuzy in the Kaszuby Lakeland (the so-called Kashubian Switzerland). Behind end moraines, there are varied landscapes of moraine plateaus: hilly, rolling, and less frequently – flat. Large areas are filled with ground moraines, locally covered by ice-dammed lake sediments. In the entire area, characteristic tunnel (subglacial) valleys with lakes and numerous kettle holes, containing small lakes are observed. In the southern part of the region, there are vast sandy outwash plains, slightly descending towards the Toruń-Eberswalde Spillway.

On moraine plateaus, the dominating soils are brown earth soils, and the potential vegetation includes deciduous forests with a lot of beech. On outwash sediments, mostly in the northern part

of the region, and on surfaces of valley terraces developed mainly podzols, with mixed coniferous forests, characterised by the dominance of pine. Many peat lands occur here, mostly around lakes.

1.4.3. Warmia, Mazury, Suwalszczyzna (Warmia, Masuria, Suwałki Region)

This region is a natural and landscape unit located to the east of the Vistula valley, in the lakeland belt, between the maximum extent of the Last Glaciation and the northern border of the country. Nearly all this lakeland area is a unique concentration of glacial landforms of various origins: end moraines, drumlins, kames, eskers, outwash plains, marginal valleys, tunnel vallleys and others. It is the part of the country with the highest number of lakes (more than 4 thousand ones with area of more than 1 ha), and where the lakes are largest and longest. This area quite smoothly transforms into the plains of northern Mazovia. The range of this land coincides with the maximum extent of the latest ice-sheet (Weichselian Glaciation) and the area of occurrence of glacial lakes.

The Great Masurian Lakes Region is particularly interesting. Morphologically diverse ground moraines occur here, numerous end moraines, kames and outwash plains. The lacustrinity index here is 20%, the highest in the country (the average for Poland is about 1%). The largest lakes in Poland are located here: Śniardwy (114 km^2) and Mamry (104 km^2). Another extraordinary region is the Suwałki Lakeland, which according to J. Kondracki (2001) is the western part of the Lithuanian Lakeland. This area is characterised by exceptional diversity of landscape. In the area of Wiżajny Ridge, Szeszupa Depression and near Lake Hańcza (the deepest lake in Poland – 108.5 m) elevation differences reach 140 m.

The climate of this region shows a clear increase of continentalism from west to east. It is reflected, among other things, in the species composition of plant communities. Geographic range limits of several dozens of plant species run across the region – most of them between Olsztyn and the Great Masurian Lakes. The presence

of beech forests in the western part with lack of spruce and in the eastern part – spruce outnumbering beech, and virtual disappearance of beech to the east of Olsztyn is a characteristic feature. High afforestation rate and the generally good condition of forests are a valuable property of the region.

1.4.4. Mazowsze and Podlasie (Mazovia and Podlachia)

Mazovia and Podlachia constitute an extensive region in the eastern part of the older moraine landscape belt. The general basin-type relief is a reflection of the geological structure, because formations of the bedrock are also arranged in the form of a basin. The fact of alternating configuration of subsequent permeable and non-permeable layers is the reason for the occurrence of artesian waters – mainly in the western part.

The main landforms in the area are the amphitheatrically-arranged moraine plateaus, outwash plains and ice-dammed lake plains. Most of them occur within the range of the Warta ice-sheet, but the outwash plains of northern Mazovia are created by meltwater of the Warta ice-sheet. Characteristic accents of moraine plateau relief are the relatively rare kames and eskers, built of sands and gravels. Moraine plateaus cut up river valleys which consequently head towards the Warsaw Basin. The Warsaw Basin and the major river valleys are areas of considerable accumulations of eolian dunes. Their characteristic feature are clusters of parabolic dunes connected by their arms.

Brown earths and podzolic soils prevail in Mazovia and Podlachia. Areas of more fertile soils have been intensively deforested and developed by settlement and agriculture for a long time. There are many examples of natural and landscape contrasts here. For example, in the Warsaw Basin a 2-million aglomeration and the Kampinos National Park with the biggest number of nature reserves in Poland are adjacent to one another. However, the most precious natural features of the area are considered to be the Białowieża Forest and marshes of the Biebrza valley.

