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Drago Perko
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The Geography of Slovenia

Small But Diverse

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World Regional Geography Book Series

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ISSN 2363-9083 ISSN 2363-9091 (electronic)
World Regional Geography Book Series
ISBN 978-3-030-14065-6 ISBN 978-3-030-14066-3 (eBook)
https://doi.org/10.1007/978-3-030-14066-3

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Preface

Slovenia is barely visible as a dot on the globe, and it is among the youngest independent countries in the world, and so at the global level, the average person has never heard of it or knows very little about the country. The editors of the volume *The Geography of Slovenia* hope that this volume will contribute at least a little to raising Slovenia's profile. With the subtitle *Small but Diverse*, we wish to emphasize that, despite its small size, Slovenia is above average in its geographical richness.

The subject matter of this book is divided into 23 chapters. The introductory chapter presents Slovenia as a European landscape hotspot. The other 22 chapters are grouped into 5 parts according to content. The first part is devoted to physical geography. It consists of six chapters dealing with rocks, landforms, water, climate, soil, and flora and fauna. The second part is dedicated to human (cultural) geography. It also consists of six chapters, dealing with archaeology, history, people, settlements, the economy, and culture. The third part of the book has three chapters and is more regionally oriented. It describes the regions, landscapes, and maps of Slovenia. The fourth part of the book, consisting of five chapters, presents the human impact on the environment and vice versa. It mostly deals with natural hazards, land use, regional development, human-induced degradation, and protected areas. The first two parts are more analytical, and the third and fourth parts are more synthetic. The last part has two chapters. It places Slovenia in the world and in Europe in a comparative manner.

All the chapter authors are employed at the Research Center of the Slovenian Academy of Sciences and Arts (ZRC SAZU). ZRC SAZU consists of 18 research institutes throughout the country and has more than 300 employees, roughly 250 of whom are researchers. Most of the chapters were written by members of the Anton Melik Geographical Institute and one chapter each by members of the Jovan Hadži Institute of Biology, the Institute of Archaeology, and the Milko Kos Historical Institute.

The Geographical Institute was founded in 1946 by the Slovenian Academy of Sciences and Arts. In 1976, it was named after Slovenia's greatest geographer, academy member Anton Melik (1890–1966). Since 1981, the institute has been one of the members of ZRC SAZU. Since the very beginning, the institute's main task has been to conduct basic and applied geographical research on Slovenia and its landscapes and to prepare basic geographical texts on Slovenia as a country and as part of the world. The institute has nine organizational units: the Geographical Museum, the Geographical Library, the Department of Physical Geography, the Department of Human Geography, the Department of Regional Geography, the Department of Natural Hazards, the Department of Environmental Protection, the Department of Geographic Information Systems, and the Department of Thematic Cartography, which produced all the maps for this volume. These maps and the many figures will help readers understand the contents of all chapters of the book *The Geography of Slovenia*.

Ljubljana, Slovenia

Drago Perko
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Acknowledgments

The material in this book is partly based on the results of research programs and projects co-funded by the Slovenian Research Agency. The authors of the chapters acknowledge financial support from the Slovenian Research Agency: program no. P6-0101 (Geography of Slovenia) for Chaps. 1, 2, 3, 4, 5, 6, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22 and 23, program no. P1-0236 (Biodiversity: Patterns, Processes, Predictions, and Conservation) for Chap. 7, program no. P6-0064 (Archaeological Research) for Chap. 8, and program no. P6-0052 (Basic Research of Slovene Cultural Past) for Chap. 9.

In addition, the authors of Chaps. 14 and 15 acknowledge financial support from the Slovenian Research Agency and the Slovenian Academy of Sciences and Arts, project no. L6-6852 (Landscape Diversity and Hotspots of Slovenia) and project no. L6-3643 (Determining the Natural Landscape Types of Slovenia Using a Geographic Information System), and the authors of Chap. 19 acknowledge financial support from the Slovenian Research Agency, the Ministry of the Environment and Spatial Planning, and the Ministry of Economic Development and Technology, project no. V6-1652 (Model of Joined Physical and Development Planning at the Regional Level).

The editors of this book would like to thank all the reviewers for their time and effort and for their insightful comments on the chapters, which improved the manuscripts, and of course all the authors that participated in this book despite being very busy with their own research projects.

The editors would also like to thank the Department of Thematic Cartography of the ZRC SAZU Anton Melik Geographical Institute for the thematic maps in all the chapters, created by Manca Volk Bahun. In addition, we acknowledge cartographic contributions by Jerneja Fridl (ZRC SAZU Anton Melik Geographical Institute) in Chap. 1 (Fig. 1.3) and Chap. 9 (Figs. 9.2. and 9.5), Rok Ciglič (ZRC SAZU Anton Melik Geographical Institute) in Chap. 1 (Figs. 1.10 and 1.11), Mateja Rihtaršič in Chap. 9 (Fig. 9.3), Daniela Ribeiro (ZRC SAZU Anton Melik Geographical Institute) in Chap. 18 (Fig. 18.7), and Mateja Breg Valjavec (ZRC SAZU Anton Melik Geographical Institute) in Chap. 20 (Fig. 20.4). Thanks to Erik Logar (ZRC SAZU Anton Melik Geographical Institute) for drawing the charts.

The editors appreciate the many photographers whose work has not only made this book much colorful and appealing to readers but has also make the text more accessible.

Thanks to Simona Lapanja, Donald Reindl, and Jean McCollister for translation and copyediting.

Special thanks also go to the Statistical Office and various ministries of the Republic of Slovenia and to the bodies within them, which contributed extensive statistical and other data, greatly enriching this volume.

Drago Perko
Rok Ciglič
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Contents

About the Editors

Drago Perko was born in 1961 in Kranj, Slovenia. In 1985, he received his bachelor's degree in geography and sociology at the University of Ljubljana's Faculty of Arts. He received his master's degree (1989) and doctorate (1993) in geography from the same institution. Since 1986, he has worked at the ZRC SAZU Anton Melik Geographical Institute. He served as the institute's director from 1993 to 2018, and since 1994, he has headed the institute's Department of Regional Geography.

His research interests focus on regional geography, geographical typification and regionalization, landscape ecology, geographic information systems, digital thematic cartography, and geographical names. He heads projects, advises junior researchers, serves as the executive editor of the journal *Acta Geographica Slovenica*, and is a member of the editorial boards of the journals *Acta Geobalcanica*, *National Geographic Slovenija*, and *Geografski vestnik* (*Geographical Bulletin*) and the coeditor of several book series. Since 1995, he has been a member of the Slovenian Government Committee for the Standardization of Geographical Names. From 2006 to 2015, he was the national coordinator for geography at the Slovenian Research Agency. He has received several awards, including the ZRC SAZU Gold Medal in 1999, which is the highest recognition in the humanities in Slovenia.

Rok Ciglič was born in 1983 in Ljubljana, Slovenia. In 2008, he received a bachelor's degree in geography at the University of Ljubljana's Faculty of Arts, and he received his doctorate in geography from the same institution in 2013. In 2008, he started working for the ZRC SAZU Anton Melik Geographical Institute, and since 2014, he has headed the institute's Department of Geographic Information Systems.

His research interests focus on geographic information systems, landscape classification, and natural disasters. He is a member of the editorial boards of the journals *Acta Geographica Slovenica*, *Acta Geobalcanica*, and *Geografski vestnik* (*Geographical Bulletin*). He is also the coeditor of the book series *Naravne nesreče* (*Natural Disasters*) and *Geografski informacijski sistemi v Sloveniji* (*Geographic Information Systems in Slovenia*). From 2008 to 2015, he was a member of the executive committee of the Ljubljana Geographical Society, where he was in charge of cartography and publishing. In 2010, he was awarded a grant from the international Society for Conservation GIS. In 2015, he received the Melik Award for Best Young Researcher from the Association of Slovenian Geographers.

Matija Zorn was born in 1975 in Kranj, Slovenia. In 2001, he received a bachelor's degree in geography and history at the University of Ljubljana's Faculty of Arts, and he received his doctorate in geography from the same institution in 2007. In 2001, he was employed by the ZRC SAZU Anton Melik Geographical Institute. He served as the institute's assistant director from 2007 to 2018, and since 2018, he has been its director. Since 2008, he has headed the institute's Department of Physical Geography.

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1 Slovenia: A European Landscape Hotspot

Drago Perko, Rok Ciglič, and Matija Zorn

Abstract

Slovenia is one of the youngest countries in the world. It has been independent since 1991, but at the same time, it is strongly dependent on its geography. Most of its natural, economic, and cultural features result from its location in the center of Europe, where completely different geographical units intersect. It is exposed to South Slavic influences via the karstified plateaus and intermediate lowlands of the Dinaric Alps to the southeast, Hungarian influences from the continental Pannonian Basin to the northeast, Romance influences from the warm Mediterranean to the southwest, and Germanic influences via the steep mountains and deep valleys of the Alps to the northwest. Because most of the territory of what is now Slovenia belonged to Germanic states for over a thousand years, Germanic influences have left the most traces in the Slovenian cultural landscapes and among its residents. Due to its great landscape diversity and despite its smallness, Slovenia is well known for being a European landscape hotspot, and among other things the young country is increasingly using this geographical fact to strengthen its identity.

Keywords

Slovenia · Geography · Landscape · Region · Landscape diversity · Landscape hotspot

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1.1 The New Kid on the Block

Slovenia (Fig. 1.1) took its place on the world map as an independent country on June 25, 1991, when it declared independence. The decision for independence was made in a referendum on December 23, 1990, in which 93% of the electorate participated, of whom 95% voted for independence. This was followed by a rapid integration of the young country into the international scene. By May 22, 1992, it had already become a member of the United Nations. It made its way through the transition to a market economy relatively successfully, and on May 1, 2004, it became a member of the European Union, within which it was expected to develop even more successfully together with other European nations and at the same time preserve its identity.

It borders Italy to the west (the border was defined by the Paris Peace Treaty on February 10, 1947, the London Memorandum on October 5, 1954, and finally the Treaty of Osimo on November 10, 1975), Austria to the north (the border was defined by the Treaty of Saint-Germain-en-Laye on September 10, 1919, the Carinthian plebiscite on October 10, 1920, and finally the Austrian State Treaty on May 15, 1955), Hungary to the northeast (the border was defined by the Treaty of Trianon on June 4, 1920; Fig. 1.2) (Fischer 2005), and Croatia to the southeast and south (the border was finally defined through international arbitration in the Hague on June 29, 2017).

With the arbitration decision, Slovenia's territory was reduced from 20,273 km^2 to 20,271 km^2, and the country's territorial water in the Gulf of Trieste now measures 231 km^2, which is nearly two-fifths of the entire gulf. The total length of the Slovenian border is 1370 km. The length of the land border is 1322 km, of which 232 km is with Italy, 318 km with Austria, 102 km with Hungary, and 670 km with Croatia. The length of the sea border is 48 km, of which 29 km is with Italy and 19 km with Croatia. The length of the Slovenian coast is 47 km.

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D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_1

Fig. 1.1 Slovenia's location in Europe

Before independence, Slovenia was a constituent republic of Yugoslavia. Within the pre-World War II Kingdom of Yugoslavia, it corresponded to the Drava Province, and in pre-World War I Austria-Hungary, its territory corresponded to the more or less ethnically Slovenian crownlands of Carniola, Carinthia, Styria, and the Littoral. Even earlier, in the seventh century, there was the principality of Carantania, the first state formation of the ancestors of today's Slovenians, who had settled an extensive area between the Danube River to the north, the Adriatic Sea to the south, Lake Balaton to the east, and the headwaters of the Drava, Mura, and Enns rivers to the west. Today Slovenians outside of Slovenia inhabit only the border areas of neighboring countries, and the presence of Slovenians in the former broader settlement area essentially continues to be attested only by certain geographical names.

Slovenia is not only one of the youngest countries in the world but also one of the smallest (Fig. 1.3). Nature has not endowed it with great wealth such as oil, gold mines, or extensive fertile fields. Alongside its forests, Slovenia's only natural treasure is basically its geography, which is shown in its location at the intersection of four major European geographical units and in its great landscape diversity. Social, economic, cultural, and other differences are also based on these geographical differences.

1.2 A Brief General Geographical Overview

Almost two-thirds of Slovenia is characterized by hilly and mountainous Alpine and Dinaric landscapes running from northwest to southeast and descending to lower and gentler Pannonian and Mediterranean landscapes toward the northeast and southwest.

The highest point in Slovenia is 2864 m at the top of Mount Triglav in the Julian Alps in northwest Slovenia, which is also represented in stylized form on Slovenia's coat of arms (Fig. 1.4), and its lowest point is 37 m below sea level in a trough beyond Cape Madonna, not far from Piran. This point has been dubbed *Podvodni Triglav* "the underwater Mount Triglav" (Orožen Adamič 1998). It is marked by a

Fig. 1.2 The three sides of the border stone at the tripoint between Slovenia, Austria, and Hungary (top, Slovenia; middle, Hungary; bottom, Austria). (Photos by Matija Zorn, GIAM ZRC SAZU Archive)

concrete pyramid with the inscription *Najgloblja točka slovenskega morja* “Deepest point in the Slovenian sea” and an inverted drawing of the Slovenian coat of arms.

In addition to topography, the principal natural geographical factors influencing the regional differences within Slovenia are rocks and vegetation (Perko 1998).

Rocks are classified by their origin as igneous, metamorphic, or sedimentary. Igneous rocks created by the hardening of magma constitute only 2% of Slovenia’s surface, and metamorphic rocks created by the transformation of any type of stone in the Earth’s interior due to increased pressure and higher temperatures constitute 4%. These two types are primarily found in the Pohorje Hills and in the eastern Karawanks. Some 94% of Slovenia’s surface is composed of loose sediments and sedimentary rocks created from whichever preexisting rock particles have been broken down by weathering and erosion. Clay, silt, sand, rubble, gravel, and till (morainic material) cover a quarter of Slovenia’s surface. The greatest amounts of these are found on the flatlands along Slovenia’s largest rivers: the Mura, Drava, Krka, Savinja, Sava, and Soča. Through the cementing of grains, claystone is created from clay, siltstone from silt, sandstone from sand, breccia from rubble, conglomerate from gravel, tillite from till, and pyroclastic rocks (e.g., tuffs) from loose volcanic materials. These cemented rocks cover a tenth of Slovenia’s surface. Marl, which constitutes the majority of the Pannonian low hills, and flysch, which constitutes the Mediterranean low hills, comprise just over a tenth of the surface. The same proportion is composed of dolomite, which primarily constitutes the Alpine hills. The greatest part of Slovenia’s surface, over a quarter, is composed of limestone, particularly the Alpine mountains and the Dinaric plateaus. The oldest rock in Slovenia is the metamorphic rocks in the Pohorje Hills and Kozjak Mountains, which are believed to originate in the Precambrian, and the oldest sediment is the Devonian limestone found in the central Karawanks (Perko 2007a; Perko et al. 2015).

Events during the Pliocene and Pleistocene were of major significance for the terrain of present-day Slovenia. In the middle of the Pliocene, the terrain was largely leveled due to strong corrosion and denudation in the moderately warm and wet temperate climate. Numerous planated areas remain from this period. As the climate became cooler at the end of the Pliocene, mechanical weathering increased, and areas primarily composed of mechanically less resistant impermeable rocks, which were considerably more widespread at the time than they are today, consequently became smaller. Through deepening and lateral erosion, the rivers carved deep valleys, above which the remnants of former terraces have survived. During the ice ages of the Quaternary, the temperature dropped by more than 10 °C. In the Alps and the Dinaric Alps, extensive glaciers developed, whose creeping widened valleys and created enormous quantities of rubble. Water flowing from under the glaciers carried it away and deposited it in lower areas. Periods of accumulation were followed by periods of erosion and the deepening of valleys. The erosion was so strong that none of the later accumulations reached the heights of the preceding ones. In the course of the many alternations of these processes, the valleys were deepened by 100–300 m, and five to seven levels of terraces, increasingly younger toward the bottoms of the valleys, remain visible on the valley sides (Perko 2007a).

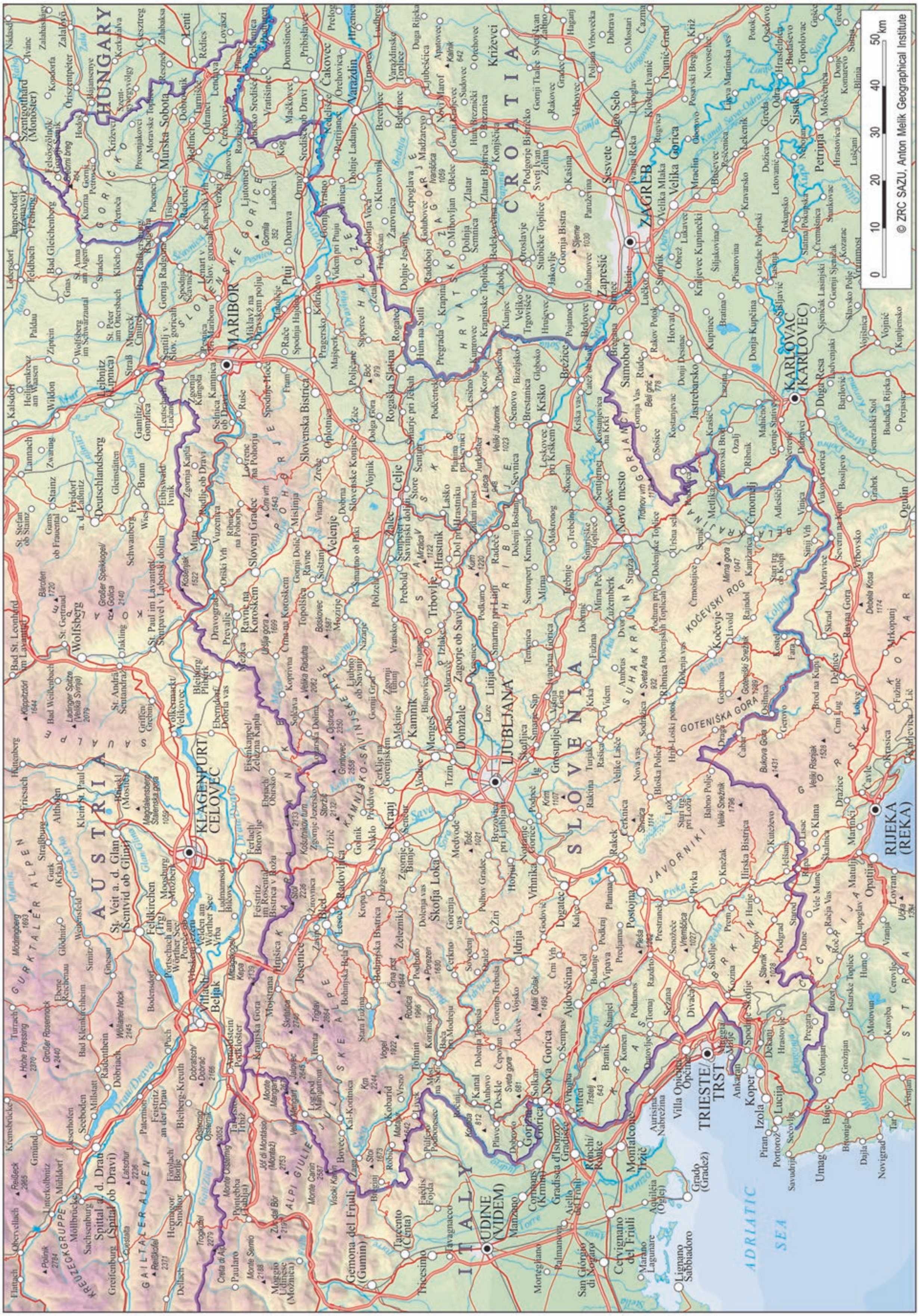

Fig. 1.3 A general map of Slovenia (geographical names in Slovenia are written in Slovenian)

Fig. 1.4 Slovenia's flag and coat of arms

Today in Slovenia six basic genetic types of landscapes are present: erosional fluvial, depositional fluvial, glacial, limestone karst, dolomite karst, and coastal. In some areas, these genetic types mix (Gabrovec and Hrvatin 2004).

Some 44% of Slovenia is covered by limestone and dolomite karst. In Slovenian, the word *kras* "karst" also means "bare rocky terrain." The basic reasons for the creation of karst are the fissure permeability and the solubility of rocks. Pure water can dissolve only a little limestone, but when CO_2 from the air and soil combines with water, a weak carbonic acid is created that accelerates the dissolution (or corrosion). The karst surface thus slowly and imperceptibly dissolves and lowers. Added up, the quantity of dissolved limestone carried away by the Ljubljanica River lowers its karst hinterland up to 10 mm every hundred years (Perko 2007a).

The characteristic surface of the limestone karst region is composed of karst depressions and rounded peaks. The most frequently occurring karst depressions are dolines. In places their density is extraordinarily high, exceeding 200 dolines per km^2. Uvalas and karst poljes rank among the larger karst depressions. In Inner Carniola, the best-known poljes are the Cerknica and Planina poljes and in Lower Carniola the Ribnica and Kočevje poljes. Slovenia's largest corrosion plain, which is several kilometers long and wide with numerous dolines, is White Carniola. Where surface rivers and streams flowed from impermeable rocks onto limestone, blind valleys were created, for example, on the southwestern rim of the low flysch Brkini Hills. Around the karst sources of the Ljubljanica, Unica, and Krka rivers, pocket valleys were formed that typically end in an unusually steep hillslope or even a vertical wall. The flowing of karst rivers underground created numerous caves and shafts. Slovenia's largest caves were created near the ponors (swallow holes) of larger rivers. Postojna and Planina caves were formed by the Pivka River and Škocjan Caves and Snake Cave (*Kačna jama*) by the Reka River. The deepest shafts explored so far, over 1000 m deep, are on Mount Rombon, Mount Kanin, and the Dleskovec Plateau. Although underground streams dominate in the limestone karst region, individual rivers such as the Kolpa and the Krka flow on the surface. Among Slovenia's dry river valleys, the Čepovan Valley between the Banjšice and Trnovo Forest plateaus is the most distinctive.

Along with the chemical dissolution of rock, erosion and denudation are significant in the dolomite karst region, and the dolomite karst is therefore less distinctive than the limestone karst and in many places resembles a fluvial landscape. Surface karst forms are rarer, and small and shallow dry valleys called dells (*dolci*) are characteristic. This relief type is frequently called fluviokarst and is typical of the Temenica River catchment (Gabrovec and Hrvatin 2004).

Six landform units are used to categorize surface morphology: flatlands, low hills, hills, mountains, low plateaus, and high plateaus (Gabrovec and Hrvatin 2004). Flatlands were created by deposition processes. Today deposition is occurring only on the youngest flood plains of rivers and streams. Older conglomerate terraces are already karstified. In the low hills, where the elevation difference between the valleys and ridges is less than 300 m, and in the hills, where it is more than 300 m, denudative and erosion processes dominate. In the mountains, the peaks and ridges extend above the tree line, which is around 1700 m in Slovenia. Numerous glacial forms have survived from the Pleistocene. The low hills, hills, and mountains are dissected by numerous valleys, but valleys are rare on the plateaus due to the prevailing karst processes. On the plateaus, rounded peaks and various karst depressions alternate. Low plateaus extend to 700 m above sea level, and the peaks on the high plateaus exceed 1000 m.