1.4.5. Dolina Wisły (the Vistula valley)

The Vistula valley is a large depression in the lakeland and middle-Poland lowlands belt (Central Polish Lowlands), which stretches from the characteristic narrowing in the belt of Southern Poland Uplands to the delta of the Vistula River. The valley developed in stages, and its present form was affected by all advances of the Scandinavian ice-sheets. It is notable how the valley of lower Vistula is developed, 50–80-metre deep, aligned with older depressions. Irregular process of erosion shaped a valley channel with variable outline and differentiated degree of terrace preservation (as many as 9 terraces have been distinguished here). A characteristic feature of the horizontal outline of the lower Vistula valley is the alternating occurrence of broadenings, called basins and narrowings (gates) – sections that are almost like gorges. The largest broadening is the Grudziądz Basin extending up to 15–18 km, and the clearest narrowing – a nearly 3-kilometre gorge near Bydgoszcz (the Fordon gorge of the Vistula River).

It must be noted that the Vistula is one of the least economically utilised large rivers in Europe. Although it doubtlessly undergoes anthropopressure, it flows almost entirely in its natural channel within a nearly unchanged valley bottom. Numerous ecosystems are concentrated here, which cannot function in the neighbouring moraine plateau areas. The primal riparian forests have disappeared, but meadows and fields still provide considerable productivity thanks to fertile fen soils. Valuable ecological roles are still fulfilled, which includes a nesting zone for 150 species of birds.

1.4.6. Polska Środkowa (Central Poland)

Polska Środkowa (Central Poland, Middle Poland) encompasses not only an extensive portion of the Central Polish Lowlands, but also the transitory belt toward uplands and the less diverse fragment of

lakelands in the north. Here, natural boundaries meet as well as the boundaries of old, great historic provinces: Greater Poland, Mazovia and Lesser Poland. As a natural and landscape region, Central Poland is an area which, apart from the Łódź Region – usually equated with the Łódź Voivodship, also includes the surrounding areas: eastern part of Greater Poland, part of Kujawy, Mazovia and even Lesser Poland. Central Poland understood in this way is a more extensive area in comparison with the approach suggested by M. Koter et al. (2000) also accepted in the regional literature. This area is characterised by a concentration of transitory features between the regions of Greater Poland and Mazovia, and between lowlands and uplands at the same time. This is the reason why not only different naming conventions are used for this area (the Łódź Upland, the Łódź Region, Central Poland, the Middle Poland, kraina podłódzka, Łódź moraine plateaus), but also why the boundaries of lands and secondary regions are outlined differently. This area is a very interesting case of methodologically difficult regional delimitation (Dylik 1948, Dylikowa 1973, Klatkowa 1972, Liszewski ed. 2001, Turkowska 2006, Kobojek et al. 2007, Wójcik ed. 2013).

This area has a clear elevation in its central part, alluding to the Southern Poland Uplands – a sort of their peninsula, although heights reach the traditional minimum value for uplands – 300 m above sea level only in the southern part of this area (and 284 m above sea level to the north-east of Łódź: Figure 1.4). However, they are the highest spots in the southern part of the Polish Lowlands.

The prevailing glacial relief, more precisely – the older moraine landscape, was in its larger part shaped by ice-sheet in the Warta Glaciation (Klatkowa 1972, Krzemiński 1974, Krzemiński and Papińska 1993, Czubla 2001, Mojski 2005, Turkowska 2006, Rdzany 2009, et al.), in a narrow zone in the south it is related to the Odra Glaciation (both advances in MIS 6). Only in a small northern fragment of the region, it is younger moraine landscape, originated during the Last Glaciation (Roman 2010). Flat, rolling and hillocky plateaus occur here. The maximum extent line of the Warta Glaciation

is not too clear in the relief. Detailed geological and geomorphological research reveal that this line runs near Piotrków Trybunalski, Tomaszów Mazowiecki and Nowe Miasto nad Pilicą, but its detailed course is still the subject of research and debate (Klatkowa 1972, Turkowska 2006, Rdzany 2009, et al.). A characteristic feature of glacial relief in this area is the exceptionally large number of kames – e.g. in the Łódź Heights there are several hundred of them. There are hills, ridges, terraces and kame plateaus. There are also eskers, outwash plains and – less numerous – end moraines (Krzemiński 1974, Klajnert 1978, Rdzany 1997, 2006, 2009, Jaksa and Rdzany 2002, Jaksa 2006, Goździk and Wieczorkowska 2002). Landscape of the region is diversified by river valleys, best developed in its border areas, known because of detailed research (Krzemiński 1965, Kamiński 1993, Forysiak 2005, Turkowska 1975, 2006, Wachecka-Kotkowska 2004, Kobojek 2009). In valleys and basin-type depressions, dunes from late Vistulian are concentrated, mostly parabolic (Manikowska 1985). Extensive areas of moraine plateaus in the region are covered with eolian sands (Goździk 2000).