Slovenia's average inclination is 15°, and the average elevation is 557 m, two-thirds of the world's average. The elevation belt from 0 to 200 m, which includes the Pannonian and Mediterranean plains, altogether encompasses less than a tenth of Slovenia's surface; the belt from 200 to 400 m, which mainly includes the Pannonian and Mediterranean low hill areas and the Alpine plains, encompasses almost a third; the belt from 400 to 800 m, which includes the majority of the Alpine and Dinaric hills, encompasses almost two-fifths; the belt from 800 to 1200 m, which mainly includes high Dinaric plateaus and the highest Alpine hills, encompasses an eighth; and the belt above 1200 m encompasses only 6%. Due to the influence of elevation, various elevation borders have formed. The snow line in Slovenia is around 2700 m, and the tree line lies between

1600 and 1700 m in the Julian Alps, between 1700 and 1800 m in the Kamnik–Savinja Alps, between 1800 and 1900 m in the Karawanks, and only a little above 1500 m on the Snežnik Plateau. The average elevation border of human settlement runs about 500 m below the tree line. The highest farmsteads are found at 1300 m in the eastern Karawanks. The elevation border for corn is 800 m and for vineyards 500–600 m (Perko 2001).

Slovenia is rich in water. It has access to the sea, rich reserves of groundwater, and a dense network of surface waters. Due to the great diversity of topography and rock types, the watercourses are short. Although the total length of all watercourses adds up to 28,000 km, as many as two-fifths of these are flashy streams, and only 46 are longer than 25 km. Only the Sava, Drava, Kolpa, and Savinja rivers are longer than 100 km. Some four-fifths of Slovenia falls into the Black Sea catchment, and the rest belongs to the Adriatic catchment (Hrvatin 2004).

The soils are distinctly linked with topography and rock types. In the Alpine mountains, the prevailing soil is Rendzina; in the Alpine hills, Cambisol; on the Dinaric and the Mediterranean plateaus, Chromic Cambisol; in the Pannonian low hills, Cambisol and Planosol; and in the Mediterranean low hills, Cambisol (Repe 2004a; Perko 2007a).

According to precipitation regimes, the average temperatures of the warmest and coldest months, and the ratio between October and April temperatures, Slovenia has three climate types with nine subtypes. It has two precipitation regimes: continental and sub-Mediterranean. The continental precipitation regime has its peak rainfall in summer and its low point in winter. The primary peak of the sub-Mediterranean precipitation regime is in autumn, and its primary low point occurs between winter and spring with a secondary peak falling between spring and summer and a secondary low point occurring in summer, which indicates the intermingling of the continental regime with the Mediterranean precipitation regime, which has its precipitation peak in winter and its low point in summer. Due to global warming, these characteristics are changing (Ogrin 2004; Perko 2007a).

The sub-Mediterranean climate (the average temperature of its coldest month is over 0 °C and in its warmest month exceeds 20 °C; the average temperature is higher in October than in April; sub-Mediterranean precipitation regime) has two subtypes: the littoral subtype or olive tree climate (the average temperature of its coldest month is over 4 °C and in its warmest month exceeds 22 °C; average annual precipitation between 1000 and 1200 mm) and the littoral hinterland subtype (the average temperature of the coldest month ranges between 0 and 4 °C, and of the warmest month between 20 and 22 °C; average annual precipitation between 1200 and 1700 mm). The latter subtype extends up the Soča Valley to Tolmin and to the high Dinaric plateaus.

The temperate continental climate (the average temperature in the coldest month is between −3 and 0 °C and in the warmest month between 15 and 20 °C; continental precipitation regime) has four subtypes: the temperate continental climate of Western and Southern Slovenia (average April temperature lower than that of October; sub-Mediterranean precipitation regime; average annual precipitation between 1300 and 2800 mm), the temperate continental climate of Central Slovenia (average April temperature lower than that of October; continental precipitation regime; average annual precipitation between 1000 and 1300 mm), the temperate continental or sub-Pannonian climate of Eastern Slovenia (average April temperature equal to or higher than that of October; continental precipitation regime; average annual precipitation between 800 and 1000 mm), and the temperate continental or sub-Pannonian climate of Southeastern Slovenia in White Carniola (average April temperature approximately equal to that of October; sub-Mediterranean precipitation regime; average annual precipitation between 1200 and 1300 mm). The regions where April temperatures are higher than those of October correspond to the wine-growing regions of Northeastern and Eastern Slovenia (Ogrin 2004; Perko 2007a).

The montane climate (average temperature of the coldest month below −3 °C) has three subtypes: the climate of higher mountain regions lying above the tree line (average temperature of the warmest month below 10 °C; sub-Mediterranean precipitation regime; average annual precipitation between 1600 and 3500 mm), the climate of lower mountain regions and intermediate valleys in Western Slovenia (average temperature of the warmest month above 10 °C; sub-Mediterranean precipitation regime), and the climate of lower mountain regions and intermediate valleys in Northern Slovenia (average temperature of the warmest month above 10 °C; continental precipitation regime, average annual precipitation between 1100 and 1700 mm).

The most important visible indicator of natural conditions is vegetation. After the retreat of the Pleistocene glaciers, forests covered the entire territory of present-day Slovenia except for the highest and steepest locations. Over many centuries, human activity cleared more than half of all the forest. However, forest overgrowth has been so intense in recent decades that according to the latest data, the proportion of forest cover is approaching two-thirds, thus ranking Slovenia among the most densely forested countries in the world. Most widespread are various beech forests, which comprise almost three-quarters of all forests and cover two-fifths of Slovenia's surface. In the Alpine mountains and hills and on the Dinaric plateaus, the predominant species are beech, fir, and spruce; on the Alpine plains, hornbeam, beech, and red pine; in the Dinaric lowlands, hornbeam, beech, fir, and pedunculate oak; on the Pannonian plains, various oaks and hornbeam; in the Pannonian low hills, beach, chestnut, and various oaks; on the Mediterranean plateaus, downy oak and hop hornbeam; and on the Mediterranean low hills, various oaks, beech, and chestnut (Repe 2004b; Perko 2007a).

As of July 1, 2018, Slovenia had a population of 2,070,050 and according to the last census, as of January 1, 2011, a population of 2,050,189. Between 1931 and 1961, the population increased by 14%, between 1961 and 1991 by 24%, and between 1991 and 2011 by another 4% or altogether almost 50% since 1931.

Because of the dynamic terrain, the population is distributed unevenly, and this unevenness is increasing further. In 2011, the average population density was 101 people per km^2. The Alpine plains had the highest population density (630 people per km^2), the highest average settlement size (1271 people per settlement), the highest settlement density (50 settlements per 100 km^2), and the largest share of built-up areas (20%). The Dinaric plateaus had the lowest population density (17 people per km^2), the lowest average settlement size (81 residents per settlement), and the lowest share of built-up areas (1%), and the Alpine mountains had the lowest settlement density (10 settlements per 100 km^2). About half of Slovenia's territory, especially the mountains, hills, and plateaus, and the majority of border areas, has rapidly decreasing population density, about a fifth slowly decreasing population density, a tenth slowly increasing population density, and the remaining sixth of Slovenia (plains only) rapidly increasing population density (Perko 1998). Declining birthrates in particular will most likely lead to sub-replacement fertility, an increasing share of the elderly, and a gradual steady population decline.

Even though only 5% of the population still makes a living with agriculture, half of the population is rural. Only the capital city of Ljubljana (Fig. 1.5) has a population of more than 100,000 (272,220 in 2011). During recent decades, suburbanization has been more characteristic for Slovenia than urbanization.

Fig. 1.5 Ljubljana is Slovenia's capital and largest city. It lies in a circular valley at the transition between the fertile Ljubljana Field to the north (in the photo) and the Ljubljana Marsh to the south. During the Roman era, it was named *Emona*, and it was first mentioned in medieval sources in 1144 with the German name *Laibach* and 2 years later with the archaic Slovenian name *Luwigana*. In the nineteenth century, it became a central town for Slovenians. Although it served as the capital of the French Illyrian Provinces, the Austrian crown land of Carniola, the Drava Province in Kingdom of Yugoslavia, and the Yugoslav Republic of Slovenia, it was only with Slovenia's independence in 1991 that it became a truly modern capital city with central state institutions and foreign embassies. The picturesque medieval part of the city, which was badly damaged in an earthquake in 1895, is nestled between the Ljubljanica River and Castle Hill, and the newer areas have developed mainly to the north. (Photo by Marjan Garbajs, GIAM ZRC SAZU Archive)

The religious, ethnic, and linguistic structure of the Slovenian population was only included in censuses until 2002.

In 2002, 63.6% of individuals declared a religious affiliation: Catholics (57.8%), Muslims (2.4%), Orthodox (2.3%), and Protestants (1.0%). Nearly 98% of Slovenians that declared their religious affiliation in the census identify themselves with Catholicism, and the rest are predominantly Lutherans.

Slovenia is relatively ethnically homogenous. Slovenians are the predominant ethnic group (95.6% of population in 1961 and 83.1% in 2002). Two recognized indigenous ethnic minorities live in Slovenia: the Italians (2258 in 2002) along the Slovenian part of the Adriatic coast and the Hungarians (6243) along the border with Hungary. Another ethnic group native to Slovenia is the Roma (3246), who predominantly live in Southern and Eastern Slovenia. All three ethnic groups together account for less than 1% of the total Slovenian population. Later significant changes in the ethnic structure between 1961 and 2002 were mainly the result of immigration from other former Yugoslav republics. In 2002, the prevailing immigrant groups included Bosniaks (40,071), Serbs (38,964), Croatians (35,642), Albanians (6186), Macedonians (3972), and Montenegrins (2667), who live in larger cities.

In 2002, 87.7% of individuals declared Slovenian as their native language and 7.8% listed Serbian, Croatian, Bosnian, Montenegrin, Serbo-Croatian, or Croato-Serbian as their native language.

Foreigners often encounter Slovenian for the first time when they look at geographical names on maps of Slovenia (Fig. 1.3).

Slovenian (also called Slovene) is the official language of Slovenia. It is also spoken in neighboring parts of Italy, Austria, Hungary, and Croatia. It is a Slavic language of Indo-European origin. It belongs to the South Slavic subgroup, but it also exhibits a few West Slavic features. It is a grammatically complex language with six cases for nouns and adjectives, three genders, and four verbal times. In addition to singular and plural, Slovenian also has a separate dual form. There are many irregularities in verb conjugations and noun declensions. The Slovenian alphabet has 25 uppercase and lowercase Latin letters. It does not have the letters Q, W, X, and Y, but it contains the letters Č, Š, and Ž (C, S, and Z with a wedge). Other diacritical marks are not used when writing Slovenian geographical names.

Table 1.1 presents some Slovenian generic geographical terms frequently used in geographical names (Fridl et al. 2007).

1.3 A Short Regional Geographical Overview

The official territorial division of Slovenia, based on the European Union's Nomenclature of Territorial Units for Statistics (NUTS), showed the following status as of January 1, 2018: 2 cohesion regions (NUTS 2 level), 12 statistical regions (NUTS 3 level), 212 municipalities, 6035 settlements, 10,396 streets, and 555,881 numbered houses. However, the former provinces of Austria-Hungary, which have already been defunct for a hundred years (Gabrovec and Perko 1999), remain very much alive among Slovenians. At the beginning of the World War I, four Austrian provinces covered most of what is now Slovenia: Styria (Slovene: *Štajerska*; German: *Steiermark*), Carinthia (*Koroška*; *Kärnten*), Carniola (*Kranjska*; *Krain*), and the Littoral (*Primorje*; *Küstenland*). Today's Slovenian cadastral districts still run nearly entirely along the borders of these former provinces.

The geographical division of Slovenia only sometimes corresponds to the official territorial division. The pioneer in producing geographical divisions of Slovenian territory was Baron Johann Weikhard von Valvasor (1641–1693), who published his encyclopedic *Die Ehre deß Hertzogthums Crain* (The Glory of the Duchy of Carniola) in 15 books in 1689. The first detailed scientific division of Slovenia came more than 250 years later. It was produced by Anton Melik (1890–1966) as part of four extensive volumes on regional geography published between 1954 and 1960. Many researchers dealt with geographical and similar divisions of Slovenian territory in the second half of the twentieth century. Most of them worked on regionalizations, combinations of regionalization and typification, or classifications that were merely based on an individual landscape element, such as climate, land use, or house types, but only a few focused on landscape typologies.

The best-established landscape typology of Slovenia is the one from 1996 with nine landscape types combined into four landscape type groups. This was also the first partly computerized typology of Slovenia, produced by overlapping elevation, inclination, lithology, and vegetation data layers in a geographic information system. Its scientific bases were first presented in 1998 (Perko 1998). It has also been published in all major geographical works on Slovenia issued after Slovenia's independence, and since 2008 it has also been part of Slovenian tax legislation.

Table 1.1 Some Slovenian geographical terms in English, German, French, and Spanish

Slovenian	English	German	French	Spanish
Slovensko		*Deutsch*	*Français*	*Español*
Barje	Bog, marsh	Sumpf	Marais	Pantano
Bel	White	Weiß	Blanc	Blanco
Bistrica	Swift stream	Gebirgsbach	Cours d'eau	Corriente de agua
Boršt	Forest	Wald	Forêt	Selva
Brda	Hills	Hügelland	Collines	Colinas
Brdo	Hill	Hügel	Colline	Colina
Breg	Bank, slope	Ufer, Hang	Rive, pente	Orilla, pendiente
Brod	Ford	Furt	Gué	Vado
Cerkev	Church	Kirche	Église	Iglesia
Cesta	Road	Straße	Route	Calle
Čret	Wet meadow	Feuchte Wiese	Pré humide	Prado húmedo
Črn	Black	Schwarz	Noir	Negro
Dežela	Land	Land	Terre	Tierra
Dobrava	Rolling lowland	Gewellte Ebene	Plaine vallonée	Llanura ondulada
Dol	Valley	Tal	Vallée	Valle
Dolenji	Lower	Nieder, unter	Inférieur	Inferior
Dolg	Long	Lang	Long	Largo
Dolič	Small valley	Kleines Tal	Petit vallée	Vallejo
Dolina	Valley	Tal	Vallée	Valle
Dolnji	Lower	Nieder, unter	Inférieur	Inferior
Domačija	Farm; home	Bauernhof; Heim	Ferme; maison	Granja; casa
Draga	Small valley	Kleines Tal	Petit vallée	Vallejo
Dvor	Hall, court	Palast, Hof	Palais, cour	Palacio, corte
Fara	Parish	Pfarre	Paroisse	Parroquia
Fužina	Foundry	Eisenwerk	Forge	Herrería
Gaj	Grove, horst	Hain	Forêt	Bosque
Globok	Deep	Tief	Profond	Profundo
Gol	Treeless	Kahl	Dénudé	Pelado
Gora	Mountain, hill	Berg, Hügel	Montagne, colline	Montaña, colina
Gorenji	Upper	Ober, hoch	Supérieur	Superior
Gorica	Hill	Hügel	Colline	Colina
Gorice	Hills	Hügelland	Collines	Colinas
Gornji	Upper	Ober, hoch	Supérieur	Superior
Gorovje	Mountain range	Gebirge	Montagne	Montaña
Gozd	Forest	Wald	Forêt	Bosque
Grad	Castle	Burg, Schloss	Château	Castillo
Gradišče	Fortified settlement	Feste Siedlung	Unité d'habitat fortifié	Núcleo habitado fuerte
Grič	Hill	Hügel	Colline	Colina
Gričevje	Hills	Hügelland	Collines	Colinas
Grm	Bush	Busch	Buisson	Arbusto
Hiša	House	Haus	Maison	Casa
Hom	Hill	Hügel	Colline	Colina
Hosta	Forest	Wald	Forêt	Bosque
Hrbet	Mountain range	Gebirgskette	Chaîne de montagnes	Cordillera
Hrib	Hill, mountain	Hügel, Berg	Colline, montagne	Colina, montaña
Hribovje	Highlands	Bergland	Montagne bas	Montaña baja
Hudournik	Flashy stream	Wildbach	Torrent	Torrente
Izvir	Spring	Quelle	Source	Fuente
Jama	Cave, grotto	Höhle, Grotte	Caverne, grotte	Caverna, gruta
Jez	Dam	Damm	Barrage	Presa
Jezero	Lake	See	Lac	Lago
Jug	South	Süd	Sud	Sur
Južen	Southern	Südlich	Méridional	Meridional

(continued)

Table 1.1 (continued)

Slovenian	English	German	French	Spanish
Slovensko		*Deutsch*	*Français*	*Español*
Kal	Pond	Teich	Étang	Estanque
Kamen	Stone	Stein	Pierre	Piedra
Kanal	Canal	Kanal	Canal	Canal
Klanec	Slope, incline	Hang, Steigung	Pente, inclinaison	Ladera, pendiente
Korito	Riverbed	Flussbett	Lit	Lecho
Kot	Closed valley	Geschlossenes Tal	Vallée fermée	Rincón
Kotlina	Basin	Becken	Bassin	Cuenca
Kraj	Settlement	Siedlung	Habitat	Colonia
Krajina	Land	Land	Pays	Tierra, país
Kras	Karst area	Karstlandschaft	Paysage karstique	Paisaje kárstico
Križ	Cross	Kreuz	Croix	Cruz
Krnica	Cirque	Kesseltal	Cirque	Valle cerrado
Laz	Clearing	Gereut	Clarière	Clara, calvero
Ledenik	Glacier	Gletscher	Glacier	Glaciar
Lep	Beautiful	Schön	Beau	Hermoso
Letališče	Airport	Flughafen	Aéroport	Aeropuerto
Log	Swampy meadow	Hain	Bocage	Prado floresta
Loka	Wet meadow	Aue, feuchte Wiese	Pré humide	Prado húmedo
Lokev	Pond	Teich	Étang	Estanque
Luka	Port	Hafen	Port	Puerto
Mali, majhen	Little	Klein	Petit	Pequeño
Meja	Border	Grenze	Frontière	Frontera
Mesto	City, town	Stadt	Ville	Ciudad
Mlaka	Pool, pond	Pfütze	Flaque	Lodazal
Mlin	Mill	Mühle	Moulin	Molino
Močvirje	Swamp, marsh	Sumpf	Marais	Pantano
Moder	Blue	Blau	Azur	Azul
Moker	Wet, moist	Feucht	Mouillé, humide	Húmedo
Morje	Sea	Meer	Mer	Mar
Most	Bridge	Brücke	Pont	Puente
Mrzel	Cold	Kalt	Froid	Frío
Na	On	An	Sur	Del
Nad	On, over, above	Über, ober	Sur	Del
Nizek	Low	Nieder	Bas	Bajo
Nižina, nižavje	Lowland	Niederung	Basse terre	Tierra baja
Njiva	Field	Acker	Champ	Campo
Nov	New	Neu	Nouveau	Nuevo
Ob	At, along	An, bei	Le long de, près	Cerca
Obala	Coast	Küste	Côte	Costa
Občina	Municipality	Gemeinde	Commune	Municipio
Obrh	Karst spring	Karstquelle	Source karstique	Fuente kárstico
Ocean	Ocean	Ozean	Océan	Océano
Okraj	District	Bezirk	District	Distrito
Otočje	Islands	Inseln	Îles	Islas
Otok	Island	Insel	Île	Isla
Park	Park	Park	Parc	Parque
Pas	Zone	Zone	Zone	Zona
Peč	Rock	Fels	Roc	Roca
Planina	Mountain; mountain pasture	Berg; Alm	Montagne; alpage	Montaña; pastos alpinos
Planota	Plateau	Hochebene	Plateau	Meseta
Pod	Under, below	Unter, unterhalb	Dessous	Debajo
Pogorje	Mountains	Gebirge	Montagnes	Montañas

(continued)

Table 1.1 (continued)

Slovenian *Slovensko*	English	German *Deutsch*	French *Français*	Spanish *Español*
Pojezerje	Lake area	Seenplatte	Zone lacustre	Zona lacustre
Poljana	Clearing, field	Feld	Champ	Campo
Polje	Field; karst field, polje; plain	Feld; Karstbecken; Ebene	Champ; champ karstique; plaine	Campo; campo kárstico; llanura
Polotok	Peninsula	Halbinsel	Péninsule	Península
Ponikva	Swallet; losing/influent stream	Schluckloch; verlierender Fluss	Chantoire; rivière à perte	Pónor; perdida de agua subterránea
Potok	Stream	Bach	Ruisseau	Arroyo
Prag	Rise	Schwelle	Seuil	Umbral
Predor	Tunnel	Tunnel	Tunnel	Túnel
Prekop	Canal	Kanal	Canal	Canal
Prelaz	Pass	Pass	Col	Puerto, paso
Preliv	Strait	Meeresstraße	Détroit	Estrecho
Preval	Pass	Pass	Col	Puerto, paso
Pri	By	Bei	Près	Cerca de, a
Pristanišče	Port	Hafen	Port	Puerto
Pristava	Estate farm	Meierhof	Métairie	Alquería
Puščava	Desert	Wüste	Désert	Desierto
Ravan	Plain	Ebene	Plaine	Llanura
Ravnica	Plain	Ebene	Plaine	Llanura
Ravnik	Tableland	Tafelland	Guyot	Bancal
Ravnina	Plain	Ebene	Plaine	Llanura
Rdeč	Red	Rot	Rouge	Rojo
Reka	River	Fluss	Fleuve	Río
Retje	Karst spring	Karstquelle	Source karstique	Fuente kárstico
Ribnik	Pond	Teich	Étang	Estanque
Rjav	Brown	Braun	Brun	Bruno
Rt	Cape	Kap	Cap	Cabo
Rudnik	Mine	Bergwerk	Mine	Mina
Rumen	Yellow	Gelb	Jaune	Amarillo
Samostan	Convent, monastery	Kloster	Couvent, monastère	Convento, monasterio
Sedlo	Pass	Sattel	Col	Paso
Selo	Village	Dorf	Village	Pueblo, aldea
Sever	North	Nord	Nord	Norte
Severen	Northern	Nördlich	Septentrional	Septentrional
Skala	Rock	Fels	Roc	Roca
Slap	Waterfall	Wasserfall	Chute d'eau	Cascada
Slatina	Mineral water	Mineralwasser	Eau minérale	Agua mineral
Snežnik	Snowcapped mountain	Schneebedeckter Berg	Mont enneigé	Pico nevado
Soteska	Gorge	Schlucht	Gorge	Garganta
Spodnji	Lower	Nieder	Inférieur	Inferior
Spomenik	Memorial, monument	Denkmal	Monument	Monumento
Srednji	Central, middle	Mittel	Central	Central
Star	Old	Alt	Vieux	Viejo
Stena	Wall	Wand	Mur	Muro
Straža	Guard	Wache	Garde	Guardia
Strm	Steep	Steil	Abrupt	Pendiente
Studenec	Spring	Quelle	Source	Fuente
Suh	Dry	Trocken	Sec	Árido
Sveti, sv.	Saint, holy	Sankt, heilig	Saint	San, santo
Špik	Peak	Spitze	Pic	Pico
Tabor	Stronghold	Feldlager	Camp bien fortifié	Campo fortificado
Topel	Warm	Warm	Chaud	Caliente

(continued)

Table 1.1 (continued)

Slovenian *Slovensko*	English	German *Deutsch*	French *Français*	Spanish *Español*
Toplice	Thermal springs, spa	Thermalquelle, Thermalbad	Source thermale, thermes	Fuente termal, termas
Trata	Meadow	Wiese	Pré	Prado
Travnik	Meadow	Wiese	Pré	Prado
Trg	Market	Markt	Marché	Mercado
Tunel	Tunnel	Tunnel	Tunnel	Túnel
Ustje	Mouth	Mündung	Embouchure	Desembocadura
V	In, at	In	Dans, en	En, de
Vas	Village	Dorf	Village	Pueblo, aldea
Velik	Great, big	Groß	Grand	Gran, grande
Vir	Spring	Quelle	Source	Fuente
Visok	High	Hoch	Haut	Alto
Višavje	Uplands, highlands	Hochland	Plateau	Meseta
Voda	Water	Wasser	Eau	Agua
Vrata	Pass; strait	Pass; Meeresstraße	Col; détroit	Paso; estrecho
Vrh	Peak	Gipfel	Cime	Cima
Vrtača	Sinkhole, doline	Karstdoline	Doline	Dolina
Vzhod	East	Ost	Est	Este
Vzhoden	Eastern	Östlich	Oriental	Oriental
Zahod	West	West	Ouest	Oeste
Zahoden	Western	Westlich	Occidental	Occidental
Zajezitveno jezero	Reservoir	Stausee	Réservoir	Embalse
Zelen	Green	Grün	Vert	Verde
Zgornji	Upper	Ober	Supérieur	Superior
Žaga	Sawmill	Sägewerk	Scierie	Aserradero

On the basis of this typology, a new natural-geographical regionalization with 48 regions and 4 macroregions was prepared in the same year (Kladnik 1996; Perko 1998, 2001, 2007b; Perko et al. 2015). The borders of the macroregions in the regionalization are the same as the borders of the landscape type groups in the landscape typology (e.g., the Alps macroregion corresponds to the Alpine landscapes type group), and every region in the regionalization corresponds to one of the representatives of each landscape type in the landscape typology (e.g., the Alps macroregion includes four regions or representatives of the Alpine mountains type, five regions of the Alpine hills type, and two regions of the Alpine plains type; Table 1.2).