Near-surface sediments of glaciogenic formations are characterised by numerous traces of periglacial processes from the Vistulian (Dylik 1953, Goździk 1973, Turkowska 1975, Petera-Zganiacz 2008). According to more recent views, periglacial processes did not introduce significant destruction into the glacial relief, but rather caused its clear correction (Krzemiński 1974, Rdzany 1997). Notable are also traces of anthropopressure in the Holocene, although they reveal varied local intensity (Papińska 2001, Twardy 2008, Kobojek 2009).

Important botanical boundaries cross the area, mainly range limits for beech, fir and spruce, i.e. the forest-forming species of trees. The significant share of fresh suboceanic fresh coniferous forest is notable among forest communities. Deciduous forests are dominated by subcontinental broadleaved forests. Central Poland is characterised by considerable deforestation, especially in its north-

ern part. Long-term settlement and agricultural activity have also contributed to the transformation of flora and hydrographical conditions. Intensive development of industry in the central part of this region – in the group of the so-called factory cities (Łódź, Pabianice, Zgierz among others) – in the 19th and 20th centuries, also had an important impact on the condition of natural environment. The last several decades saw tremendous changes to natural environment in the area of Bełchatów and Konin, related to the operation of brown coal mining industry.

Despite strong anthropopressure, Central Poland is a region which contains many naturally valuable areas. There are as many as 140 reserves, 9 landscape parks, about a thousand natural monuments and 11 bird sanctuaries including 3 of European class (Olaczek 2008).

1.4.7. Wielkopolska i Ziemia Lubiska (Greater Poland and Lubush Land)

In the northern part of the region, the landscape is strongly marked with the Toruń-Eberswalde Spillway (Pradolina Toruńsko-Eberswaldzka) – the largest marginal valley in the European Plain. This channel has characteristic basin-like widenings (up to 35 km in the Gorzów Basin), separated with narrower sections (from 2 km near Nakło). To the south of the spillway, there is the area of Lakelands: Greater Poland, Lubush and Leszno, formed during the latest glaciation. It is notable for lower lacustrinity and less diverse landscapes that the Pomerania area.

The South Greater Poland Lowland extends between the borderline of the last glaciation (Vistula) and Silesian Rampart. It covers the area of Fore-Sudetic Monocline and the Mogilno-Łódź Syncline. These structures contain important mineral deposits, including crude oil, natural gas and salts. In the Neogenic sediments which lie on top of older structures, brown coal occurs and the so-called Poznań silts. Landscape of the northern part is dominated

by rolling and flat moraine plateaus of the Warta glaciation, highlighted in some places with kame hills and outwash plains from the Vistula glaciation. The plateaus are cut up with large river valleys of the Warta and Prosna rivers. Behind Silesian Rampart (Trzebnica Ridge), there is an elongated Milicz-Głogów Depression, built of elements of various origin, including marginal depressions in the Warta ice-sheet and a section of the Odra valley. During the Leszno stage of Vistula glaciation, they were transformed by meltwater and river water which flowed westward to the North Sea into the Głogów-Baruth Spillway.

The climate here is relatively mild, with modest rainfall, especially in the eastern part of the region. Apart from Lubusz Land, the area is quite poorly afforested and considerably transformed as a result of human activity. Natural deciduous forests of this area, represented mainly by Central European broadleaved forest, were preserved in a fairly small quantity.

1.4.8. Nizina Śląska (Silesian Lowlands)

This region mostly coincides with the extent of the Silesian Lowlands and Silesian-Lusatian Lowlands according to J. Kondracki (2001). It is limited with the Sudetes Foreland, Silesian Rampart and the Silesian Uplands. Moraine plateaus with kames and eskers occur here with vast outwash plains and broad fluvial terrace levels of the Odra basin valleys. The area reaches between 90 and 200 m above sea level. The entire lowland was formed by the Odra ice-sheet. In the southern part, the glaciogenic sediments are covered with loess, which developed fertile brown earths and chernozems. The climate of the lowlands is characterised by quite short winters, early spring, and quite dry and warm summer. The vegetation season is the longest in Poland (over 220 days), which is favourable for agriculture. The climate is influenced by the so-called foehn effect, resulting from the presence of a mountain barrier of the Sudetes in the south.

1.4.9. Sudety and Przedgórze Sudeckie (Sudetes and Sudetes Foreland)

Sudetes are the highest northern part of the Bohemian Massif. They are also very diverse as regards geological structure and relief. In Poland they are traditionally included in the belt of old orogens and uplands. Structures of the Sudetes show traces of the Variscan orogeny and rejuvenation as a result of the Alpine movements. They are medium-height fault-block mountains. In the north-east, it borders on the Sudetes Foreland, separated with the so-called Marginal Sudetic Fault.

Internal structure of the Sudetes massifs is very complex, and the differences in age and kinds of rocks are exceptionally abundant. Some parts of the mountains contain old (Palaeozoic) fold structures, e.g. Góry Bardzkie, Bialskie, Orlickie, Złote. Others are examples of crystalline massifs: Karkonosze, Góry Sowie, Śnieżnik. Góry Kaczawskie and Wałbrzyskie have the form of inselbergs, whereas the Table Mountains are an example of plated structure, unique in Poland.

The Sudetes stretch in the form of two parallel ranges, separated by vast intramontane basins. Massifs are characterised by fairly smooth relief. Most ridges are levelled, with some inselbergs. More prominent peaks are of monadnock type. Slopes and planation surfaces surrounding the hills are usually covered with thick layers of rubble. They are mostly an outcome of frost action, polar solifluction (gelifluction) and other sloping processes. The largest concave forms in the Sudetes are the intramontane basins. They have tectonic origins but are considerably transformed by sloping, fluvial and even glaciation processes. Bottoms are lined with postglacial and fluvial sediments as well as loesses. Configuration of postglacial sediments proves that tongues of the Scandinavian ice-sheet reached quite deep inside the basins.

As regards landscape, the Sudetes are a system of medium-height and partially low mountains, foreland, uplands built

mainly of siliceous rocks, basins and other depressions. The climate is relatively cool and moist. Climate and vegetation zones are quite clearly defined but lower than zones in the Western Carpathians by an average of 200 m.

In the north-east, the Sudetes border on the Sudetes Foreland, separated by a marginal fault. Over their plains and undulating hill-tops, there are steep monadnock-type mountains with the Ślęża massif, with a relative height of more than 500 m (719 m above sea level).

1.4.10. Wyżyny Polski Południowej (Southern Poland Uplands)

This region shows high diversity of land relief style, geological structure and age of landforms. It includes low mountains with the structure of Variscan orogen, surrounded with upland areas with very diverse geological structure and landscape.

Silesian Upland, located in the western part, is built of Carbon structures of the Upper Silesian Foredeep, containing hard coal. This structure is to a large extent covered with younger forms, aligned into an extensive convex structure. In the central and northern part, it has clear features of structural relief. More resistant rocks, from the Triassic and Jurassic, emerge from under the cover of loose sediments, forming NW-SE cuestas. Landscape of the southern part of the Silesian Upland is slightly different, with fault-block relief, and the surface of the upland descends in steps to the south. Almost every larger fragment of the Silesian Upland is an example of human interference with the environment. There are many mining excavations, tectonic depressions formed as a result of crumps and settlement, burrows, cuts and embankments.

Cracow-Wieluń Upland is characterised by a notable structural threshold, stretching from Cracow through Częstochowa to Wieluń.

This largest cuesta in Poland is created by rocks of the Upper Jurassic in the form of plate and grey limestone. The hilltop surface of the upland reaches 400–460 m above sea level. It is the remnant of the Paleogenic planation surface. Numerous limestone rocks, in the form of karst monadnocks, overlook the area. The highest of them is located in Ogrodzieniec (Góra Zamkowa, 504 m above sea level). There are also many concave formations, particularly tectonic depressions and karst valleys. Curiosities include river valleys of ravine or canyon type (the Prądnik Ravine). They have unlevel gradients, narrow bottoms and often asymmetrical slopes. They are highlighted with rocks of various shapes: gates, towers, spires and rock columns. Numerous karst caves occur here.

Lying further to the east, Nida Trough is a broad depression in the upland belt, with smooth morphology, varied by the presence of structural thresholds and river valleys. The relief corresponds to the geological structure – a unit called Miechów Synclinorium. The basin is formed of Cretaceous rocks, covered with Miocene formations in the south. The northern part is dominated by plains and slightly rolling areas, developed on the base of Cretaceous marls, coated with a thin Quaternary cover. They are restricted by two structural thresholds of up to 35 m in height, built of sandstones, spongiolites and Cretaceous marls. Larger concave formations in the area include the Pilica and Nida valleys. Many forms of gypsum karst occur in this area.