Slovenia's natural landscapes are closely related to its cultural landscapes. They are distinguished by their embeddedness in the natural environment and their high ecological, cultural, and emotional value. The basic appearance of today's cultural landscapes was created during medieval colonization, which is particularly evident in the configuration and arrangement of settlements and the distribution of cultivated fields. Various states (Austria-Hungary, Yugoslavia, etc.), the administrative measures linked with them, and their level of economic development reshaped natural landscapes into cultural landscapes. Climate conditions and changes also had an influence. For example, at the end of the Middle Ages, winegrowing disappeared completely in Upper Carniola because the climate grew colder. Today, only some geographical names testify to its existence. On the Karst Plateau, the Austrian authorities encouraged deforestation of the region in the 18th and 19th centuries, when the marvelous forests were replaced by the barren karst landscape. Because of this strong deforestation linked to excessive grazing and other land uses, and consequently accelerated water and wind erosion, the Karst Plateau became a "rocky desert" during this period (Zorn et al. 2015). However, it was precisely this barren karst landscape that not only carried the glories of karst phenomena into the world but also formed a unique cultural landscape. Reforestation in this case would mean the loss of natural and cultural values. The period following the World War II was marked by a negative attitude toward farmers as private producers and by measures regarding maximum land ownership, due to which the average size of farms decreased. Only a small proportion of farmers were able to carry out modernization, and the proportion of the rural population began to decrease rapidly. In recent years since independence, extremely rapid and profound changes have taken place due to the changed economic and social situation. Free-market policies have accelerated the differentiation of the countryside. First-class agricultural land is disappearing due to freeway construction and the growth of cities; the cultural landscape is disintegrating in the hilly, mountainous, and

Table 1.2 Relations between landscape typology and natural-geographical regionalization of Slovenia from 1996

Landscape type groups	Macroregions	Landscape types	Regions
Alpine landscapes (*alpske pokrajine*)	Alps (*Alpe*)	Alpine mountains (*alpska gorovja*)	Julian Alps and three more regions
		Alpine hills (*alpska hribovja*)	Sava Hills and four more regions
		Alpine plains (*alpske ravnine*)	Sava Plain and one more region
Pannonian landscapes (*panonske pokrajine*)	Pannonian Basin (*Panonska kotlina*)	Pannonian low hills (*panonska gričevja*)	Slovenian Hills and eight more regions
		Pannonian plains (*panonske ravnine*)	Drava Plain and two more regions
Dinaric landscapes (*dinarske pokrajine*)	Dinaric Alps (*Dinarsko gorovje*)	Dinaric plateaus (*dinarske planote*)	Bloke Plateau and 11 more regions
		Dinaric lowlands (*dinarska podolja*)	Ljubljana Marsh and six more regions
Mediterranean landscapes (*sredozemske pokrajine*)	Mediterranean (*Sredozemlje*)	Mediterranean low hills (*sredozemska gričevja*)	Koper Hills and three more regions
		Mediterranean plateaus (*sredozemske planote*)	Karst Plateau and one more region
Total: 4 groups	Total: 4 macroregions	Total: 9 types	Total: 48 regions

remote regions; rural settlements are becoming suburbs; the countryside is becoming a place of residence and recreation; and the boundaries between cities and the countryside are already quite indistinct in Slovenia. All of these could cause the loss of identity of the countryside, its population, and the entire country because rural landscapes represent the vast majority of Slovenia (Perko and Urbanc 2004).

Practically all natural and cultural typologies and regionalizations of Slovenia as well as the names of natural and cultural landscape types and regions are somehow related to four extensive European regions that meet and intertwine in this tiny piece of central Europe: the southeastern part of the Alps (Fig. 1.6), the western margin of the Pannonian Basin (Fig. 1.7), the northwestern part of the Dinaric Alps (Fig. 1.8), and the northern margin of the Mediterranean (Fig. 1.9) all extend into Slovenia.

1.4 Europe's and Slovenia's Landscape Diversity

Slovenians are certain that Slovenia is among the most diverse countries in Europe, especially in relation to its size. However, the question is whether other Europeans perceive Slovenia similarly and whether this belief is also justified by research.

Geographical studies of Slovenia (Kladnik et al. 2009) show that it is contact point between various landscape types in particular that prove to be especially interesting and that the area along the borders between different landscape types can be defined as a kind of landscape hotspot. This is true throughout Europe and the rest of the world. The main purpose of the relatively simple analysis in this chapter is to identify places in Europe that can be described as very diverse according to various natural landscape types and to determine whether Slovenia is such a place. In order to obtain these landscape hotspots, several geographical divisions for most of Europe at a 5 km resolution were examined. First, maps of landscape variety were produced, with each division of Europe taken into account. This step was carried out for each cell by counting the number of different unique natural landscape types or regions that are present in a radius of 50 km around the cell. Several maps of landscape diversity were produced and weighted; the cell values were divided by the number of all unique types or regions in a division. In the final stage, all of the maps were synthesized (averaged) into one map showing landscape diversity for Europe. With these data it was possible to determine Europe's landscape hotspots and to define the most naturally heterogeneous countries (Ciglič and Perko 2013).

This analysis includes four European landscape classifications (Fig. 1.10), which are primarily based on natural landscape elements, have a similar number of types or regions, and are accessible in digital format.

The first classification chosen, the Environmental Stratification of Europe (Mücher et al. 2003; Metzger et al. 2005; Jongman et al. 2006), has a spatial resolution of 1 km^2 and 84 environmental classes, combined into 13 environmental zones and further into 6 biogeographic regions: Alpine, Anatolian, Atlantic, Boreal, Continental, and Mediterranean.

The European Landscape Classification (Mücher et al. 2003, 2006, 2009) also has a spatial resolution of 1 km^2. Based on data on elevation, soil, and land use, Europe was first divided into smaller segments, and then climate data

Fig. 1.6 The old medieval core of Kranj stands on a conglomerate terrace between the Sava and Kokra rivers in the central part of the Sava Plain. In the background are the Kamnik–Savinja Alps and Karawanks. (Photo by sonsam, Shutterstock.com)

Fig. 1.7 The wine-growing Pannonian Haloze Hills at the edge of the Pannonian Plain. (Photo by daniturphoto, Shutterstock.com)

were used to classify segments at the first level, and eight types were defined: Atlantic, Boreal, Continental, Arctic, Mediterranean, Steppic, Anatolian, and Alpine.

The next classification, Biogeographic Regions (version 2011), combines forest communities into 11 biogeographic regions: Alpine, Anatolian, Arctic, Atlantic, Black Sea, Boreal, Continental, Macaronesian, Mediterranean, Pannonian, and Steppic (European Environmental Agency 2011).

The last classification chosen, the Terrestrial Ecoregions of the World (Olson et al. 2001), shows units with a special combination of natural communities and species. The land is

Fig. 1.8 The rocky karst landscape around the entrance to Škocjan Cave, which has been on the UNESCO World Heritage List since 1986. (Photo by Jure Tičar, GIAM ZRC SAZU Archive)

Fig. 1.9 Koper, known to the Romans as *Capris*, lies on the northwest coast of Istria. The town's old medieval core stands on a former island and the newer parts of the city extend along the nearby hills. The growth of the port strengthened Koper's role as Slovenia's third regional center alongside Ljubljana and Maribor. In the foreground are the Koper Hills, and in the background are the low Karst Plateau and high Trnovo Forest Plateau on the left and Mount Nanos on the right. (Photo by Cortyn, Shutterstock.com)

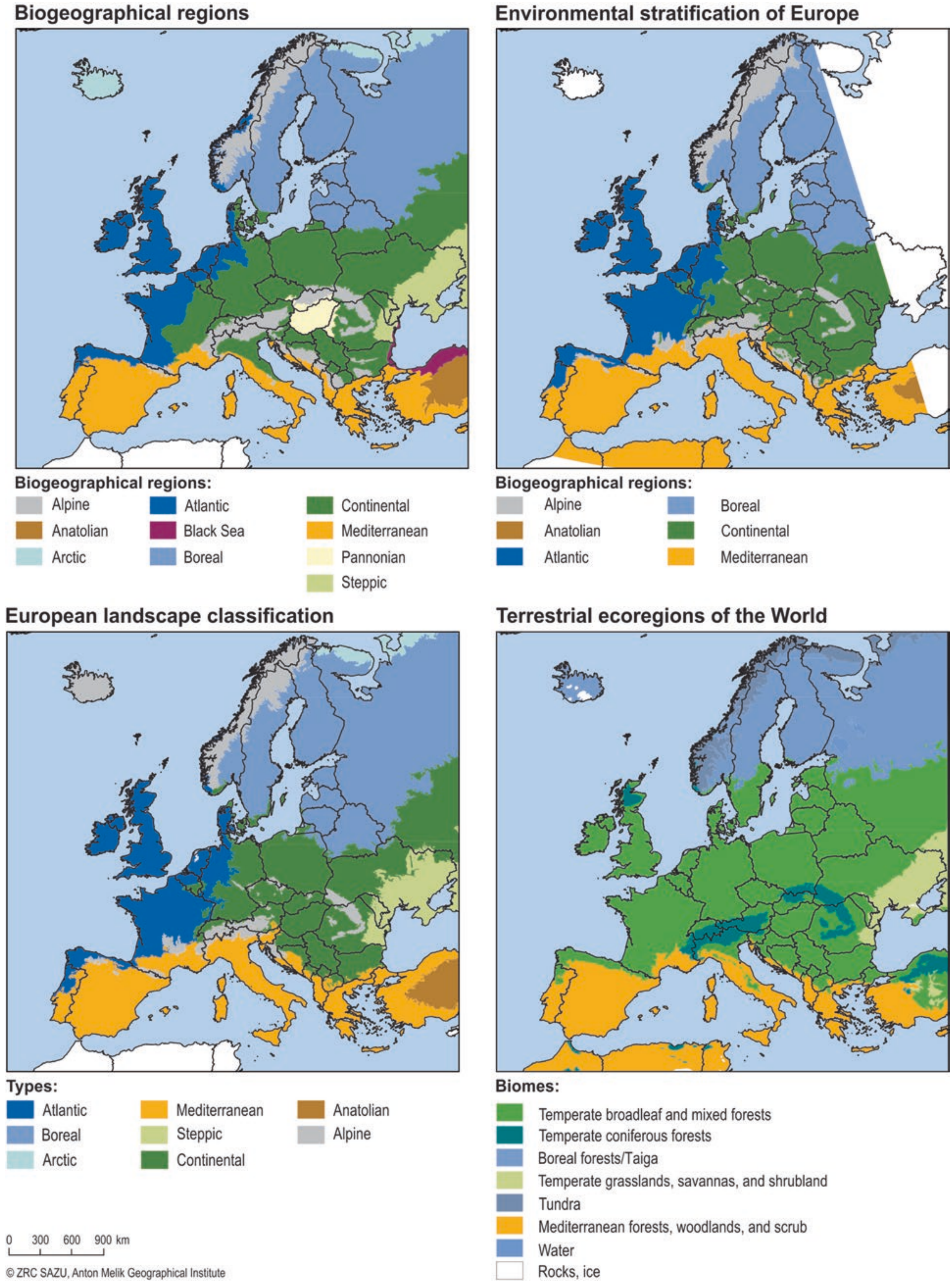

Fig. 1.10 Individual classifications of Europe. (European Environmental Agency 2011; Jongman et al. 2006; Metzger et al. 2005; Mücher et al. 2003, 2006, 2009; Olson et al. 2001)

divided into 8 geographic realms (Oceania, Nearctic, Neotropic, Afrotropic, Palearctic, Indo-Malay, Australasia, and Antarctic) and 14 biomes: tropical and subtropical moist broadleaf forests; tropical and subtropical dry broadleaf forests; tropical and subtropical coniferous forests; temperate broadleaf and mixed forests; temperate coniferous forests; boreal forests/taiga; tropical and subtropical grasslands, savannas, and shrublands; temperate grasslands, savannas, and shrublands; flooded grasslands and savannas; montane grasslands and shrublands; tundra; Mediterranean forests, woodlands, and scrub; deserts and xeric shrublands; and rock and ice, alongside the biomes mangroves and lakes (which were not included in the analysis).

The part of Europe covered in all four classifications was analyzed. This ensured that the entire area analyzed had data for all classifications; extreme Eastern Europe, Iceland, and Cyprus were excluded.

For each classification, the number of types appearing in a ten-cell (or 50 km) radius was calculated for each cell. Thus some sort of landscape diversity map was obtained for each of the four classifications. The radius was defined subjectively (a smaller radius would yield similar results, but landscape diversity would be limited to a smaller area, and a larger radius would yield landscape diversity for larger areas). After creating the landscape diversity map for each classification analyzed, all of them were joined into a combined landscape diversity map. This was done such that each landscape diversity map was first divided by the number of all possible classification categories (landscape types or regions) in the study area. This therefore showed the percentage of landscape categories of a specific classification in a radius of 50 km for each cell. Then all of the weighted landscape diversity maps were used to calculate an average (Ciglič and Perko 2013). The map of average landscape diversity in Europe (Fig. 1.11) shows the percentage of landscape categories that appear in a radius of 50 km around each cell on average with regard to all of the classifications analyzed.

From the map it is clear that the points of contact of various landscapes, including the most diverse landscapes, are primarily along chains of mountains (the Pyrenees, the Alps, the Dinaric Alps, the Carpathians, and the Massif Central), in southern Scandinavia, and in western Anatolia. These areas have on average contact with at least 30% of all categories that appear in an individual landscape classification. The area where the most different types intersect is extreme Southern Norway, where on average 49% of all landscape categories mix. Only a small area of the Massif Central and the Western Alps also exceed 40%. Analyzing diversity by countries (Table 1.3) shows that small countries have the highest landscape diversity (Slovenia, Liechtenstein, Montenegro, Switzerland, Macedonia, Andorra, Bosnia-Herzegovina, Austria, and Croatia average over 25%); however, many small countries (e.g., Malta, Ireland, Estonia, and Latvia) do not exceed 15%, which means that the size of a country is not a decisive factor for diversity (Ciglič and Perko 2013). From the perspective of the diversity of the entire country, an example of a hotspot is Slovenia, which is the most diverse country on average. Within Slovenia, in a 50 km radius, the cells have an average of 32.5% of all categories defined for the European study area.

1.5 Slovenia as a Hotspot

Among all of the countries (Table 1.3), Slovenia has the highest average landscape diversity, which Slovenian researchers have long emphasized (Melik 1935; Gams 1998; Perko 1998; Plut 1999). They all confirm that Slovenia is at the intersection of various European macroregions. An examination of European territory classifications (Ciglič 2009; Ciglič and Perko 2012) shows that non-Slovenian researchers also place Slovenia at the intersection of various European landscape categories. With regard to the classifications that were examined in this analysis, it can be concluded that Slovenia is at the intersection of the mountain (Alps and Dinaric Alps), continental (Pannonian Basin), and coastal/maritime (Mediterranean) landscape types. Three (or 50%) of the categories (Alpine, Continental, and Mediterranean) out of the six European categories from the Environmental Stratification of Europe meet in Slovenia, three or 38% (Alpine, Continental, Mediterranean) of eight from the European landscape classification, three or 30% (Alpine, Continental, Mediterranean) of ten from the Biogeographical Regions, and three or 43% (temperate coniferous forests; temperate broadleaf and mixed forests; and Mediterranean forests, woodlands, and scrub) of seven from the Terrestrial Ecoregions of the World.

Such a ranking (Table 1.3) can also be used as one of the additional factors for a country's attractiveness ranking (Tang and Rochananond 1990) and gives the country some advantages in tourism based on the natural values of the landscape. Of course, this does not mean that less diverse countries or landscapes such as deserts cannot be attractive.

Slovenia has few natural resources, and so its landscape diversity is a development opportunity, has its marketing and promotional value, and is making it possible to advertise the country as a tourist destination. Some countries are already using their geographical characteristics or geographical position for their tourism slogans. Albania is advertised as "A new Mediterranean love," Andorra as "The Pyrenean country," Croatia as "The Mediterranean as it once was," Malta as

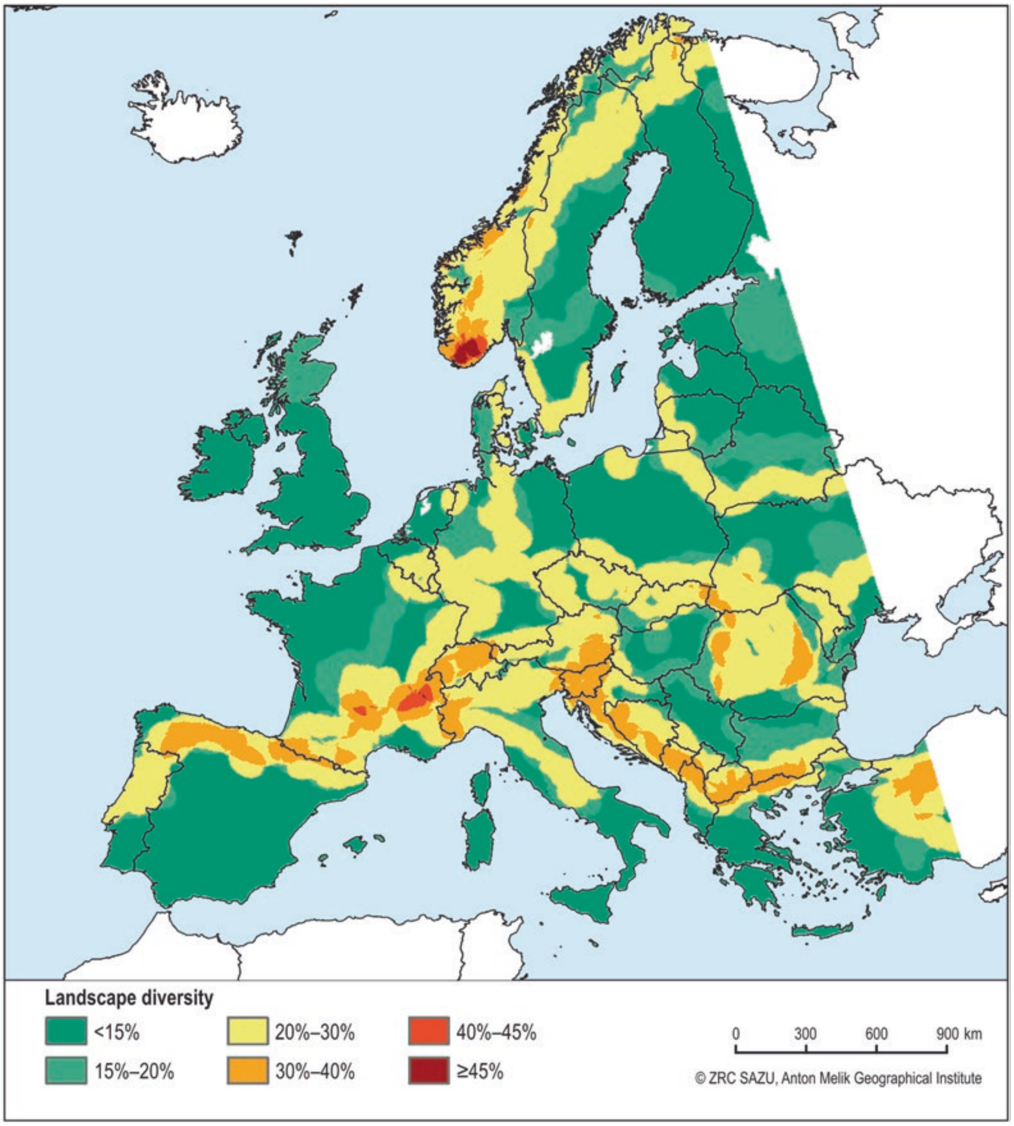

Fig. 1.11 Europe's landscape diversity (share of landscape categories in percentages appearing in a 50 km radius of each cell, average for all classifications used; Ciglič and Perko 2013)

"Truly Mediterranean," Portugal as "Europe's West Coast," and Romania as "Explore the Carpathian garden."

The landscape diversity of Slovenia can be used in geographically designed slogans, such as "Slovenia: Europe in Miniature," "Slovenia: All of Europe in One Place," or "Slovenia: Half of Europe All Together." These slogans express that Slovenia offers a "pan-European experience"—almost as much as a trip across Europe but certainly at least as much as Alpine, Mediterranean, Dinaric, and Pannonian Europe, or the coastal and inland areas of Europe (Perko and Ciglič 2015).

Table 1.3 Highest and average share of landscape categories in Europe in a 50 km radius around an individual cell for all cells within individual countries (Ciglič and Perko 2013)

Country	Maximum in %	Average in %
Slovenia	39.4	33.2
Liechtenstein	32.1	32.1
Montenegro	34.6	30.1
Switzerland	39.4	29.8
Macedonia	34.6	29.6
Andorra	30.4	29.5
Bosnia and Herzegovina	37.7	26.6
Austria	35.2	26.0
Croatia	37.7	25.2
Norway	49.2	25.0
Kosovo	34.6	24.9
Romania	37.7	24.2
Slovakia	30.4	22.9
Albania	34.6	22.8
Luxembourg	21.3	21.3
Moldova	23.8	20.8
Czech Republic	30.4	20.8
Bulgaria	34.6	20.4
France	46.0	20.1
Belgium	23.8	19.8
Portugal	32.1	19.7
Italy	35.2	19.6
Germany	32.1	19.6
Sweden	30.4	18.8
Denmark	23.8	18.3
San Marino	18.1	18.1
Spain	37.7	17.7
Greece	34.6	17.2
Hungary	34.6	16.8
Poland	30.4	16.5
Lithuania	23.8	16.2
Serbia	27.9	15.7
Finland	31.0	15.6
Netherlands	23.8	15.3
United Kingdom	18.1	14.8
Latvia	21.3	14.7
Estonia	18.1	14.2
Ireland	14.0	14.0
Malta	14.0	14.0

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Part I

Physical Geography

2 Rocks and Tectonic Structure of Slovenia

Mauro Hrvatin, Jure Tičar, and Matija Zorn

Abstract

The rocks that can be seen on Slovenia's surface today formed from at least the early Paleozoic to the Quaternary, or the present. The oldest metamorphic rocks probably date even back to the Precambrian. Sedimentary rocks predominate, covering 65.1% of Slovenia's surface. Among these, two carbonate rocks are especially common: limestone and dolomite. Loose sediments fill the tectonic depressions and river valleys, covering 29.2% of Slovenian territory. Metamorphic rocks account for 4.1% and are mostly concentrated in northeast Slovenia. Igneous rocks account for the smallest share, covering only 1.6% of the territory. Intrusive igneous rocks can only be found on the surface along the Periadriatic Seam and in the Pohorje Hills, whereas extrusive igneous rocks (or volcanic rocks) are scattered across smaller areas of the Alpine hills and mountains. Slovenia lies at the intersection of the following geotectonic units: the Dinarides, Southern Alps, Eastern Alps, and Pannonian Basin. All of these units form part of the Adriatic microplate, and their current distribution was achieved only as late as the Neogene—that is, during the past 20 million years.