Kielce Upland encompasses the Paleozoic orogen of the Świętokrzyskie Mountains and their upland rim, built of Mesozoic and younger formations. The Świętokrzyskie Mountains are an example of mountains with ranges of monadnock type, with examples of inverted relief. The surrounding uplands are mostly characterised by structural relief. Part of them is covered with loess with a rich network of gullies (Sandomierz Upland).

The upland region described above is characterised by the highest biodiversity in the country (both natural and anthropogenic) and high geodiversity.

1.4.11. Wyżyna Lubelska, Roztocze and Polesie (Lublin Upland, Roztocze and Polesia)

The Lublin Upland stretches between the Vistula and Bug valleys. It is built of Upper-Cretaceous marls, limestones, spongiolites and gaizes, covered with discontinuous Neogenic and Quaternary formations. The surface is dominated with loess formations. Relief of the upland shows a dependence of relief forms on rock resistance. Around hills, there are elevated loess plains and basins. A characteristic feature are the structural thresholds related to faults. The highest, a 100-metre threshold forms the edge of Roztocze along the Zawichost-Horyniec line. Characteristic landscape accents of the Lublin Upland are the rims of loess covers with a dense network of gullies.

The landscape of Polesia is characterised by a definite predominance of plains. Although they are of different origin (ground moraine plains, outwash plains, fluvial and peat bog accumulation plains), they are not clearly separated. Peat bog plains are particularly characteristic, developed in karst depressions and valley bottoms. In the area of the Łęczno-Włodawa Lakeland, there are also formations of normal karst and reproduced karst as well as the so-called thermokarst lakes, originated as a result of selective degradation of long-term permafrost. More diverse landforms with glacial hillocks occur in the Włodawa Hump and on the boundary with the Lublin Upland.

1.4.12. Kotlina Sandomierska (Sandomierz Basin)

Between the verge of the Carpathians and the Southern Poland Uplands, within the range of Carpathian foredeep, stretches an elongated and quite flat foreland depression of the Sandomierz Basin. The basin is filled with nearly flat sediments of the Miocene sea, whose thickness reaches up to several hundred metres. Silts, sands, sandstones, limestones, gypsums and sulphur occur here. They are

covered by a relatively thin coat of Quaternary formations in the form of clays, sands and postglacial gravels, fluvial sands and gravels as well as dune sands.

As regards land relief, it is a lowland area, mostly flat and rolling. The main formations in the basins are plateaus. They reach from 240 to 320 m above sea level. They are separated by clearly cut river valleys. Plateaus, built mainly of Miocene silts with thin and discontinuous Quaternary cover are more compact in the south – from the side of the Carpathians. Some sections of river valleys developed along rift valleys, e.g. the Vistula valley between Oświęcim and Zator and in the Cracow Gate.

1.4.13. Beskidy, Tatry i Pieniny (Beskids, Tatra Mountains and Pieniny)

This region represents young Alpine orogens. It contains a 330-kilometre section of the Carpathian arch, constituting less than a tenth part of these mountains (about 20 thousand km^2). They include a small area of high mountains with Alpine relief, represented by the Tatra Mountains, a vast area of medium-height mountains in the form of Beskidy as well as uplands and low mountains – Carpathian Upland.

Tatra Mountains are the only mountain massif in Poland, which is an example of high mountains of Alpine type. The mountains are 52-km long and 18-km wide. Poland has only ¼ of them (about 180 km^2). In Poland, the highest peak is Rysy (2499 m). The main Tatra ridge runs latitudinally, about 1200–1300 m above the valley floor in Zakopane.