Keywords

Physical geography · Geology · Stratigraphy · Rocks · Tectonics · Raw material

2.1 Slovenia's Basic Geological Characteristics

More than nine-tenths of Slovenia's territory is covered by sediments and sedimentary rocks, which accumulated at the bottom of the sea and in lakes or were deposited by rivers and glaciers. The sedimentary rocks of the Mesozoic Slovenian Basin and the Neogene Paratethys stand out in terms of diversity. Igneous and metamorphic rocks are largely present only in northeastern Slovenia, but they are nonetheless very diverse, even though they cover only 5.7% of the entire territory (Natek and Natek 1998; Verbič 1998).

The diverse rock composition is the result of a long geological history and location at the contact of the Dinarides, Southern Alps, Eastern Alps, and Pannonian Basin. Even though today these tectonic units lie close to one another, even overlapping in places, they have a different development. All of them are part of the Adriatic microplate, which broke away from the African Plate in the Mesozoic. While moving toward the north, it collided with the Eurasian Plate during the Neogene, causing Alpine orogeny. The two plates have continued to move toward one another after their collision, which is the main factor influencing the formation of Slovenia's tectonic structure (Novak 2016).

Due to their diversity, rocks play an important role in Slovenia's landscapes. They largely influence the structure of today's terrain, the network of rivers and creeks, soil types, the spread of many plant species, and human activity in the landscape (Natek and Natek 1998).

Individual rock types are fairly unevenly distributed across the country (Fig. 2.1). Alpine mountains are built primarily from limestone and dolomite, whereas large quantities of carbonate gravel, rubble, and till have accumulated in the valleys. Quartz sandstone and conglomerate and dolomite predominate in the Alpine hills of central Slovenia. The Alpine hills in the northeast are an exception in this regard, consisting of metamorphic and igneous rocks. Carbonate gravel, which has already conglomerated in places,

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© Springer Nature Switzerland AG 2020
D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_2

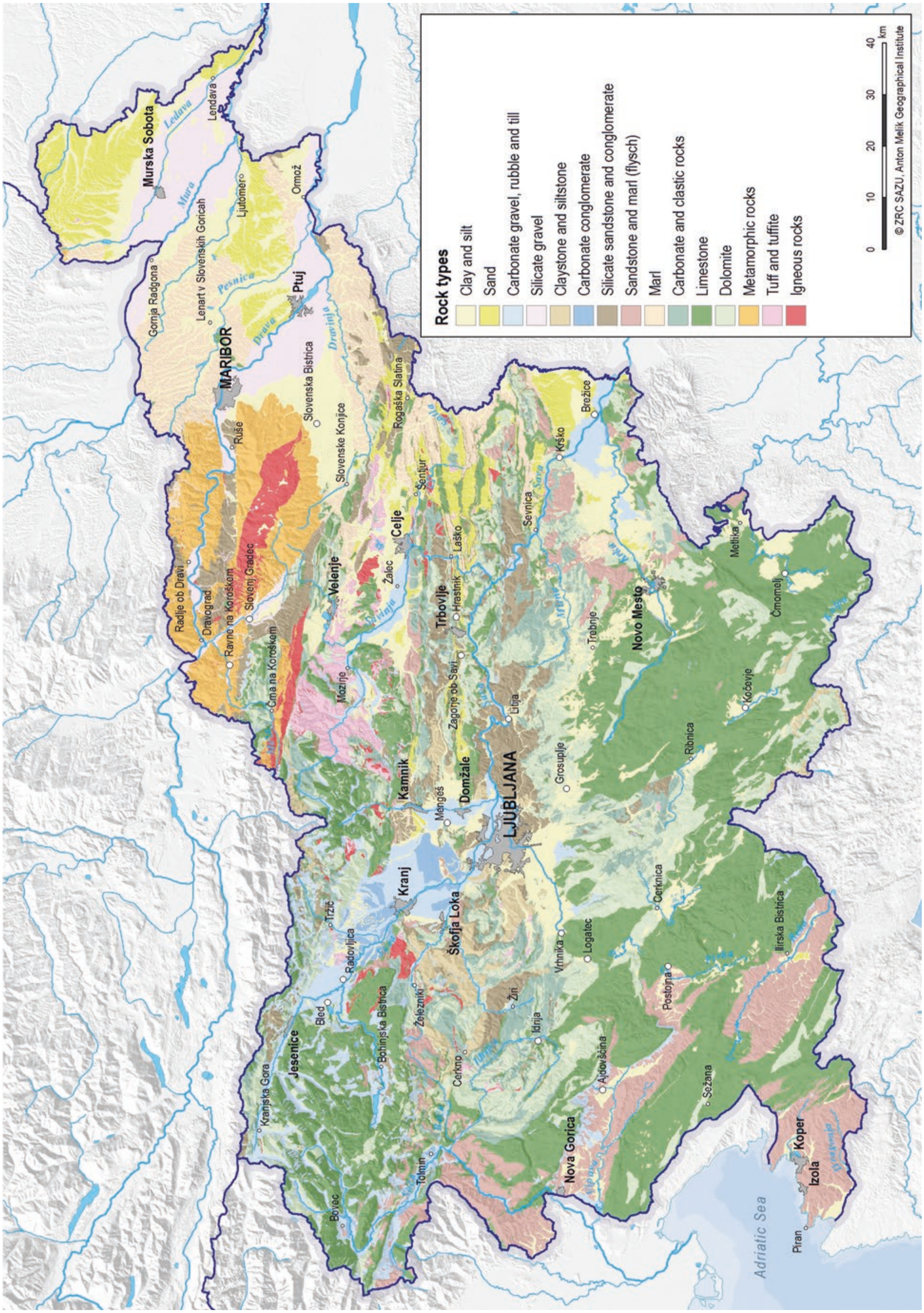

Fig. 2.1 Rock types in Slovenia

predominates on Alpine plains. The Pannonian low hills are made partly of marlstone and partly of loose fine-grained sediments, including clay, silt, and sand. Quartz gravel predominates on the Pannonian plains, and the remaining surface is covered in clay and silt. Dinaric plateaus are made of limestone and dolomite, and Dinaric lowlands exhibit a similar rock composition; the only difference is that in places carbonate rocks are covered by thick clay deposits. The Mediterranean low hills are composed of flysch sandstone and marlstone, and limestone predominates on Mediterranean plateaus (Perko 1998).

2.2 Slovenia's Geological Development

Slovenia's surface structure and landscape features are closely connected with its rock composition and tectonic setting, which developed over several hundred million years (Buser et al. 1989). The rocks making up Slovenia's territory formed over a considerably larger area, but tectonic forces later compressed them onto a smaller area. Many rocks had a unique development, and hence geologists have combined them into several groups and named them after Slovenian places (Buser 1997). For instance, the rocks of the Lower Carboniferous in the wider area of Jezersko along the Slovenian–Austrian border have been named the Jezersko Paleozoic. The Carnian bauxite, sandstone, siltstone, clay stone, tuffite, and breccia in central Slovenia make up the Borovnica Formation. The Eocene marlstone and clay stone with layers of coal between Rogaška Slatina and Velenje can be classified under the Socka beds, and the Bača dolomite is a typical platy rock with chert found in the southern part of the Julian Alps.

2.2.1 The Precambrian and Paleozoic

The oldest rocks in Slovenia are high-grade metamorphic rocks that were formed through a metamorphosis of sedimentary and igneous rocks. They make up the Pohorje Hills, the Kozjak Mountains, and the Mount Strojna and include gneiss, mica schist, amphibolite, and marble. Based on their location and metamorphosis stage, some claim they are of Precambrian and early Paleozoic age (Buser et al. 1989; Fodor et al. 2008), whereas others date them to the period between the Ordovician and Devonian (Hinterlechner-Ravnik and Trajanova 2009; Novak 2016). They were exposed to metamorphosis several times and especially heavily during the Cretaceous. Slates and phyllites are somewhat less metamorphized and younger, and the slates of the Magdalensberg Series along the Austrian border near Dravograd have undergone only partial metamorphosis (Buser 1997).

The oldest sedimentary rocks attested through fossils have been found in the gravel of the Permian conglomerate east of Ljubljana. Based on the fossil remains of cephalopods from the genus *Orthoceras*, it has been established that these are Upper Silurian limestones, which formed approximately 420 million years ago (Vrabec et al. 2009).

Devonian rocks are present in the Karawanks between Jezersko and the Logarska Valley, where they form prominent rocky peaks. They are composed of deep marine platy limestones with conodonts in their lower section, shallow marine massive limestones with corals in the center, and deep marine limestones again in their upper section (Buser 1997).

Due to the collision between Euramerica (or Laurussia) and Gondwana, the Variscan or Hercynian orogeny took place during the Devonian and Carboniferous, causing a sinking of the sedimentation environment at the edge of the continent (Vrabec et al. 2009). Therefore, during the Lower Carboniferous, the area of southern Karawanks was flooded by deep sea, in which flysch shales, sandstones, and limestones were deposited. The tectonic shifts of that time also caused the oldest volcanic activity in Slovenian territory, which is indicated by the porphyritic volcanic breccias and tuffs found around Jezersko (Buser 1997). In the Middle Carboniferous, the Paleo–Karawanks were formed, and after a brief emergence of dry land, quartz sandstones and conglomerates, shales, and limestones with several foraminifers, shells, and corals formed in the shallow sea of the Upper Carboniferous. These rocks contain lead and zinc ore, baryte in the area around Litija, and iron ore in the Karawanks (Buser et al. 1989).

During the Lower Permian, the shallow marine sedimentation of siliciclastites and carbonates continued in the coastal area of the continental shelf, and bryozoans, crinoids, and algae built reef mounds toward the open sea, providing a habitat for brachiopods. Many of these fossils have been found in the Dovžan Gorge near Tržič (Fig. 2.2). The sedimentation at the end of the Lower Permian was interrupted by an orogenetic phase that caused the sea to recede (Vrabec et al. 2009). During the Middle Permian, the mainland was exposed to a desert climate, and rivers only occasionally deposited violet–red and green quartz clastic rocks; these contain uranium ore in the vicinity of Žiri. During the Late Permian, the sea again gradually covered the saline tidal flats. An extensive shallow continental shelf called the Slovenian Carbonate Platform took shape, with dolomites predominantly being formed on it (Novak 2016).

2.2.2 The Mesozoic

On the Slovene Carbonate Platform, the Late Permian shallow marine sedimentation continued into the Early Triassic.

Fig. 2.2 The Dovžan Gorge near Tržič is distinguished by a great diversity of Paleozoic rocks and fossils. (Photo by Xseon, Shutterstock.com)

Mixed clastic-carbonate sedimentary rocks formed due to the inflow of debris from the nearby mainland (Novak 2016). During the Anisian, the inflow of debris stopped and shallow marine sedimentation of limestone prevailed. This limestone later largely transformed into dolomite (Vrabec et al. 2009).

The Middle Triassic Ladinian stage was the most turbulent stage in Slovenia's geological history. Long and deep faults cut the Earth's crust into large tectonic blocks, and the rifting of the Meliata Ocean began along Pangaea's eastern edge. The central part of what had been a single continental shelf until then sank several hundred meters below sea level. The deepest sea formed in the belt running from the Gorjanci Hills across the Krško Hills, the Bohor Mountains, Mount Boč, and the Tuhinj Valley, Selška Sora River, and Bača River valleys toward Tolmin and Kobarid. A long narrow channel called the Slovenian Basin was covered by the sea for nearly 150 million years until the Late Cretaceous. At first, dark shales alternating with sandstones and tuffs formed in it, and two carbonate continental shelves remained on both edges of the deep basin. On the northern side, the carbonate rocks that make up the Julian Alps, the Kamnik–Savinja Alps, and the Karawanks were deposited on the Julian Carbonate Platform, and on the southern side, the carbonate rocks that make up the Dinaric karst plateaus were deposited on the Dinaric Carbonate Platform (Buser et al. 1989; Novak 2016).

Volcanos along deep faults spewed lava and ash, leaving behind volcanic rocks and tuffs, which appear between layers of other rocks. This suggests that the largely submarine volcanic eruptions repeated several times. The Ladinian tectonic and volcanic activity is also connected with the formation of the Idrija mercury deposits and the Mežica lead and zinc deposits (Pleničar 2004; Novak 2016).

Toward the end of the Ladinian, some blocks rose from the sea as dry land in the area of the Karawanks and Idrija. Erosion there removed part of the older rocks, which were resedimented into colorful conglomerates (Buser et al. 1989).

During the Carnian, massive limestone deposits with frequent fossil remains of calcite algae initially formed on both carbonate platforms. A large portion of this limestone later turned into dolomite. When the inner part of the Dinaric Carbonate Platform turned into dry land for a short while, reddish sandstones, clay stones, and breccias formed alongside bauxite. During the Norian and Rhaetian, reef limestone formed on Mount Begunjščica (2060 m) and in the Bohinj Valley, whereas thick-bedded Dachstein limestone deposits with stromatolites and large megalontidae formed elsewhere on the Julian Carbonate Platform (Fig. 2.3). At the same time, shallow marine limestone deposits formed on the Dinaric Carbonate Platform, which later turned into Main Dolomite (Vrabec et al. 2009).

Approximately 1200 m of Dachstein limestone and Main Dolomite were deposited on the Julian and Dinaric Carbonate Platforms, whereas only 350 m of platy limestone and dolomite with nodules or lenses of chert formed in the Slovenian Basin (Novak 2016).

At the end of the Triassic, Pangaea broke up into Laurasia and Gondwana. During the Atlantic rifting, a narrow oceanic trough initially developed from transform basins. Its expan-

Fig. 2.3 View of thick layers of Late Triassic Dachstein limestone along the ridge of Mount Velika Mojstrovka in the Julian Alps. (Photo by Ales Krivec, Shutterstock.com)

sion during the Jurassic caused the formation of deep marine basins and submarine plateaus, which existed up until the end of the Cretaceous (Vrabec et al. 2009).

During the early Jurassic, the Slovenian Basin deepened again, with deep marine platy limestones with chert and marl forming inside it. The sea also deepened somewhat on both carbonate platforms and calcite ooids up to 2 mm developed in it, making up thick layers of oolitic limestone. An especially interesting feature found in southern Slovenia is black limestone with white cross sections of lithiotid bivalves (Buser et al. 1989).

During the Lower Jurassic, the Julian Carbonate Platform became mainland for a short while, before sinking again deeper into the sea, where reddish nodular and crinoidal limestones with ammonites formed. In the deep sea of central Slovenia, clay stone, marl, and chert deposits formed. At that time the Slovenian Basin sunk deepest, with radiolarites accumulating from tiny radiolarian skeletons at its bottom (Buser et al. 1989).

During the Upper Jurassic, a large coral reef formed along the northern edge of the Dinaric Carbonate Platform. It ran relatively contiguously from Northern Italy across the Banjšice Plateau, the Trnovo Forest Plateau, and the Hrušica Plateau to Trebnje, Novo Mesto, and White Carniola, and onward toward Croatia. The southern part of this carbonate platform rose above the sea for a short while, with bauxite forming in some places. White platy limestones with chert accumulated in the deep sea of the Slovenian Basin and the Julian Carbonate Platform. At the end of the Jurassic and the beginning of the Cretaceous, extensive beds of green algae thrived in the shallow marine lagoon of southern Slovenia (Buser et al. 1989).

On the Dinaric Carbonate Platform, shallow marine sedimentation with short breaks and deep marine stages continued for most of the Cretaceous. Extensive stretches of limestone with rich deposits of rudists and other fossils formed in what is now the Karst Plateau. In the past, in many places these limestones were quarried as decorative natural stone, but today they continue to be extracted only at the quarry near Lipica (Pleničar 2004; Novak 2016).

During the Cretaceous, Alpine and central Slovenia was covered by deep sea, in which flysch marlstones and sandstones initially formed, and later on also the characteristically red marlstones and marly limestones. Elsewhere in the Alps, these rocks—which have been best preserved near Mount Krn (2245 m)—were largely eroded away. Platy limestones with layers of marlstones and sheets of chert formed in the Slovenian Basin (Buser 1997).

During the rifting of the North Atlantic Ocean in the Cretaceous, the Eurasian Plate broke away from Laurasia. At the end of the Cretaceous, the oceanic part of the Adriatic microplate traveling north collided with the Eurasian Plate, lifting the land and causing the displacement of large quantities of terrestrial and marine sediments and the deposition of various flysch rocks. Flysch initially filled the area of the Slovenian Basin and later on also the territory at the foothills of the rising Alps, reaching and covering the northern edge of the Dinaric Carbonate Platform even before the end of the Cretaceous (Novak 2016).

Fig. 2.4 Most of the Slovenian coast and the cliffs in the Bay of Strunjan are composed of Eocene flysch sandstones and marlstones. (Photo by Dejan K, Shutterstock.com)

2.2.3 The Cenozoic

During the Paleocene and Eocene at the beginning of the Cenozoic, the flysch marlstones and sandstones that make up the Gorica Hills, Vipava Valley, Pivka Lowland, Brkini Hills, and Koper Hills were deposited in the deep sea of southwestern Slovenia (Fig. 2.4). These rocks are also thought to have once covered a large portion of today's Dinaric Karst region, but they have only been preserved in smaller patches in southeastern Slovenia. Shallower sections of the sea were populated by numerous foraminifers, whose tests form the miliolid, nummulitic, and alveolina limestones below Mount Slavnik (1028 m) in southwestern Slovenia (Buser 1997).

The collision between the continental part of the Adriatic microplate and the Eurasian Plate during the Paleogene caused the formation of the Alps, the Dinaric Alps, and the Carpathians, which separated the Paratethys Sea from the Atlantic and Tethys oceans during the Oligocene. The Paratethys covered Slovenian territory up until the Pliocene. Paratethys sediments and sedimentary rocks predominate in eastern Slovenia and in the Ljubljana Basin (Novak 2016).

During the Oligocene, central Slovenia was characterized by large swampy basins, in which layers of marlstones and clastic sediments were deposited. They included thick layers of brown coal, which was mined for decades in Zagorje ob Savi, Trbovlje, Hrastnik, Laško, and Senovo in central Slovenia (Buser et al. 1989).

The lithospheric plate collision along the Periadriatic Seam (Fig. 2.6) caused magma to rise toward the surface. The Mount Smrekovec volcanism became active in the sea, beginning with eruptions of lava flows and continuing with explosive eruptions of volcanic ash. Andesite and its tuff predominate among the rocks of volcanic origin; they can be found among the layers of marine sedimentary rocks in a wide belt along the upper course of the Savinja River and around Radovljica, Celje, and Rogaška Slatina (Novak 2016).

During the Miocene, western and northeastern Slovenia sank quickly, creating the extensive Pannonian Basin, into which rivers deposited large volumes of sediments, which later consolidated into sandstones, conglomerates, and clay stones. In the Pohorje Hills, metamorphic rocks rose to the surface, and a large granodiorite body intruded between them; this process was accompanied by dacitic volcanism (Vrabec et al. 2009).

During the Middle Miocene, deposits of lithothamnian limestones, marls, and sands formed in eastern Slovenia, followed by a thick succession of clastic sediments (Buser 1997; Vrabec et al. 2009).

The Neogene shortening of the area south of the Periadriatic Seam caused the folding and thrusting of tectonic blocks in a north–south direction. The thrusting, which began during the Middle Miocene, mostly subsided by the Pliocene, even though it probably still continues in the Julian Alps and its surroundings today (Vrabec et al. 2009).

During the Pliocene, the rivers in eastern Slovenia filled the large depression that remained after the receding sea mostly with quartz gravel. The emerging dry land was broken apart, lifted, and sunken by tectonic forces. During the Middle Pliocene, large tectonic depressions filled by lakes formed in Slovenia's interior. A lignite layer up to 160 m thick formed from the extensive Upper Pliocene forests near Velenje; thinner lignite layers developed at Ilirska Bistrica and near Krmelj (Buser 1997).

The last volcanic eruptions in Slovenia's vicinity took place during the Late Pliocene, with Austrian Styria as the center of volcanic activity. It began with the release of basaltic lava, followed by several explosive eruptions of ash, which formed the basaltic tuff in the Goričko Hills in the northeast of the country (Novak 2016).

Due to large variation in temperature, the Quaternary was characterized by the growth and retreat of glaciers. During the period of the lowest temperatures, glaciers extended from the Alpine high mountains far into the foothills. Their moraine material is still visible in the upper Alpine valleys of both branches of the Sava, Soča, and Savinja rivers, as well as in the Pohorje Hills, and on the Trnovo Forest Plateau and Mount Snežnik. In the Ljubljana, Brežice–Krško, and Celje basins and the Maribor–Ptuj Plain, the rivers deposited enormous quantities of gravel, which has already been cemented into conglomerates in places (Fig. 2.5). In the Ljubljana Marsh, the gravel is also covered by silt and clay (Šifrer 1969; Buser 1997; Novak 2016).

2.3 Tectonic Division

The structure of Slovenian territory is connected with the development of the Tethys Ocean and its shrinking during the Mesozoic and Cenozoic due to the African and Eurasian plates drifting closer to one another. An important role in this was played by the intermediate Adriatic microplate, which, seen from a geotectonic perspective, is the edge of the African Plate (Placer 1999).

Slovenia is located at the intersection of the geotectonic units of the Dinarides, Southern Alps, Eastern Alps, and Pannonian Basin (Fig. 2.6). Their current distribution was largely achieved only as late as the Neogene. All of its structural units are part of the Adriatic Plate, and the boundaries between them run along the Periadriatic, Lavanttal, Ljutomer, and Sava faults as well as the South Alpine thrust front and the external front of the thrust area of the External Dinarides (Poljak 2007; Celarc and Placer 2016).

The Dinarides are divided into the External and Internal Dinarides and a transitional area between the two. Slovenia only includes the External Dinarides and the transitional area, whereas the Internal Dinarides, which are characterized by deep marine sediments and ophiolites, are located in neighboring Croatia. In terms of sedimentation, the External Dinarides cover the majority of the Dinaric area and a smaller part of the Adriatic area of the Adriatic–Dinaric Mesozoic Carbonate Platform.

Fig. 2.5 Peričnik Falls in the Vrata Valley near Mojstrana cascades over a 52-m Pleistocene conglomerate cliff. (Photo by Sasha Taran, Shutterstock.com)

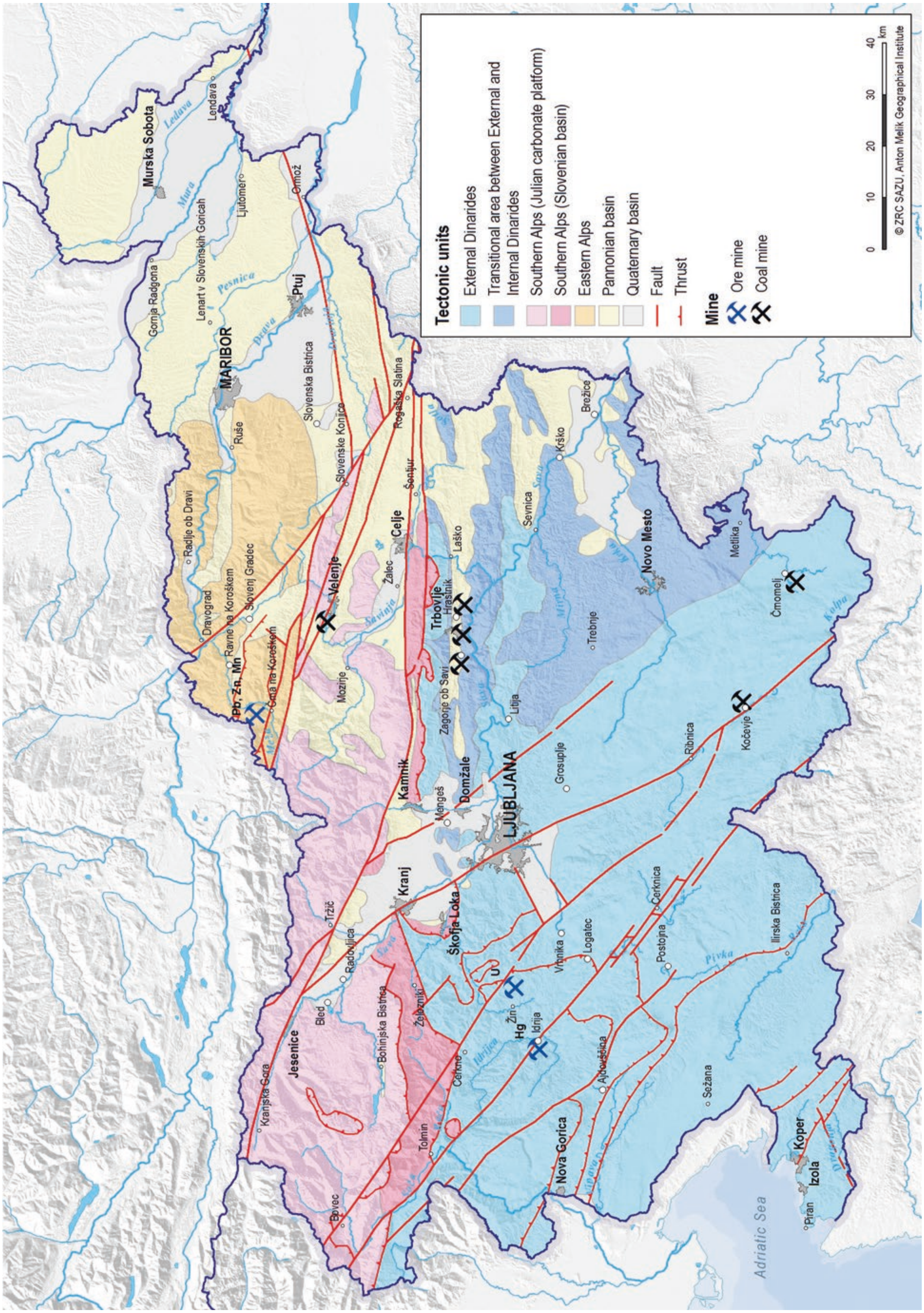

Fig. 2.6 Slovenia's tectonic structure

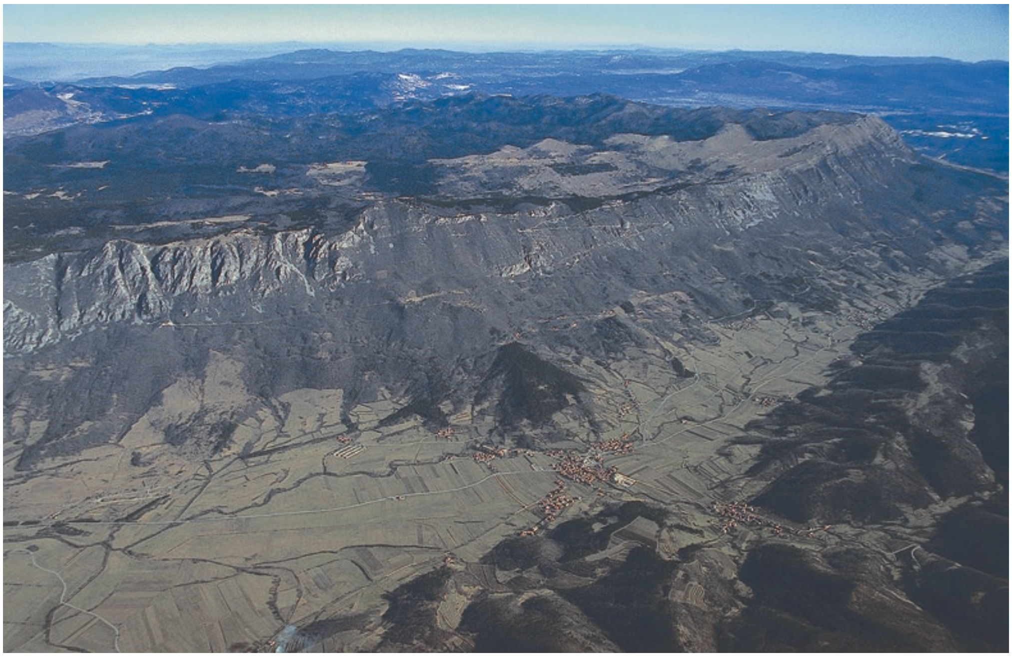

Fig. 2.7 The steep thrust front of Mount Nanos above the flysch Vipava Valley. (Photo by Marjan Garbajs, GIAM ZRC SAZU Archive)

The External Dinarides are characterized by the thrust and nappe structure that formed at the end of the Eocene and the beginning of the Oligocene. It is composed of extensive Mesozoic carbonate rock nappes thrusted one on top of the other. The thrusting proceeded in a northeast–southwest direction, with thrust sheets sliding across the Paleozoic bedrock. They are thrusted onto soft Eocene flysch layers at the front.

Typical examples of thrusting in the area of the External Dinarides include the Trnovo and Hrušica nappes and the Snežnik thrust block (Fig. 2.7; Placer 1999, 2008; Celarc and Placer 2016).

Paleogeographically, the Southern Alps are part of the Dinarides, but they separated during the Miocene. They border the Periadriatic, Lavanttal, and Ljutomer faults in the north and the South Alpine thrust front and the Sava fault in the south. They are composed of the Upper Triassic rocks of the Julian Carbonate Platform and the Mesozoic rocks of the Slovenian Basin. They include the Julian Alps, the Kamnik–Savinja Alps, the western Karawanks, the Paški Kozjak Hills and Mount Boč, the Alpine hills along the Bača and Selška Sora Rivers, and part of the Škofja Loka Hills.

The thrust sheets of the Southern Alps largely formed between the Eocene and Middle Oligocene. Because of the north–south direction of thrusting, the ridges of the mountains and hills predominantly run in a west–east direction (Placer 2008).

The Eastern Alps are composed of the Precambrian and Early Paleozoic metamorphized rocks and the Permian and Mesozoic sedimentary rocks north of the Periadriatic Seam. The Kozjak Mountains, Pohorje Hills, Mount Strojna, and eastern Karawanks with Mount Peca and Mount Uršlja gora form part of the Eastern Alps in Slovenia (Placer 2009).

The Eastern Alps are made of extensive nappes called the Austroalpine nappes. These are pressed and stretched remnants of rocks that were deposited on the edges of the intermediate sea between the Adriatic and Eurasian plates. The nappes formed during the Cretaceous and Tertiary orogeny, and because of their close links to the thrusted Adriatic microplate, they are considered part of this plate. In addition to its nappe structure, another important feature of the Eastern Alps is plutonism, which is divided into Periadriatic tonalite intrusions and Pohorje granodiorite pluton with dacitic sills and dykes. The Periadriatic intrusion, which includes the southern belt of the Eisenkappel magmatic zone, dates back to the Oligocene (c. 32 million years ago), and the Pohorje pluton with dacite dates back to the Miocene (18–19 million years ago). Because of the age difference and a different location, the Pohorje granodiorite is not classified under Periadriatic intrusions (Placer 2008; Fodor et al. 2008).

The Pannonian Basin includes a series of Paleogenic and Neogenic depressions filled with Paratethys Sea sediments. The Paratethys Sea was the sea that stretched between the Pannonian Plain and the Black Sea in parallel with the Tethys Ocean during the Neogene (Placer 2009).

The Pannonian Basin began to form more intensely with the post-collision tectonic escape of the Eastern Alps toward the east during the Early Miocene. Due to the interchanging extensional and compressional conditions, this was a polyphase development. The results of these processes are the numerous subbasins in northeastern Slovenia, which developed from the Mura–Zala Basin and the Styrian Basin. The western edges of the Pannonian Basin also feature isolated basins in the Eastern and Southern Alps and the Dinarides, the most prominent among which are the Smrekovec, Celje, Tunjice–Motnik, Laško, Planina, Senovo, Krško, and Bohinj basins (Jelen et al. 2008; Placer 2008).

Another geotectonic unit in Slovenia's immediate vicinity is the Adriatic–Apulian foreland, which represents the solid core of the Adriatic microplate. It covers the major portion of Istria and is composed of the rocks of the Adriatic–Dinaric Mesozoic Carbonate Platform and the flysch rocks that formed during its degradation. The foreland extends to the border with the External Dinarides, which runs across the northern part of Croatian Istria (Placer 2008).

Slovenian territory is intersected by numerous faults and fault zones, which developed after the collision of the Adriatic and Eurasian plates. The most prominent is the Periadriatic tectonic zone, which runs from west to east and is bordered by the Periadriatic Seam in the north and the Sava Fault in the south. The Šoštanj and Donat faults are the most important faults in the Periadriatic tectonic zone, which is diagonally intersected by the Lavanttal Fault. The Periadriatic Seam east of Zreče runs along the Ljutomer Fault (Placer 1999).

The Mid-Hungarian or Zagreb tectonic zone runs in a wide belt between Krško and Zagreb in a southwest–northeast direction or toward central Hungary. The zone has not been thoroughly studied yet, and so there is no agreement on where individual faults run. More important among them are the Orlica Fault in the northwest of the zone and the Zagreb Seam in the southeast (Placer 1999).

The Idrija tectonic zone includes faults in the External Dinarides running from northwest to southeast. The central place belongs to the Idrija Fault, and other important faults also include the Divača, Raša, Sovodnje, Želimlje, and Stična faults (Placer 1999). The Periadriatic, Mid-Hungarian, and Idrija fault zones make up a triangle in which the Sava folds formed (Placer 1998).

During the Late Pliocene and Early Pleistocene, numerous faults cut Slovenian territory into large blocks. High plateaus, such as Pokljuka and Jelovica, formed on raised blocks, with extensive basins, such as the Ljubljana, Brežice–Krško, and Celje basins, lying in between (Buser et al. 1989).

2.4 Mineral and Energy Raw Materials

Mineral raw materials include minerals and rocks of economic significance. They are divided into metallic and nonmetallic mineral raw materials. Metal raw materials comprise ores, from which metals are extracted, including native elements, sulfides, oxides, hydroxides, carbonates, and silicates. Native elements include mercury and copper, sulfides include cinnabar, galena, sphalerite, and chalcopyrite, and oxides include uraninite, hematite, and magnetite (Drovenik 1993).

In Slovenia, mercury, lead–zinc, uranium, antimony, copper, iron, and manganese ores formed in various geological eras, rocks, and conditions (Drovenik 1993). Here, special mention should be made of the Idrija mercury mine and the Mežica lead and zinc mine.

The Idrija mine is the second-largest mine in the world in terms of the volume of mercury extracted. Ore mining began as early as 1490, and over nearly five centuries, 144,000 tons of mercury were extracted from it; this equaled 13% of the total world production (Cigale 2005). Mineralization was triggered by Middle Triassic magmatic and tectonic activity, which affected Late Paleozoic and Early and Middle Triassic sedimentary rocks. The ore mineral extracted was cinnabar, but native mercury was also mined in the last years of the mine's operation (Fig. 2.8; Drovenik 1993).

The 1.5-km-long and 300- to 600-m-wide ore deposit lies directly below the town of Idrija. The mineralized area is 420 m deep, and the total length of shafts maintained exceeded 150 km. Even though the ore deposit had not been fully exhausted, production was temporarily halted in 1977 and terminated for good in 1986 (Cigale 2005). The abandoned Anthony's Shaft has been converted into a museum.

Lead and zinc deposits in the Upper Mežica Valley between Mount Peca and Mount Uršlja gora were already discovered by the Romans. The first written sources on mining date back to 1665 (Fajmut Štrucl 2005). The Middle Triassic carbonate rocks mineralized with galena and sphalerite contain approximately 5% lead and zinc. The ore minerals formed during sedimentation and later processes taking place within the sediments. Galena has no accessory components, and therefore extremely pure lead was produced by the smelting plant at Žerjav. In contrast, sphalerite contains some cadmium and germanium. In Mežica, a molybdenum concentrate containing up to 23% molybdenum was also extracted from wulfenite (Drovenik 1993).

The processing industry developed in parallel with the Mežica mine. In the second half of the nineteenth century, zinc ore was mined alongside lead ore. Zinc concentrate was extracted from the zinc ore and sold to the Celje zinc plant and abroad. Toward the end of the twentieth century, the use of lead declined, and the mine was closed, also because of environmental problems (Fajmut Štrucl 2005). Part of the mine's shafts are now open to visitors.

In the past, mercury ore was also mined in Podljubelj north of Tržič, lead ore was extracted in Litija and elsewhere in the Sava Hills, antimony ore was mined at Trojane, and copper ore was extracted on Škofje Hill above Cerkno. An iron ore called siderite was extracted in the area between Jesenice and Tržič, and near Vitanje, and crusty limonite ore and iron pisolites were extracted on the surface on the

Fig. 2.8 Reddish cinnabar ore was mined for five centuries in Idrija. (Photo: Rudnik živega srebra Idrija, GIAM ZRC SAZU Archive)

Pokljuka and Jelovica plateaus in the Julian Alps. Of economic relevance was also the manganese ore mined at Mount Begunjščica northwest of Tržič (Drovenik 1993).

Economic exploitation of nonmetallic mineral raw sources is also important in some places. The most important raw materials of this type include quartz sand, chert, calcite, clays for the ceramics and brick industry, cement raw materials, and natural, decorative, and technical stone (Pirc and Herlec 2009).

In Slovenia, extracting energy raw materials, such as coal, hydrocarbons, and nuclear raw materials, is primarily intended for fulfilling domestic needs. Coal has a low calorific value because Slovenia barely has any real hard coal. Brown coal and lignite are more common and important. The brown coal at Trbovlje, Hrastnik, and Zagorje ob Savi formed during the Oligocene, whereas the brown coal in Kočevje and Kanižarica and the lignite in Velenje date back to the Miocene and Pliocene (Pleničar 2004; Bajželj 2005).

Many coal mines were closed after 1970. Slovenia now has only one left (in Velenje), and so it needs to import its coal, which is a vital energy raw material. The country generates approximately one-third of its electricity from the coal-fired power plant in Šoštanj (Bajželj 2005).

Oil and natural gas were discovered in 1943 near Lendava. Immediately after the Second World War, hydrocarbons began to be extracted at the Petišovci oil and gas field and the Dolina gas field. Production is currently very low (Pirc and Herlec 2009).

The Middle Permian Gröden layers at Žirovski Vrh near Žiri contain uranium ore. Both ore minerals (uraninite and coffinite) are dispersed in a cement of gray quartz sandstone, and the ore-bearing zone is up to 200 m thick. Ore began to be extracted in 1982, but the production of uranium oxide was not economical and therefore halted as early as 1990 (Drovenik 1993). Uranium ore deposits around Žirovski Vrh are estimated at 25,000 tons, more than 15,000 of which could be extracted. These ore deposits are sufficient to fuel one nuclear power plant for more than 20 years (Viler 2005).

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3 Landforms of Slovenia

Matija Zorn, Mateja Ferk, Matej Lipar, Blaž Komac, Jure Tičar, and Mauro Hrvatin

Abstract

Slovenia has very heterogeneous landforms because it lies at the intersection of the Alps, Dinaric Alps, Pannonian Basin, and Adriatic Sea Basin, all characterized by unique geology, tectonics, and geomorphic processes. Four major geomorphic landscape types can be defined based on their genesis. More than half of Slovenian territory has fluvial characteristics dominated by valleys and ridges. This is followed by karst terrain on roughly two-fifths of the territory, dominated by dolines, caves, and the absence of surface drainage. Glacial and coastal landscapes, dominated by glacial valleys and moraines and by coastal cliffs, respectively, are the least common types at the national scale. In addition, human activities such as mining, agriculture, and urbanization have influenced the landscape over the years, playing an important role in today's cultural landscape as an anthropogenic landscape.

Keywords

Physical geography · Geomorphology · Karst landscapes · Fluvial landscapes · Glacial landscapes · Coastal landscapes · Anthropogenic landscapes

3.1 Basic Landscape Characteristic

Slovenia lies at the intersection of the Alps, Dinaric Alps, Pannonian Basin, and Adriatic Sea Basin. It thus has a diverse topography, the formation of which is a result of interconnected components of tectonic and geomorphological processes. They formed a diverse landscape containing various *genetic types* (according to origin; Figs. 3.1 and 3.2) and *morphological types* (landform units according to topography; Figs. 3.3 and 3.4) (Gabrovec and Hrvatin 1998). Lithology and geological structure are often reflected in the landscape. The influence of rocks is especially notable in karst landscapes (Habič 1988), while elsewhere in Slovenia their influence is limited as rocks are usually tectonically highly disturbed (Hrvatin 2016). Using analysis of morphometric characteristics of topography in various geological settings, Hrvatin (2016) demonstrated that around 20% of the topography could be explained by the influence of lithology. In addition, based on three study areas, he discovered that the influence of tectonic structures is similar to the influence of lithology. Geological structures strongly influenced the directions of valleys and ridges. Clear examples are the influence of Alpine faults (in an east–west direction; e.g., the Upper Sava Valley formed alongside the Sava Fault) and Dinaric faults (in a northwest–southeast direction; e.g., the Inner Carniola lowland formed alongside the Idrija Fault Zone) (Gabrovec and Hrvatin 1998; Kunaver 2004).

More than half of Slovenia is characterized by a fluvial landscape (Tables 3.1 and 3.2), with a predominantly erosional type (66%). Erosional fluvial landscapes dominate in Alpine regions, and depositional fluvial landscapes dominate in Pannonian regions. They are followed by karst landscapes, which characterize two-fifths of Slovenian territory, with corrosion as the main geomorphological process. Almost two-thirds of these developed on limestone and a third developed on dolomite. Karst landscapes dominate in Dinaric regions, followed by Alpine regions (around a quarter) and Mediterranean regions (a tenth). Glacial landscapes are characteristic of mountainous regions in western and northern Slovenia and partly also in the Dinaric Alps. Especially during colder periods of the Quaternary, these landscapes were subject to glacial abrasion and deposition. Coastal landscapes are characteristic for the Slovenian Adriatic coastline as well as some shores of large lakes, with abrasion and

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© Springer Nature Switzerland AG 2020
D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_3

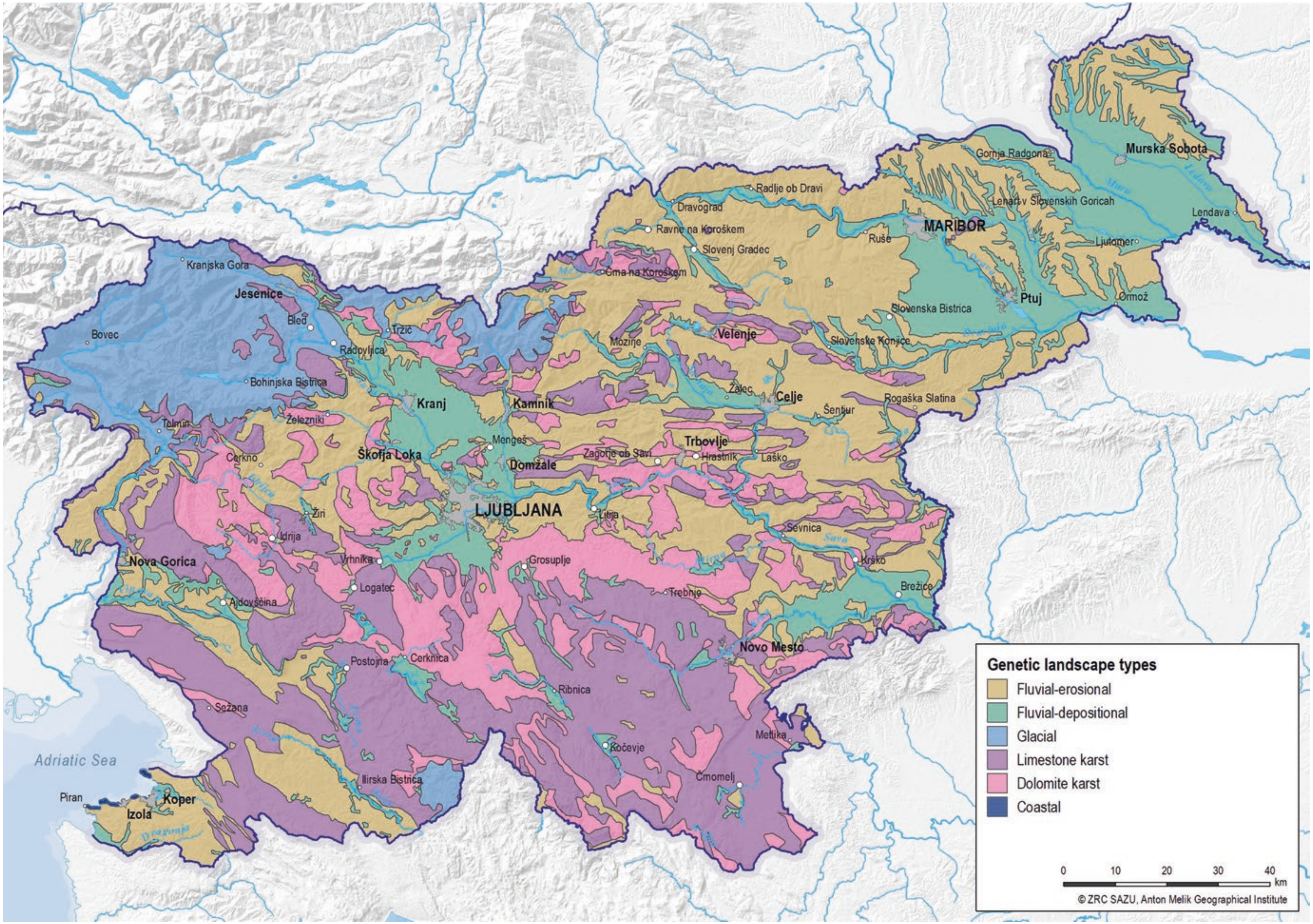

Fig. 3.1 Genetic landscape types in Slovenia according to Gabrovec and Hrvatin (1998; Fridl et al. 2001)

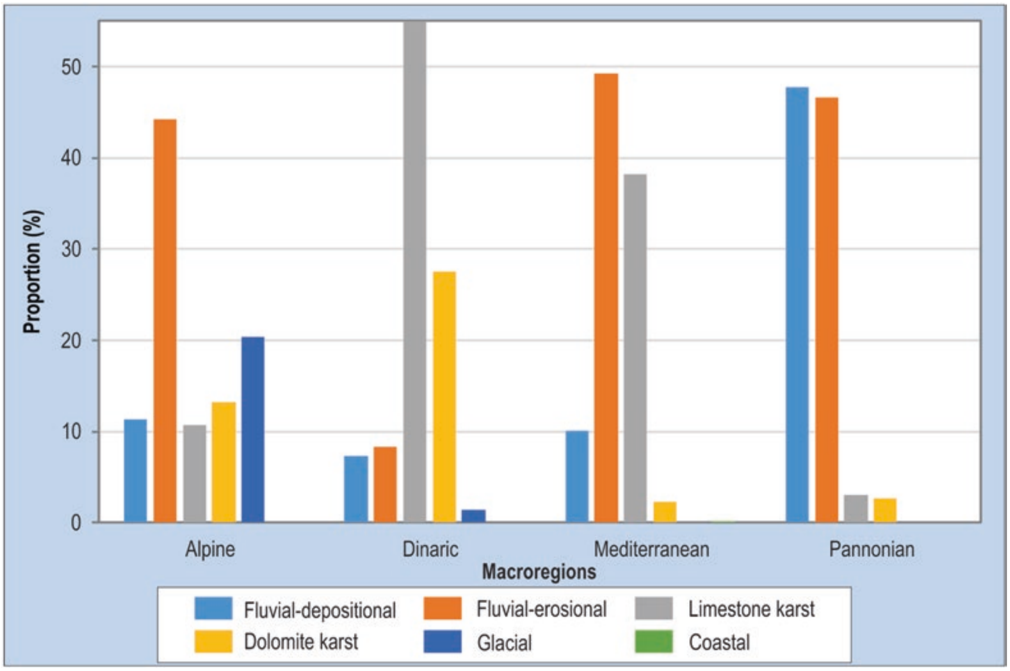

Fig. 3.2 Distribution of genetic landscape types in physical-geographical macroregions. (Based on Fig. 3.1)

deposition as the main geomorphological processes. Some regions, however, are characterized by multiple genetic landscape types. For example, karst is formed on certain depositional fluvial landscapes with limestone conglomerate, or on certain mountain areas that were reshaped by glaciers in the Pleistocene, and where the chemical weathering of carbonate rock dominates today so that glaciokarst landforms prevail. Anthropogenic landscapes are limited and mostly related to mining activity and erosional-depositional processes related to dammed lakes (Andonovski et al. 1992; Gabrovec and Hrvatin 1998). Of special interest are underwater geomorphological features such as deltas in the sea or lakes, karst underwater springs close to the town of Izola, a topographical step that follows the coastline at a depth of around 10 m, and drowned riverbeds that were formed in the Pleistocene when the sea level was lower. The Pleistocene surface with relicts of riverbeds and meanders was covered with sea again in the Holocene, and it is now subject to shallow sea sediment deposition.