From the geological point of view, the Tatra Mountains are an asymmetrical horst, bounded by normal faults. The Tatra Mountains, built of rocks of different age: Palaeozoic, Mesozoic and Cenozoic ones, are the oldest tectonic unit of the Polish Carpathians. The geological structure of the Tatra Mountains consists of two main elements: the crystalline core and sediment cover. The crystalline

core is formed by metamorphic rocks, characteristic of the Western Tatras: gneisses, crystalline schists, amphibolites and others, and intrusive igneous rocks: granites, granodiorites and tonalities, which occur in the High Tatras. Metamorphic rocks are less resistant to destructive factors, which is why the main ridge of the Western Tatras is lower than that of the High Tatras by 300–400 m. Upon the crystalline core lies a sedimentary cover, which thickens northwards. It is created by rocks of marine origin, folded to the form of nappes, from the Mesozoic. They were deposited to the south of the crystalline core. In the Upper Cretaceous, during movements of the Mediterranean stage of the Alpine orogeny, the sediments were shifted over the core to the north. Later in the Paleogene, Neogene and Quaternary, in several stages the Tatra Mountains were intensely raised. Simultaneously, they were modelled by various processes: weathering, mass movements, fluvial erosion and karst processes. In the southern part, the destructive processes ripped the sedimentary cover completely and cut up the crystalline rocks. In the Quaternary, when the climate cooled down, intensive glacial processes also left their mark.

At the feet of the Tatra Mountains lies Podhale. It is a foredeep with a relatively mild relief, corresponding to the tectonic lines. In its southern part, the Tatra Foredeep is notable, cut by Neogene rivers in the schists of the Podhale flysch. In the Quaternary it was alternately filled with sediments of glacial meltwater and river water and cut up.

Pieniny are one of the most scenic mountain ranges of the Carpathians. They are an element of the so-called Pieniny Klippen Belt, a narrow zone of rocks, mainly limestone, which divides the entire Carpathian chain into the Inner and Outer Carpathians. Although they occupy a small area – just 30 km^2, they are a concentration of most diverse relief and other great natural attractions. Limestones of the Pieniny are punctured with Neogenic andesites in many places.

Beskids form a mountain range, 35–60-kilometre wide, along a straight line between the Pieniny Klippen Belt and the Carpatian Foothills. Beskids are dominated with medium-height mountain

relief, and locally – low mountains and plateaus. Rounded ridges prevail here, cut up with deep valleys with steep walls. Height differences between the tops and bottoms of valleys reach 800 m. Beskids are most elevated in the massif of Babia Góra (1725 m). Despite their considerable area and relief diversity, the mountains are built almost exclusively of one characteristic type of rocks – flysch. Flysch formations consist of alternately occurring sandstones, siltstones and silt schists in different proportions. In the Palaeogene and at the onset of the Neogene, these formations, still plastic at that time, were deformed to the form of nappes. From the north we can distinguish: the sub-Silesian Nappe, Silesian Nappe (overlapping the sub-Silesian one), Magura Nappe (the largest one), and in the east of the Carpathians – the Skole unit and the Dukla unit.

In the Beskids, apart from peaks and characteristically formed slopes, also occur, with a certain regularity, planation surfaces. The following levels are distinguished: the Beskids level, creating nappes at various heights, the intramontane level, occurring along the rim of the highest mountain ranges as the ridges of lower part of the Beskids, and the foothill level, in the higher parts of valley slopes and in the rims of basins. The reason for creating the planation surfaces (levels) was the periodicity of raising this area and the destructive processes in the Neogene.

Carpathians have mountain climate with clearly defined altitudinal zonation, closely related to vegetation zones. Annual precipitation sums range from 800 to 1600 mm. Areas of unusual natural value concentrate here. Many protected areas were established here, including 5 national parks and about 100 nature reserves.

1.4.14. Bieszczady i Przedgórze Przemyskie (Bieszczady Mountains and Przemyśl Foothills)

This unit is an extension of the Outer Western Carpathians. Similar to them, they are built of flysch, but they are characterised by a relatively significant neotectonic uplift, with traces of young, Neogenic

folding. The foothills threshold is much less clearly expressed in the landscape, so the mountains are in direct contact with the not very diverse areas of the Sandomierz Basin. Two basic landscape belts occur here: the outer, lower, called Wooded Beskids and the inner, higher – the Polonynian Beskids. However, they differ most from the Beskids in the Western Carpathians as regards their biogeographical features.

It is an area with a high afforestation rate, dominated by the Carpathian beech forest, mixed beech and fir forest and fertile fir forest. In the valleys, riparian forests with elm, ash and grey alder occur, and in the northern, edge part, a variety of continental broadleaved forest appears. A significant part of this region lies beyond the range of spruce and pine, and a number of species have their range limits here. For this reason, the geobotanical division defines a meeting point of three geobotanical provinces here. Consequences of the war, including low population rate, resulted in the fact that the natural environment of this region has not been intensively altered. It is protected here by means of the Bieszczady National Park and about 40 nature reserves.

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