Based on morphology, there are six *landform units* (Fig. 3.3). Flat land (10.1% of the surface) is characterized by depositional processes, whereas hills (26.2%) and low hills (21.3%) are characterized by fluvial and erosion processes. Mountains (8.7%), glaciated during the Pleistocene, are at present characterized by fluvial and erosion processes and corrosion due to the dominance of carbonate rocks. Due to lithology, corrosion is a dominant process on low karst plateaus (10.2%) and high karst plateaus (23.5%; Fig. 3.4; Gabrovec and Hrvatin 1998).

The average elevation of Slovenia is 553 m, which is only around two-thirds of the world average (870 m). The highest average elevation is in the Alpine macroregion (732 m), followed by the Dinaric (580 m), Mediterranean (352 m), and Pannonian (261 m) macroregions. Almost a fifth of Slovenian territory lies in a belt between 200 and 300 m. The elevation belt between 0 and 200 m, which is characterized by Mediterranean and Pannonian flat lands, corresponds to only a tenth of Slovenian territory, and regions below 100 m comprise only 1% of Slovenian territory. In the elevation belt between 200 and 400 m, which contains almost a third of Slovenia, are mostly Mediterranean and Pannonian low hills, valleys, and basins. In the elevation belt between 400 and 800 m, which includes almost two-fifths of Slovenia, are mostly hills. In the belt between 800 and 1200 m (an eighth of Slovenia) are high hills and high plateaus. Eighty percent of Slovenian territory lies below 700 m, only 9% of the territory over 1000 m, and only 6% over 1200 m (Perko 1998a; Ogrin and Plut 2012).

The average slope inclination in Slovenia is 13°; the steepest is found in the Alpine macroregion (18°), followed by the Dinaric (11°), Mediterranean (10°), and Pannonian (6°) macroregions. Almost a quarter of Slovenia is characterized by a slope inclination between 12° and 20°, followed by an inclination span of 6–12° (a fifth of the territory) and 20–30° (a sixth of the territory). A flat landscape (0–2°) is only present in a sixth of the territory (Perko 1998b).

An east–west ridge direction dominates in the largest Alpine macroregion, and thus almost a third of the

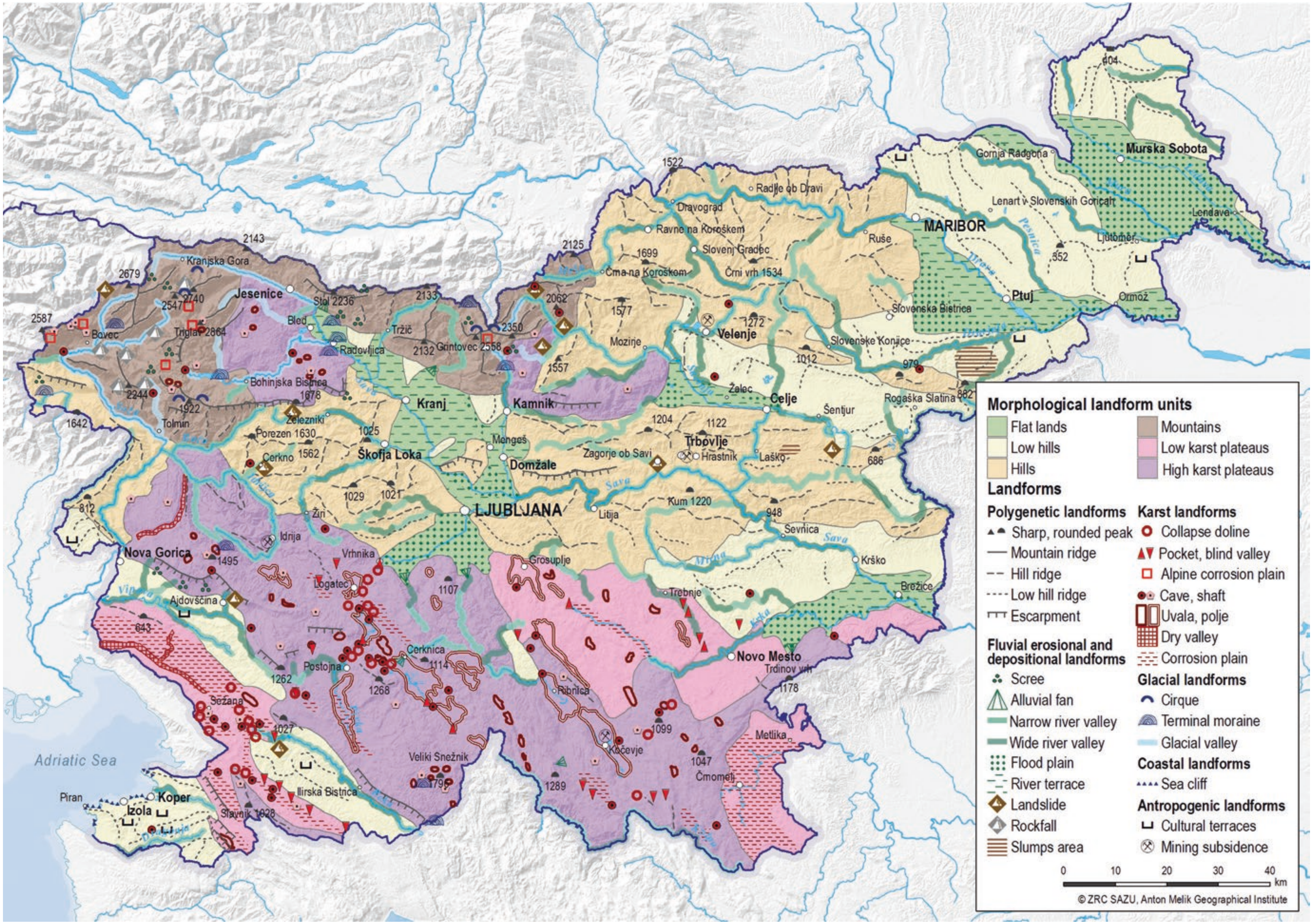

Fig. 3.3 Landform units and their typical landforms (Gabrovec and Hrvatin 1998; Fridl et al. 2001)

macroregion has a northern or southern exposure, and only a fifth has an eastern or western exposure. In the Dinaric macroregion, the prevailing ridge direction is northwest–southeast, and consequently almost a third of the macroregion has a northeast or southwest exposure, and less than a fifth has a northwest or southeast exposure. An eastern exposure (16.7%) dominates in the Pannonian macroregion, followed by northwest (7.6%). In the Mediterranean macroregion, most of the land has a southern exposure (14.7%), and the least has an eastern exposure (7.5%; Perko 1998c). In general, the greatest share of Slovenian territory has a southern exposure (14.7%), followed by southeast (13.7%), eastern (12.3%), northern (11.5%), western (10.7%), and northwest (9.2%). The greater amount of southern than northern exposures is a result of the border between Austria and Slovenia; namely, the northern slopes of the Karawanks are mostly in Austria (Ogrin and Plut 2012).

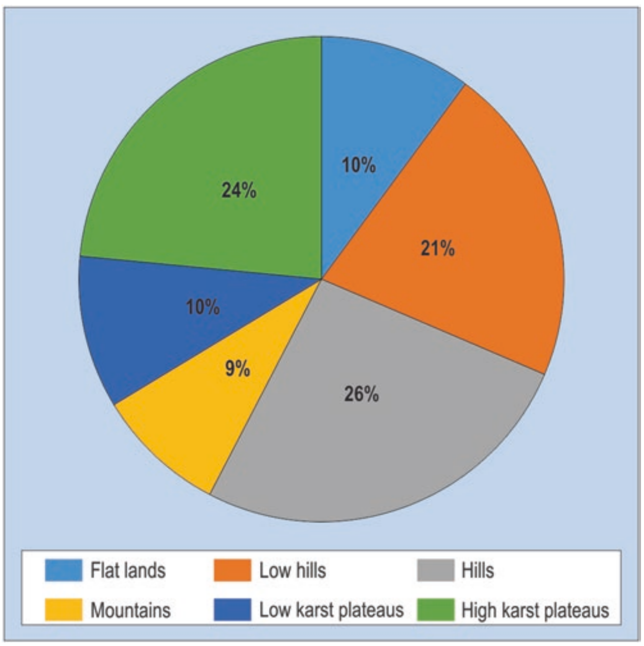

Fig. 3.4 Landform units. (According to Fig. 3.3)

3.2 Karst Landscapes

Karst landscapes are characterized by the dissolution of carbonate rocks by water enriched with CO_2. The rock is removed as a solution, and underground drainage prevails, forming caves and other characteristic karst depressions. The denudation rate of the karst surface in Slovenia by corrosion is around 2–10 μm (Gabrovec and Hrvatin 1998). In some areas, denudation is also accelerated by frost weathering.

Slovenia currently has almost 13,000 registered caves. In addition to distinctive surface features (e.g., dolines) and subterranean features (e.g., caves), karst terrain is also characterized by the absence of surface drainage patterns and generally flat plains. In Slovenia, *Kras* is the name of the Karst Plateau in southwest Slovenia, and *kras* is also a generic word referring to rocky, barren limestone or dolomite karst terrain (Ferk and Zorn 2015).

Although the Karst Plateau is now overgrown by pine forest due to reforestation in the last century (Zorn et al. 2015), this region has become a classical reference site for the karst-type landscape (Gams 2004; Mihevc et al. 2016).

Based on lithology, karst landscapes in Slovenia are divided into limestone karst and dolomite karst (Tables 3.1 and 3.2). Limestone karst is characterized by depressions such as solution dolines (Fig. 3.5), poljes, and conical hills (Table 3.3). The density of karst depressions can reach more than 200 per km² (Fig. 3.6). Poljes, such as the Cerknica

Table 3.1 Genetic landscape types in Slovenia

Type, *subdivision*	Description	Gabrovec and Hrvatin (1998), 1:750,000		Andonovski et al. (1992), 1:500,000	
		km²	%	km²	%
Fluvial	Dominates on less permeable rocks with surface drainage	*10,692.51*	*53*	*10,530.51*	*52*
Erosion	Characteristic of high-topography landscapes with valleys and ridges	*7097.86*	*35*	*6684.78*	*33*
Deposition	Characteristic of flat landscapes and plains	*3594.65*	*18*	*3845.73*	*19*
Glacial	Formed due to glacial erosion and deposition, especially during colder periods of the Quaternary	1829.90	9	1368.22[a]	6.7[a]
Karst	Characterized by chemical weathering of carbonate rocks (limestones and dolomites), circular surface depressions, and subsurface drainage	7747.55	38	8374.19	41.3
Limestone		*4884.24*	*24*	*3911.10*	*19.3*
Dolomite		*2863.31*	*14*	*4463.09*[b]	*22*[b]
Coastal	Limited to a narrow Adriatic coastal belt and shores of large lakes	2.02	0.0001	–	–
Abrasion	Occurs where waves erode the coastline				
Deposition	Occurs where water flows discharge into the sea/lake				

[a]Glacio-nival landscape
[b]Fluviokarst

Table 3.2 Genetic landscape types in physical-geographical macroregions (Based on Fig. 3.1)

	Macroregion							
	Alpine		Dinaric		Mediterranean		Pannonian	
Type	km²	%	km²	%	km²	%	km²	%
Fluvial	4747.40	55.59	890.66	15.61	1028.57	59.35	4045.52	94.30
Deposition	*964.66*	*11.29*	*415.27*	*7.28*	*174.32*	*10.06*	*2047.20*	*47.72*
Erosion	*3782.74*	*44.29*	*475.39*	*8.33*	*854.25*	*49.29*	*1998.32*	*46.58*
Karst	2050.81	24.01	4733.78	82.95	702.74	40.55	244.31	5.70
Limestone	*918.26*	*10.75*	*3163.03*	*55.42*	*662.85*	*38.25*	*130.17*	*3.03*
Dolomite	*1132.55*	*13.26*	*1570.75*	*27.52*	*39.89*	*2.30*	*114.15*	*2.66*
Glacial	1742.54	20.40	82.49	1.45	–	–	–	–
Coastal	–	–	–	–	1.75	0.10	–	–

Fig. 3.5 Dolines on the Podgorje Karst Plateau in southwestern Slovenia. (Photo by Jure Tičar, GIAM ZRC SAZU Archive)

Polje, Planina Polje, Ribnica Polje, and Kočevje Polje, are characterized by specific hydrological settings with springs and ponors (Fig. 3.3; Gabrovec and Hrvatin 1998).

Dolomite karst is characterized by dry shallow valleys, or dells (Fig. 3.7; Komac 2003), resulting in a topography similar to fluvial topography, but the prevailing geomorphic processes are corrosion and erosion (Table 3.3). These types of landscapes can be termed fluviokarst (Komac 2004). Surface karst features are rarer, and there are fewer long and deep caves (Gabrovec and Hrvatin 1998).

Based on general morphological and hydrological conditions and evolutionary history, karst areas in Slovenia are divided into three main types (Fig. 3.8; Mihevc 1998; Mihevc et al. 2016): Alpine karst, subalpine and isolated karst, and Dinaric karst.

Based on the physical-geographical regionalization of Slovenia, karst topography prevails in the Dinaric macroregion (part of the Dinaric karst), where it comprises over four-fifths of the surface (82.9%; Table 3.2, Fig. 3.1). Karst topography is also present in the Mediterranean macroregion (also part of the Dinaric karst), corresponding to two-fifths of the surface, as well as in the Alpine macroregion (part of the Alpine and subalpine and isolated karst), corresponding to at least a quarter of the surface (much of the karst topography here occurs alongside glacial topography). Only 5% of karst topography occurs in the Pannonian macroregion (part of the isolated karst).

Alpine karst is developed in the Julian Alps, Karawanks, and Kamnik–Savinja Alps. It is characterized by dynamic surface relief and deep karst groundwater (Ogrin and Plut 2012). Karst springs appear at the bases of the mountains. Due to the great elevation difference between the tops of the mountains and the valleys, deep vertical shafts have formed. The deepest shaft in Slovenia (and currently the tenth deepest in the world) is Čehi 2 Cave in the Julian Alps with a

Table 3.3 Basic characteristics of limestone and dolomite karst geomorphic systems

Characteristic	Limestone karst	Dolomite karst
Basic features	Circular depressions (e.g., solution dolines) and hills (e.g., conical hills)	Linear surface features with no permanent surface water flow; denudation is important; circular features are rare
Size	Feature sizes are limited: the largest dimension cannot be greater than the dimension of an influence area with vertical water drainage, and it cannot be smaller than the dimension of a basic component element of vertical drainage	Upper size not limited (e.g., valley), but the smallest size is determined by underground water flow effects, including dissolved material in the flow
Predisposition	Even solubility and permeability of rock	Lower permeability of rock
Sediment transport	Transport perpendicular to the surface	Transport parallel to the surface, rarely perpendicular
Deposition	Chemical deposition (flowstone, tufa), only occasional clastic deposition	Chemical and clastic deposition
Intersection (transport, surface)	Intersection of transport and the surface is a point	Intersection of transport and the surface is a line or point
Effects on the surface	Destroys the hypsographical order of the surface	Surface has a hypsographical order (surface drainage is related with concave features), sometimes disturbed by karst features
Geomorphic processes	Corrosion	Corrosion and erosion
Subsurface features	Frequent caves	Rarer and smaller caves, mostly forming on tectonically crushed zones or at contacts of tectonic or stratigraphic units

Aadapted from Šušteršič (1986) and Komac (2004)

depth of 1505 m. In addition, the Alpine karst also currently has the longest cave system in Slovenia: the M-16 (Mount Tolminski Migovec) Cave System, with more than 40 km of passages measured. Due to a high amount of rainfall and colder climate, pit caves lack flowstone and allochthone sediments. Horizontal caves are rare, and they mostly occur at the contact of different rock types, for example, at the contact of limestone and dolomite. Large parts of mountainous regions are above the tree line, and the surface is a barren rocky landscape with isolated patches of thin soil and some shrubs and grassy areas. Because the mountains were repeatedly glaciated during the Pleistocene, the surface morphology is a result of interaction between karst and glacial processes (Kunaver 1983; Ferk et al. 2017). A variety of large and small features have formed on the exposed bedrock. Typical glaciokarst features are limestone pavements (Sln. *podi*), which are intersected with deep grykes (Fig. 3.9), snow kettles (Sln. *kotliči*), and shaft entrances. Smaller features are runnels (or rillenkarren) and solution pans (or kamenitzas; Ginés et al. 2009).

Dinaric karst is a karst landscape in western and southern Slovenia. Its western part drains toward the Adriatic Sea, whereas the central and southern part belongs to the Black Sea catchment. The region is divided into high Dinaric karst (with elevations between 800 and 1700 m), characterized by high karst plateaus and hills, and low Dinaric karst, characterized by low karst plateaus, corrosion plains, and lowlands in the Dinaric (northwest–southeast) direction with several poljes. Karst features such as poljes, dolines, collapse dolines, karrens, and caves occur throughout the area. These caves include one of the most visited show caves in Europe and the second longest cave system in Slovenia, the Postojna Cave System (Fig. 3.10), with more than 24 km of passages measured.

Dinaric karst is characterized by a deep vadose zone, and karst water may lie deep below the surface. As water percolates vertically, it forms shafts. However, there are many fragments of horizontal caves that evolved deep in the phreatic zone and are now filled with flowstone, clay, and other sediments. Dolines are the most common surface karst landforms (Figs. 3.5 and 3.6). Many of them have been artificially leveled for agricultural use (resulting in cultural dolines; Fig. 3.11). The occurrence and distribution of surface and subsurface karst features also depend on lithology. The Karst Plateau, for example, is marked by the limestone of the Lipica Formation with 101 dolines and 20 caves per km^2, followed by the limestone of the Sežana Formation with 85 dolines and 11 caves per km^2, and the limestone of the Liburnia Formation with 43 dolines and only 2 caves per km^2 (Hrvatin 2016). Collapse dolines (Fig. 3.12) are much larger depressions that form above hydrologically active cave channels (Stepišnik 2010). After the karst surface has been denuded by corrosion, subterranean features such as caves become exposed as surface karst features, known as unroofed caves (Mihevc 2001).

Two typical high Dinaric karst areas are the Snežnik Plateau and Trnovo Forest Plateau, with a deep vadose zone and deep vertical shafts. The highest peaks of these regions were covered by ice during the Pleistocene (Šifrer 1959; Kodelja et al. 2013). Karst bedrock was transformed by

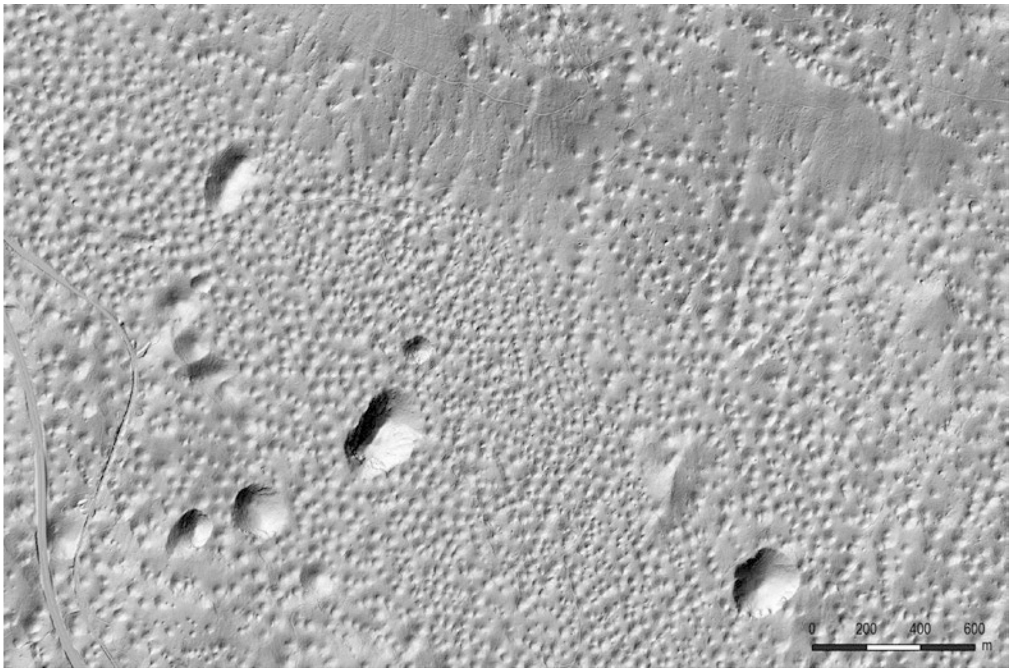

Fig. 3.6 In some limestone karst areas, the density of karst depressions can reach more than 200 per km^2. Smaller circular features are dolines, and larger circular features are collapse dolines. (Location: north of Planina Polje; Source: Surveying and Mapping Authority of the Republic of Slovenia)

Fig. 3.7 On dolomite karst dry shallow valleys, or dells, are typical (the Žibrše Hills in western Slovenia). (Photo by Blaž Komac, GIAM ZRC SAZU Archive)

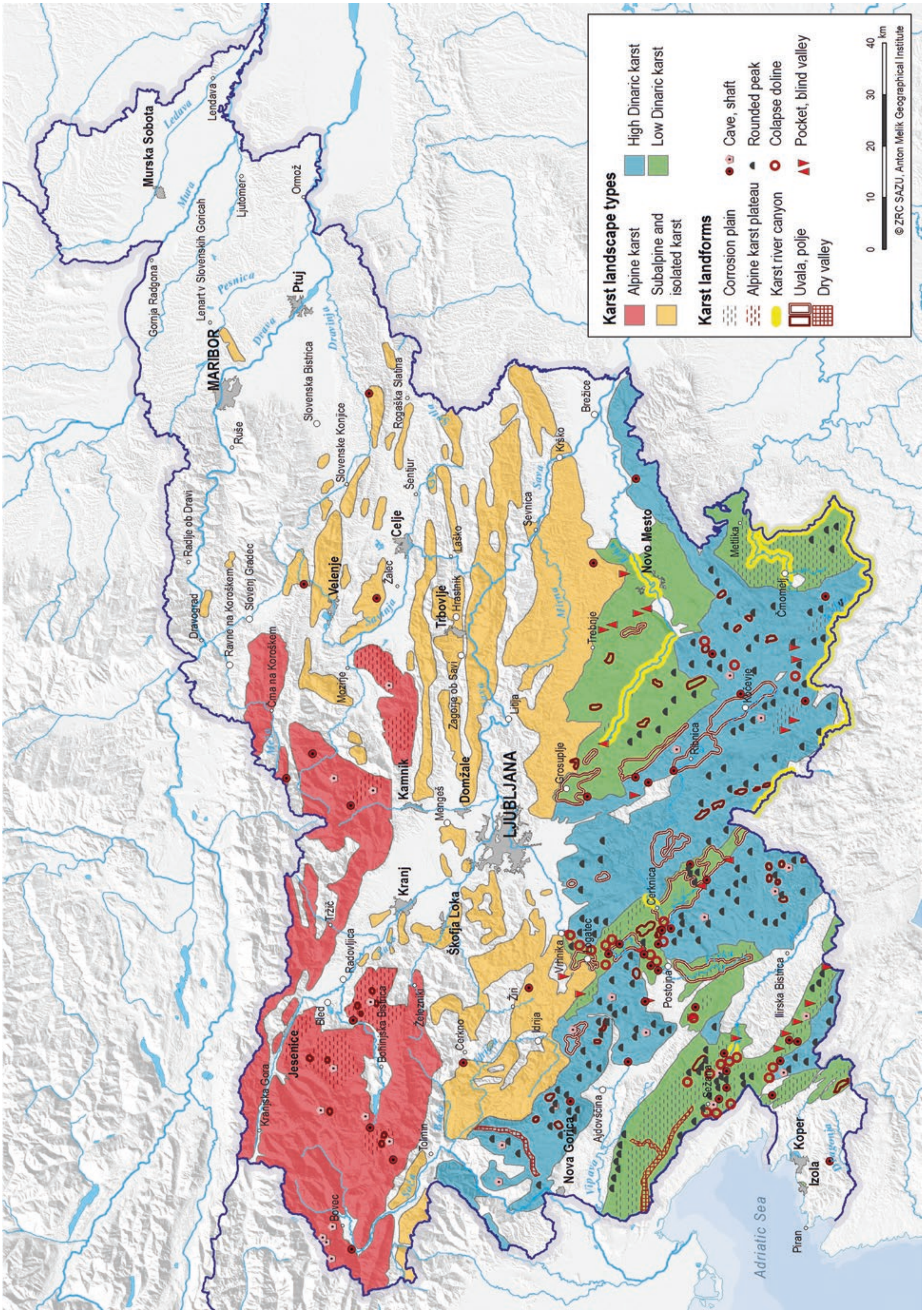

Fig. 3.8 Karst landscape types and some typical karst landforms (Mihevc 1998; Fridl et al. 2001)

Fig. 3.9 Glaciokarstic terrain in the Triglav Lakes Valley. The limestone terrain that was shaped by glacial erosion in the Pleistocene is today highly karstified with deep grykes. (Photo by Bojan Erhartič, GIAM ZRC SAZU Archive)

Fig. 3.10 Abundant speleothem formations in the Postojna Cave System. (Photo by Matej Lipar, GIAM ZRC SAZU Archive)

Fig. 3.11 Dolines were important for agriculture in karst regions because they contain more soil than the surrounding areas (Karst Plateau, southwestern Slovenia). (Photo by Nataša Ravbar, GIAM ZRC SAZU Archive)

glacial erosion, forming features such as roches moutonnées, arêtes, and striations. In other places a depositional landscape was formed by sedimentation of till with features such as moraines and glacial erratics. Other common surface karst features are large depressions (Sln. *konte*), uvalas, and dolines. These areas have always been sparsely populated, and the anthropogenic influence on the surface morphology is negligible.

Subalpine and isolated karst lies between the Alpine and Dinaric karst regions at elevations typically up to 800 m. Usually small isolated limestone areas are surrounded by impermeable rocks that determine their evolution (Mihevc et al. 2016). The karst features are usually smaller than those in the Dinaric karst region and are often described as fluviokarst due to a combination of fluvial and karst relief. The most apparent karst features are caves, springs, and ponors. A special type of isolated karst formed on carbonate conglomerates of fluvioglacial origin (Kranjc 2005). Due to the young (Quaternary) diagenetic stage of the conglomerate, this karst has also been defined as eogenetic karst (Lipar and Ferk 2011; Ferk and Lipar 2012).

Contact karst features develop where rivers from nonkarst areas flow onto the karst. Gradually the water sinks through small cracks or large ponors. Where it enters caves, river valleys end abruptly as blind valleys (Fig. 3.13). In areas where the supply of fluvial sediment is large enough the sediment is deposited over the carbonates forming alluvial fens. If the inflow of water decreases the alluvial fans become inactive and with time the features become imprinted into the carbonate base forming relict alluvial fans (Stepišnik et al. 2007a, b). Around the karst springs of the Ljubljanica, Unica, and Krka rivers, pocket valleys were formed that end in steep slopes or even vertical walls (Tičar 2015).

3.3 Fluvial Landscapes

Fluvial landscapes developed in areas of non-permeable or less permeable rock with surface drainage. Characteristic is the interweaving of valleys and intervening ridges. Due to mechanical and other types of weathering as well as denudation, the slopes are subject to erosion, whereas the flat areas are subject to accumulation of material (Table 3.4).

This type of topography is most common in the Pannonian macroregion (94.3%) and Mediterranean macroregion (almost three-fifths of the surface). In the Alpine macroregion, it comprises slightly more than half of the surface (55.6%); it also occurs in areas with glacial topography. In the Dinaric macroregion, however, it only accounts for around a sixth of the surface (Table 3.2).

In the mountainous area, in some places, rivers carved their riverbeds into narrow and deep gorges. The small Mlinarica and Mostnica rivers in the Julian Alps, for example, carved gorges several dozen meters deep. Characteristic of mountainous areas are ravines such as the Iška Gorge and the valley of the Hudinja River. In hilly areas, the valleys are

Fig. 3.12 The collapse doline (*Velika Dolina*) with vertical walls at the entrance of UNESCO-protected Škocjan Caves. (Photo by Matija Zorn, GIAM ZRC SAZU Archive)

usually wider and have alluvial bottoms, for example, the valleys of the Pesnica and Ščavnica rivers in the Slovenian Hills. On slopes covered by a thicker layer of weathered debris and soil, slumps are frequent. They are most frequent in the Kozje region and the Haloze Hills (Fig. 3.14), where they are mainly triggered by heavy rains. Landslides are more frequent on less resistant sediments in the subalpine hills. Among the largest are landslides in the Upper Savinja Valley, in the Soča Valley, and below the Kladje Pass in the Cerkno Hills (Gabrovec and Hrvatin 2004). Rockfalls and debris flows are periodically triggered from mountain walls and the steep rocky slopes of mountain valleys. The best known in recent years are the rockfalls triggered by the 1998 (Fig. 3.15) and 2004 earthquakes in the Upper Soča Valley

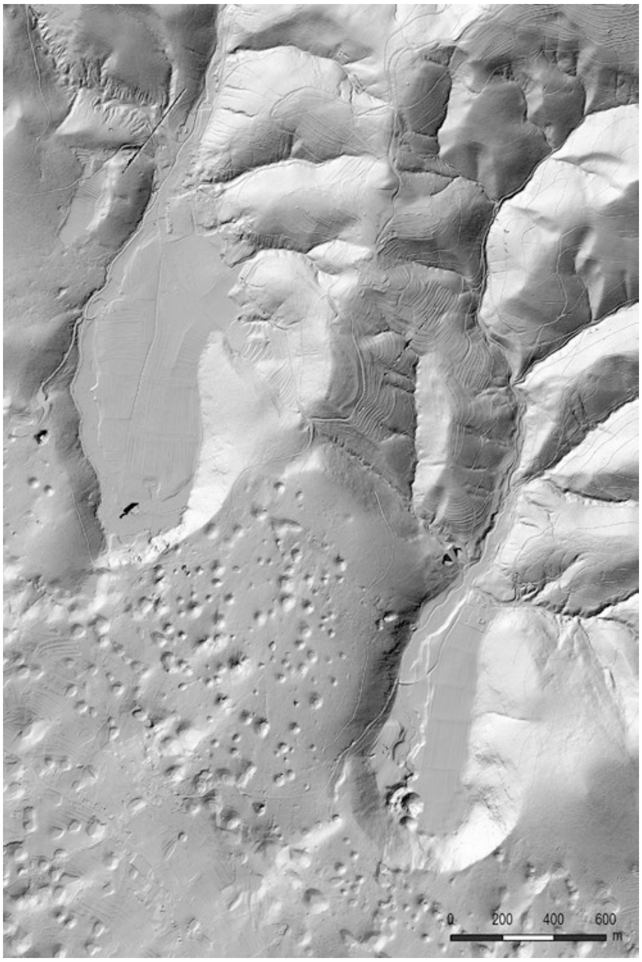

Fig. 3.13 Blind valleys in Matar Lowland (sln. *Matarsko podolje*) in southwest Slovenia were formed by streams from the flysch Brkini Hills. (Source: Surveying and Mapping Authority of the Republic of Slovenia)

Table 3.4 Basic characteristics of fluvial landscapes (Zorn 2008)

Basic features	First-order linear-based water flows
Size	Feature size is not strictly limited; the largest is a drainage basin and the smallest erosional rills
Predisposition	Location above the erosional line; humidity and impermeability of the surface
Sediment transport	Parallel to the surface
Deposition	Clastic deposition, sometimes also chemical deposition
Intersection (transport, surface)	Intersection is a line in accordance with the system of water discharge
Effects on the surface	Surface becomes hypsographically ordered
Geomorphic processes	Active change of geomorphological forms, erosion
Subsurface features	Subsurface features are extremely rare, karst processes are influenced by non-karst ones

and the debris flow triggered in the Mangart Range, which partially destroyed the village of Log pod Mangartom (Zorn and Komac 2002).

Geomorphic processes are very intense on destructive fluvial landscapes, especially in areas with steep inclinations and less resistant rock such as shale, siltstone, sandstone, and marl. In the Pannonian low hills, erosion appears to a great extent in particular on Tertiary marl and sandstone, where landslides and slumps are frequent. In the Mediterranean low hills, steep flysch slopes are most vulnerable to erosion. Flashy streams especially threaten the Alpine mountains and hills and the Pannonian and Mediterranean low hills. More than 700 flashy streams threaten almost a fifth, or 400,000 hectares, of Slovenia (Hrvatin et al. 2006).

Deposition occurs on plains and basins and on the bottoms of wider valleys. Rivers that had their watersheds in glaciated areas during the Pleistocene deposited large quantities of material during the cold periods and carved out riverbeds during the warmer periods. Numerous fluvioglacial terraces are the result of the many alternations of cold and warm periods and the corresponding depositing and carving by the rivers. The best-preserved terraces are found in the Dobrava between Radovljica and Kranj (Šifrer 1998).

The thickness of Quaternary alluvium in the areas of deposition varies substantially, from 5 to 200 meters. Where narrow valleys open into wider valleys or plains, the rivers deposited alluvial fans. Among the larger ones are the Šentjernej fan, which was created by streams from the Gorjanci Hills at the edge of the Krško Plain, and the fan of the Iška River at the junction of the Iška Gorge and the Ljubljana Marsh. Deposition also occurs at the foot of some steep slopes, where extensive fossil and recent screes are found (Gabrovec and Hrvatin 2004).

Erosion-sensitive areas include dolomite areas and less resistant non-carbonate rocks. On dolomite badlands in the pre-Alpine Polhov Gradec Hills with an inclination of 42°, sediment production of 175 t/ha per year was measured (Komac 2003), and in the Mediterranean flysch badlands with an almost vertical inclination, sediment production with up to 842 t/ha per year was measured (Zorn 2012). Estimates of sediment production across the country range between four and six million m^3 annually. Specific sediment production averages between 3.1 and 4.2 t/ha annually (Rainer and Pintar 1972; Lazarević 1981; Horvat 2002; Komac and Zorn 2005).

Half to three-fifths of sediment production settles on hillslopes, screes, and fans, as well as in erosion ravines and the ravines of flashy streams. The remaining material reaches streams and rivers, but almost a quarter stops in the upper parts of catchment areas, where it is exposed to torrential or debris flow transport. Due to the deposit of material, the riverbeds constantly rise, gravel beds widen at the expense of other land, and the flood hazard increases (Komac and Zorn

Fig. 3.14 Typical topography of the Pannonian low hills (the Haloze Hills in northeast Slovenia). (Photo by Marjan Grbajs, GIAM ZRC SAZU Archive)

2005). The data for the longest Slovenian river show that the sediment production in the upper Sava catchment (in the Alps) is around 1100 m^3/km^2 per year and the sediment yield around 580 m^3/km^2 per year, meaning that the sediment delivery ratio is 53%. In the lower catchment (at the beginning of the Pannonian basin), the sediment delivery ratio drops to around 36% (sediment production of 259 m^3/km^2 per year versus a sediment yield of 93 m^3/km^2 per year) (Mikoš 2000).

Data on the sediment yield according to size of the water basin indicate that about 15.2 t/ha of material is deposited in rivers and streams each year in the Soča River catchment, 6.3 t/ha annually in the Sava River catchment, 5.6 t/ha annually in the Drava River catchment, and 2.6 t/ha annually in the Kolpa River catchment. In the coastal low hills, as much as 6.4 t/ha of material is deposited annually in rivers and streams (Fig. 3.16) (Zemljič et al. 1970).

3.4 Glacial Landscapes

Glacial landscapes, which comprise around a tenth of Slovenian territory (Table 3.1), were formed by glacial erosion and deposition during the cold phases of the Quaternary. They are characteristic for mountain regions, such as the Julian Alps, the Kamnik–Savinja Alps, and to some extent also the Karawanks and Dinaric Alps (i.e., the Trnovo Forest Plateau and Snežnik Plateau) and the Pohorje Hills (Ferk et al. 2017; Fig. 3.17). In the Alpine macroregion, they comprise a fifth of the territory, whereas in the Dinaric macroregion, they only account for 1.5% of the territory (Table 3.2).

The Julian Alps were covered with an icefield and cirque glaciers drained by valley glaciers. These two features were also characteristic for the Kamnik–Savinja Alps and Karawanks (Šifrer 1998; Ferk et al. 2017). The most prominent valley glaciers were the Sava Glacier (Gams 1992) and the Soča Glacier (Kunaver 1990). Because it was up to 80 km long at its greatest extent (Kunaver 1980, 1990; Bavec et al. 2004), the Soča Glacier can also be termed a piedmont glacier due to its large area below the equilibrium line elevation.

Ice caps and cirque glaciers were supported by two Dinaric high karst plateaus (the Trnovo Forest Plateau and Snežnik Plateau), and they were drained by outlet glaciers toward lower-lying karst depressions (Kodelja et al. 2013; Žebre et al. 2013).

At present, only two glaciers exist in Slovenia: the Triglav Glacier in the Julian Alps and the Skuta Glacier in the Kamnik–Savinja Alps. Both of these are subject to long-term monitoring and are therefore important for studying past and present environmental changes. The Triglav Glacier lies in a relatively sunny position on the northeast side of Mount Triglav at an elevation between 2400 and 2500 m. In the second half of the nineteenth century, it still covered nearly 46 hectares. In 1946, when regular monitoring started, the ice covered approximately 14 hectares, but now it covers less than half a hectare (Gabrovec et al. 2013, 2014). The Skuta Glacier is a cirque glacier that lies in a year-round shady area

Fig. 3.15 Rockfall triggered by the 1998 earthquakes in the Lepena Valley (northwest Slovenia). (Photo by Matija Zorn, GIAM ZRC SAZU Archive)

between 2000 and 2100 m above sea level with an area of less than a hectare (Pavšek 2007). Both glaciers have lost glacial features such as crevasses, and their ice no longer moves. Holocene glacial variations in the Alps (Ivy-Ochs et al. 2009) suggest that both glaciers are most probably remnants of the Little Ice Age and cannot be considered a remnant of Pleistocene glaciation (Ferk et al. 2017). In formerly glaciated areas, erosion and karstification dominate today (Gabrovec and Hrvatin 1998).

The presence of various glacier types resulted in various erosional features caused by abrasion, plucking and quarrying, meltwater action, chemical action, and freeze-thaw processes (Menzies 2009). A prominent effect of glacial erosion in the Slovenian Alps can be seen in rock surfaces polished by glaciers. Cirque glaciers, confined by their hosting bedrock hollows, left behind amphitheater-like basins called cirques, which are now snowfields and subject to slope processes forming screes. Valley glaciers formed U-shaped valleys (Fig. 3.18) with broad flat bottoms and steep sides. Glacial erosion produced sediments for transport and glacial deposition. Ground, marginal, and terminal moraines are generally found in all places in Slovenia where glaciers occurred. In wider basins (e.g., the northern Ljubljana Basin), glacial sediments have been largely reworked by fluvioglacial processes (Gams 1998). The moraines are mound-like and are overgrown by forests. Glacial lakes formed in depressions surrounded by moraines (e.g., the Triglav Lakes, Lake Bled, and Lake Krn) (Gams 1998; Erhartič 2012; Ferk et al. 2017).

Compared to areas covered by ice, even larger areas were affected by periglacial and fluvioglacial processes (Fig. 3.17). Deposition of fluvioglacial material occurred at the edge of glaciers in the Alpine valleys, and the material was transported along the valleys, forming outwash fans and outwash plains. During interglacial periods, rivers cut into their own deposited material, forming terraces (Šifrer 1969). Šifrer (1998) identified six major Quaternary terraces in the Ljubljana Basin alongside the large quantities of material deposited along the Sava River down to the Krško–Brežice Plain. Similarly, the Savinja, Drava, and Mura rivers deposited fluvioglacial material. The Soča River in the west transported fluvioglacial material (Fig. 3.19) all the way to the Adriatic Sea (Gams 1998; Šifrer 1998).

In the Slovenian Alps, rock glaciers—masses of coarse angular debris as a product of differential movement of discrete layers of enriched ice debris—and protalus (and pronival) ramparts have been identified. Those periglacial landforms are often used as markers for the occurrence of permafrost in mountain terrain. Most rock glaciers are possibly related to the Younger Dryas phase, whereas ramparts could have continuously developed during the entire Holocene (Colucci and Žebre 2016; Colucci et al. 2016).

Subterranean periglacial landforms also occur in Slovenia in the form of sorted patterned ground in caves such as Hrušica Ice Cave (*Ledenica pod Hrušico*, elevation 750 m, southwest Slovenia). During the winter relatively colder air enters the cave and creates a pool of cold air. Because little air exchange occurs during the summer, a periglacial environment is sustained throughout the year (Obu et al. 2016).

3.5 Coastal Landscapes

Coastal landscapes in Slovenia are limited to a narrow belt along the Adriatic coast, which (based on different sources) is from 47.0 to 53.5 km long (Orožen Adamič 2002; Ogrin and Plut 2012; Kolega 2015), as well as narrow belts along the shores of lakes. The geology of the Adriatic coastline is mostly flysch (60%), followed by carbonate rocks (11%), which dominate around Izola, and fluvial deposits (29%) (Senegačnik 2013).

Fig. 3.16 Flashy streams in the coastal low hills carry an extensive sediment load (the Dragonja River in the southwestern Slovenia). (Photo by Matija Zorn, GIAM ZRC SAZU Archive)

The Adriatic coastline lies perpendicular to the geological structure (Natek et al. 2012) and was formed after the last glacial maximum, when the regressing sea flooded lower parts of the valleys, which later became bays (and previous ridges became peninsulas with cliffs up to 80 m high; Šifrer 1965; Ogrin and Plut 2012). From the genetic point of view, there are abrasion and accumulation types of coastline (Gabrovec and Hrvatin 1998). Based on morphology, Slovenia has a high coastline, where abrasion and erosion formed cliffs (Fig. 3.20), and a low coastline, where fluvial deposition formed coastal flats.

Cliffs are made of flysch Eocene rocks with interbedded layers of marl and sandstone. As a result of sea abrasion and gravitational processes on steep slopes as well as water erosion, cliffs retreat up to several centimeters a year (Zorn 2008; Natek et al. 2012). Deposited eroded material at the base of the cliffs builds today's beaches, and on the places where the material is eroded, there are abrasion terraces around 10 m wide (Šegina et al. 2012). The terraces end abruptly with steep inclinations into the deeper sea (Ogrin and Plut 2012), which, however, does not reach lower than a depth between 17 and 23 m. The deepest point is −37 m, which means that the maximum span between Slovenian elevations (from the deepest sea point to the highest point, Mount Triglav at 2864 m) is 2901 m (Gams 1998).

3.6 Anthropogenic Landscapes

Anthropogenic landscapes are an important part of the Slovenian cultural landscape. The territory is anthropogenically reworked by farming as well as by urbanization, industry, and mining.

Farming influences the topography directly with surface modifications, for example, with the building of cultivated terraces or clearing rock from the karst surface (Komac and Zorn 2005; Perko et al. 2017), or indirectly due to sediment transport after intensive grazing or deforestation.

Direct changes to the surface are made by the mining industry through digging as well as tailings depositions. Underground mining also causes subsidence of the surface. For example, in the Velenje Basin, subsidence lakes formed above the underground mines. Subsidence has also been observed in Idrija at the former mercury mine. The topography around coal mines has changed due to tailings deposition (in Trbovlje, Zagorje, and Hrastnik as well as around industrial zones; e.g., in Celje). Because karst landscapes cover around two-fifths of Slovenian territory, there are a large number of limestone and dolomite quarries. In more than 200 locations, a million tons of raw minerals and 4.5 million tons of coal are mined annually (Senegačnik 2011).

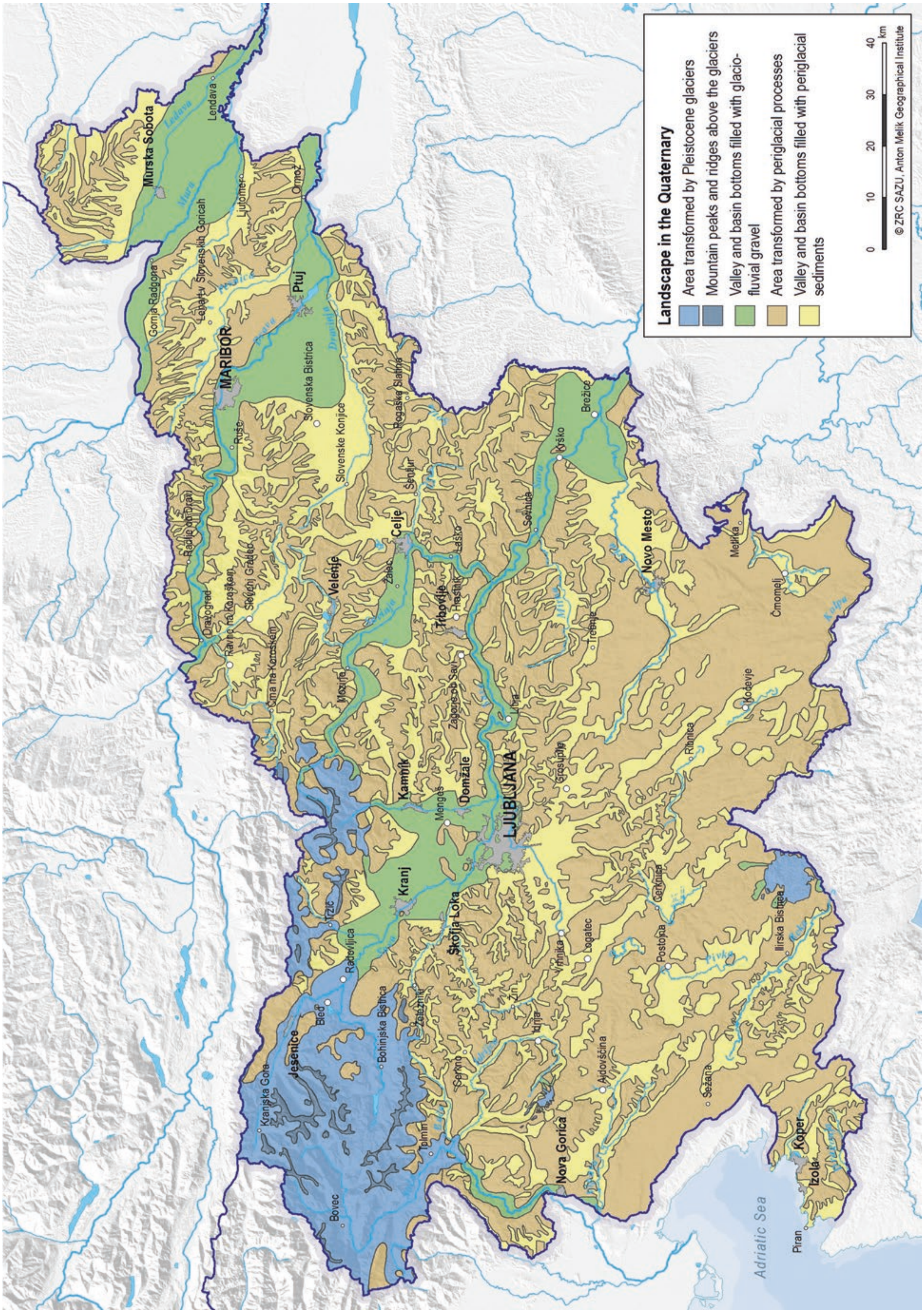

Fig. 3.17 Pleistocene glacial and periglacial areas. (Adapted from Šifrer 1998 and Ferk et al. 2017)

Fig. 3.18 The U-shaped Kot Valley in the Julian Alps. (Photo by Matej Lipar, GIAM ZRC SAZU Archive)

Fig. 3.19 Fluvioglacial material (conglomerate) in the Bovec Basin in the Upper Soča Valley. (Photo by Matija Zorn, GIAM ZRC SAZU Archive)

For industrial needs, the topography is often leveled by filling depressions (Breg Valjavec 2014). In almost half of Slovenia's municipalities, there are more than 200 places that are degraded due to transport, military, mining and industry (including quarries), deserted farming regions, and major landfills. Half of these places are industrial.

Tourism also affects topography by reshaping ski slopes and building artificial drainage systems as well as other complexes. There are around 300 km of ski slopes in Slovenia, which adds up to around 15 km^2 of reworked topography (Fig. 3.21). Due to tourism, much coastline has been changed as well. Only a fifth of the coastline remains unaffected,

Fig. 3.20 Vertical flysch cliffs along the Slovenian coastline. (Photo by Matija Zorn, GIAM ZRC SAZU Archive)

Fig. 3.21 Urbanization of a mountain valley (the Planica Valley in the Julian Alps) due to ski jumping. (Photo by Matija Zorn, GIAM ZRC SAZU Archive)

whereas the other four-fifths has been changed due to urbanization, transport, salt production, and farming. Artificial filling of wet flat plains between 1854 and 2010 resulted in 364 hectares more land (and less sea), with only 18 hectares of actual land lost (Kolega 2015). The largest area of artificial land due to filling is at the Port of Koper.

Urbanization plays an important role in long-term soil sealing. One of the more evident examples is the star-shaped

Fig. 3.22 Bomb craters and trenches from the First World War around the village of Vrtojba in western Slovenia. (Breg Valjavec et al. 2018)

urban growth of the city of Ljubljana at the intersect of the Ljubljana Plain, the Ljubljana Marsh, the Sava Hills and the Polhov Gradec Hills (Tičar et al. 2017). There is around 870 km^2 of built-up areas in Slovenia, half of them dedicated to transport. Transport land accounts for around 2% of Slovenian territory (Bole 2015).

Transport affects topography with tunnels and embankments. Since Roman times, the topography has been reshaped by building roads and related walls and embankments (Kosi 1998). In addition, the topography was also been reshaped by railway construction in the mid-nineteenth century and by freeway construction at the end of twentieth century. Construction of the Port of Koper after the Second World War reshaped the coastal landscape.

Hydroelectricity indirectly influences the topography by damming rivers and consequently trapping sediments behind dams. These sediments do not reach the sea and are artificially transported elsewhere. The lack of sediments in riverbeds downstream consequently causes erosion and changes to the landscape. There are around 50 large dams and many smaller dams in Slovenia (Lenart et al. 2017).

Topography has also changed because of wars. During the First World War, the Soča/Isonzo Front stretched across Slovenian territory, and in this belt the topography was largely changed due to bombing (Fig. 3.22), for example, the blasted top of Mount Batognica (2164 m). The topography has also been changed around the Poček military area, which lies above the vulnerable karst water catchment close to Postojna (Zorn and Komac 2009).

3.7 Conclusion

Six typical landform units are characteristic for Slovenia: flat land, low hills, hills, mountains, low karst plateaus, and high karst plateaus. The diverse topography of Slovenian territory can be roughly divided into fluvial, karst, glacial, and coastal landscapes.

Fluvial landscapes have developed on non-permeable or less permeable rock, where water consequently flows on the surface and correspond to 53% of Slovenian territory, mostly in Pannonian, Mediterranean, and Alpine macroregions. Two basic geomorphic processes prevail: erosion, which is dominant on slopes, and deposition, which is dominant on flat land. These processes are most apparent in areas with less resistant rock such as shale, siltstone, sandstone, or marl.

Karst landscapes are also related to rock characteristics and are formed on permeable soluble rocks such as limestone and dolomite, which comprise 38% of Slovenian territory. Karst landforms are most apparent in the Dinaric Alps (i.e., Dinaric karst) and include poljes, dolines, collapse dolines, karrens, and caves. Alpine karst, on the other hand, has less apparent circular depressions due to high relief but the deepest vertical caves due to the water table deep beneath the surface. Some of these areas were glaciated during the Pleistocene, and so glaciokarst features are typical. Between the Alpine and Dinaric karst, one can also distinguish subalpine and isolated karst, with their landforms often described as fluviokarst.

Glacial landscapes are limited to the Alpine region and partly to the Dinaric Alps, altogether comprising 9% of Slovenian territory. Processes related to glaciation were most active during (glacial erosion) and/or immediately after Quaternary glaciations (accumulation). Glacial valleys and moraine ridges are the most prominent glacial features, which are both remnants of past glaciation periods. At present, only two glaciers exist in Slovenia: the Triglav Glacier in the Julian Alps and the Skuta Glacier in the Kamnik–Savinja Alps.

The coastal landscape is limited to southwest Slovenia along the approximately 50-km-long coast. The most prominent coastal features are cliffs with a dominant abrasion process and shallow bays with a dominant accumulation process.

Throughout history and especially since Roman times, Slovenian landscapes have been strongly influenced by human activity. One of the major impacts was caused by agriculture (e.g., cultural terraces and removal of rocks), mining (e.g., side-product mounds and land lowering), industry, and tourism (e.g., leveling the surface and artificial drainage).

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Waters of Slovenia

4

Mauro Hrvatin, Miha Pavšek, and Maja Topole

Abstract

Slovenia is a country characterized by an abundance of water in a great variety of forms. The river network comprises almost 28,000 km of watercourses (1.4 km/km^2), but they are not equally distributed because about 40% of Slovenia is karst and therefore almost without surface waters. Rivers from four-fifths of Slovene territory flow several hundred kilometers to the Black Sea and from less than one-fifth into the nearest Adriatic Sea. The few small natural lakes are either tectonic, glacial, or karst. There are more artificial lakes, including reservoirs for hydroelectric power plants, multipurpose reservoirs, and pit lakes in basins formed by abandoned mine excavations. The once-extensive swamps and marshes have shrunk significantly due to water regulation, and climate change has also caused the two Slovenian glaciers on Mount Triglav and Mount Skuta to shrink drastically. The population's water supply relies heavily on groundwater. This is divided into aquifers with intergranular porosity, karst fissure porosity, and fissure porosity, all of which are threatened by pollution. Slovenia also has a small share of coastal water: part of the Adriatic Sea's Gulf of Trieste.

Keywords

Physical geography · Hydrology · Surface water · Groundwater · Sea

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4.1 Introduction

On a global scale, Slovenia has an above-average volume of water. Across the planet's continents, average annual precipitation is 750 mm; of this amount, 480 mm evaporates and 270 mm runs off. From 1971 to 2000, Slovenian territory received an average of 1579 mm of precipitation, of which 717 mm evaporated and 862 mm ran off (Frantar 2008). In addition to this considerable amount, Slovenia is also characterized by its large variety of water forms. Surface water includes rivers, streams, and torrents, natural and artificial lakes, swamps and marshes, and a small but economically very important share of the Adriatic Sea. The groundwater includes various aquifers, thermal, and mineral water (Kolbezen 1998). Because of the considerable precipitation received and the great number of watercourses, it is generally believed that Slovenia has plentiful water. However, the flashy nature of many streams, lack of water-use planning, and irresponsible polluting have seriously threatened the apparently abundant water supply in recent decades. There are frequent shortages of drinking water during droughts. The regions most affected are Goričko Hills, Slovenian Hills, and White Carniola Plain in the Pannonian area, Dry Carniola Plateau in the Dinaric area, and Karst Plateau with Koper coastal area in the Mediterranean area (Natek and Natek 1998; Kolbezen 1998).

4.2 Surface Water

Surface land water (Fig. 4.1) includes river network, lakes, wetlands, snowfields, and glaciers. The river network consists of a multitude of major rivers, streams, and torrents with a total combined length of nearly 28,000 km. The average density is 1.4 km of watercourses per km^2 of land, which is among the highest in Europe (Bat et al. 2004).

The surface watercourses are not evenly distributed. The river network branches extensively throughout areas of

© Springer Nature Switzerland AG 2020
D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_4

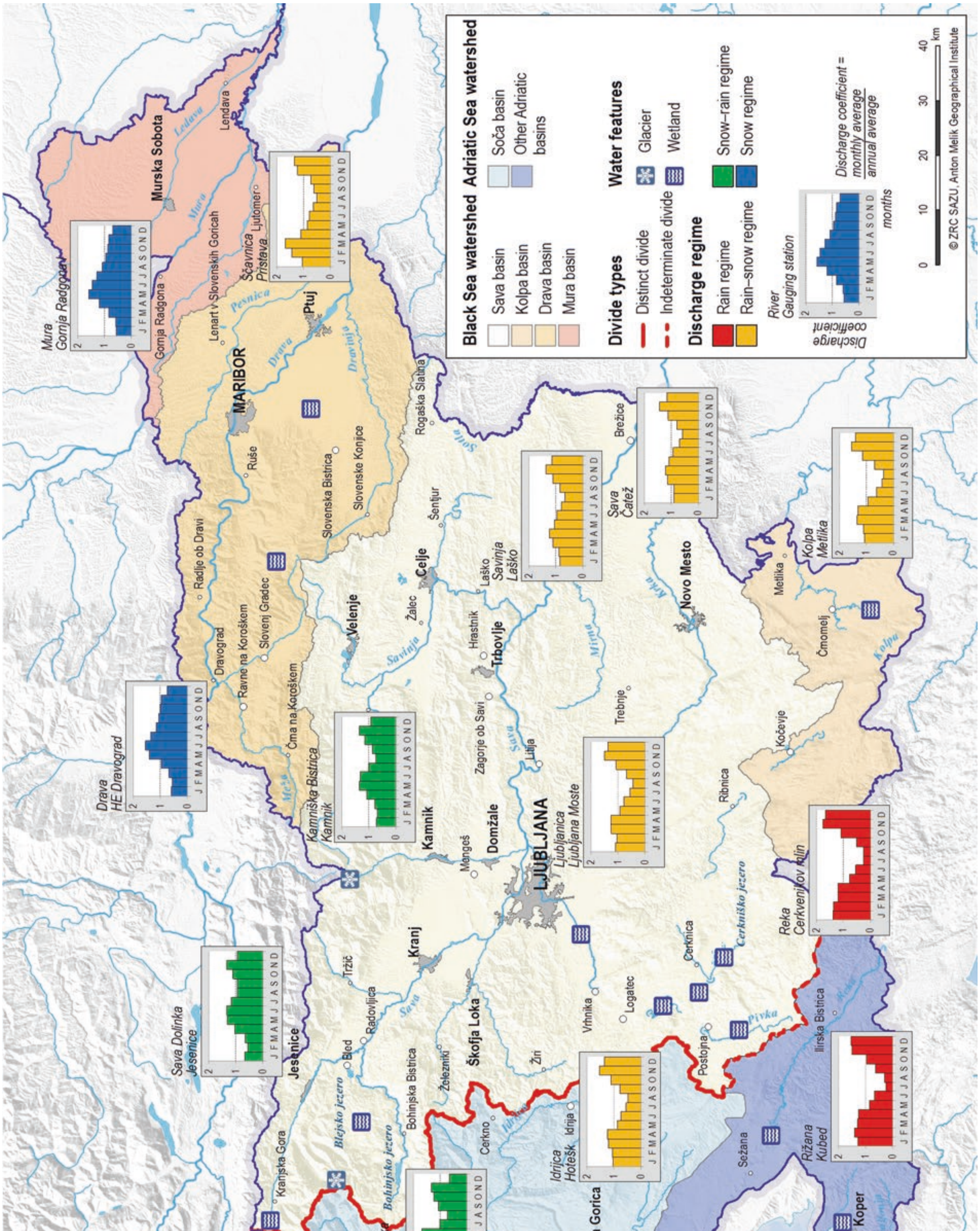

Fig. 4.1 Surface water of Slovenia

Fig. 4.2 The Soča is the most important river in Slovenia's Adriatic catchment. Its upper arm is one of the best-preserved natural rivers in the Alps. (Photo by Robert Fesus, Shutterstock.com)

impermeable rock, and in places the density of streams exceeds 3 km/km^2 (Kolbezen 1998). More than 40% of Slovenia's land is karst and hardly has any surface streams. The rare surface watercourses in karst areas tend to be sinking streams. These are streams that flow alternately on the surface and underground in karst formations. A typical example of a sinking stream is the Ljubljanica karst river system. It has two arms, the Cerknica and the Pivka arms, which join underground in Planina Cave. Along the Cerknica arm the river has various names, the Trbuhovica, Obrh, Stržen, and Rak, but the Pivka arm is simply called the Pivka. The joined water originates from Planina Cave as the Unica. The final point at which the karst river reemerges on the surface is near Vrhnika at the edge of the Ljubljana Marsh Basin. From here the Ljubljanica flows through the marsh to Ljubljana, soon joining the Sava River after exiting the city. Due to its repeated emergences and disappearances, the Ljubljanica is also called the "river of seven names" (Šušteršič 1994). A catchment divide between the Black Sea and Adriatic Sea crosses Slovenian territory. Rivers on four-fifths of this territory drain into the Black Sea many hundreds of kilometers away, whereas those on barely one-fifth drain into the Adriatic. The Mura, Drava, Sava, and Kolpa drainage basins belong to the Black Sea watershed, whereas the Soča (Fig. 4.2) and Reka drainage basins belong to the Adriatic catchment, in addition to rivers that directly flow into the sea (Kolbezen 1998).

The most significant characteristic of Slovenian rivers and streams is their torrential nature, which is best illustrated by the enormous variance between their highest and lowest discharges. When it rains, torrential streams rise very quickly, carrying large amounts of sediment with them. Various water regulation measures are only partially able to calm and control them. This is why it would be best to leave the lowest flood areas undisturbed so that the high water can run off without doing major damage, thus shedding its destructive power (Natek and Natek 1998; Komac et al. 2008).

Short watercourses are characteristics of Slovenia's river network, and only 46 rivers are longer than 25 km. The longest river is the Sava, whose Slovenian part is 221 km long. It is followed by the Drava, at 142 km, and the Kolpa, at 118 km. The longest rivers entirely within Slovenian territory are the Savinja (102 km) and the Krka (94 km). Other rivers with more than 50 km inside Slovenia or along its borders are the Mura, Soča, Sotla, Ledava, Dravinja, Pesnica, Idrijca, Ščavnica, Reka, and Sora together with the Poljanska Sora (Hrvatin 2004).

With regard to the volume of water, the Drava is in first place, with an average annual discharge of 306 m^3/s at Ptuj. The Sava has almost as much, with a discharge of 289 m^3/s at Čatež near the Croatian border, whereas the Mura has only about half as much, with a discharge of 157 m^3/s at Gornja Radgona. Rivers with over 50 m^3/s average annual discharges also include the Soča, Kolpa, Ljubljanica, and Krka (Hrvatin 2004).

An average of 1579 mm of precipitation falls across Slovenia. Of this, 45.4% of the water evaporates and the remaining 54.6% runs off into streams (Frantar 2008). The runoff coefficients, which show what share of water flows into streams, vary significantly in different regions of Slovenia. These differences are due mostly to evapotranspiration, rainfall regimes and amounts, and the regional relief characteristics. In the mountains, where there is usually abundant rainfall and the water quickly runs off the surface, the runoff coefficient is higher than in areas with good vegetative cover, gentler hills, and flatlands under agricultural cultivation. The runoff coefficients in the Upper Soča Valley exceed 80%, whereas in most of the country, the coefficients range between 40% and 60%; they are lowest in Prekmurje Plain, where they only rarely exceed 30% (Kolbezen 1998).

According to the average oscillation in the discharge during the year, we distinguish four types of discharge regimes. The snow regime is characteristic of the Drava and Mura rivers, whose watersheds extend into the glaciated and snow-covered high mountains of Hohe and Niedere Tauern in Austria. The single discharge maximum occurs at the transition of the spring into the summer and the minimum in the winter. The snow–rain regime is characteristic for the alpine Kamniška Bistrica, Tržiška Bistrica, Kokra, Koritnica, Meža, Radovna, and Tolminka rivers and the upper reaches of the Sava, Savinja, and Soča. The primary discharge maximum occurs with the thawing of snow in late spring, and the secondary maximum occurs during the fall rains. The winter discharge minimum is more distinct than the summer one. The rain–snow regime is characteristic of the Dravinja, Idrijca, Kolpa, Krka, Ledava, Ljubljanica, Mirna, Pesnica, Sora, Sotla, Ščavnica, and Vipava rivers and in the lower stretches of the Sava, Savinja, and Soča. The spring snow discharge maximum always exceeds the fall rain maximum, but the summer discharges are substantially lower than those in winter. The rain regime is characteristic for the Pivka, Reka, and Rižana rivers in southwestern Slovenia. Above-average discharges occur here in the colder half of the year from November to April, while in late spring and summer, the discharges are modest due to high temperatures and strong evapotranspiration (Hrvatin 1998).

Recent decades have seen decreases in discharges and gradually changing discharge regimes in all Slovenian rivers. The reasons for these changes are higher average temperatures, a lower amount of annual rainfall, a lower amount and duration of snow cover, and a rise in the proportion of forested land (Bat and Uhan 2004; Hrvatin and Zorn 2017).

Rivers also have an important role in shaping the landscape. Weathering and erosion processes in mountain areas cause 1100–1300 m^3 of various materials to be released every year; in hilly areas this amount is 400–700 m^3 and in areas with low hills 200–400 m^3. Much of this weathered material is carried away by rivers. At the Šentjakob gauging station on the bank of the Sava near Ljubljana, every year around 40,000 m^3 of gravel and around 105,000 m^3 of suspended solids are carried past. By the time the river reaches the border with neighboring Croatia, these amounts rise to 63,000 m^3 of gravel and 612,000 m^3 of suspended solids. The Soča also carries a large amount of material, with an annual amount of around 73,000 m^3 of gravel and around 57,000 m^3 of suspended solids measured at Kobarid gauging station. Much of this material, around 142,000 m^3 per year, is deposited in the reservoir at Most na Soči (Natek and Natek 1998).

In the past, the power of rivers was harnessed by more than 4000 water-driven watermills and sawmills, but most of these were abandoned in the twentieth century. They were replaced by hydroelectric power plants that produce more than one-third of Slovenia's electric energy supply. River water is also used for cooling in thermoelectric power plants and the nuclear power plant in Krško, as technological water in industry, and for irrigation. Due to the pollution of the river water, it can no longer be used directly for the supply of drinking water (Bat 1997).

Standing surface water covers 68.93 km^2, or only 0.3% of Slovenian territory, which is below the European average. Many phenomena such as swamps, various types of ponds and pools, sloughs, side channels, and retention basins are relatively short-lived. Natural lakes with characteristic temperature, biological, and chemical stratification are rare. Most of these are found in Alpine and Dinaric regions (Remec-Rekar and Bat 2004).

Nearly half of the total area of standing water is artificial reservoirs, most of which are in the Pannonian region. These include the reservoirs at hydroelectric power plants (Moste, Mavčiče–Medvode, and Vrhovo–Boštanj); multipurpose reservoirs intended to control and stabilize water flow, often for agricultural purposes and irrigation, fishing, and as stop-over sites for migratory birds (Ptuj, Ormož, Šmartno, Slivnica, Pernica, Trojica, Ledava, Gajševci, Vogrščček, Klivnik, and Molja lakes); and pit lakes that form in basins caused by abandoned mine excavations, such as the Šalek lakes near Velenje (Šterbenk et al. 2004). Many artificial lakes are ecologically unsound due to inflows of industrial wastewater and accumulations of heavy metals, pesticides, and organic compounds.

Compared to those in neighboring countries, Slovenian lakes are significantly smaller, but they are very attractive to tourists. The best-known natural lakes are Lake Bohinj and Lake Bled, which are of tectonic and glacial origin, and the karst Lake Cerknica. Other lakes popular with tourists are the small alpine karst-glacial lakes in the Julian Alps, such as the Triglav, Križ and Krn lakes (Dobravec and Šiško 2002) and certain lakes in the Dinaric Alps.

Slovenia's largest natural permanent lake is Lake Bohinj (Fig. 4.3), which covers 3.28 km^2 and has a maximum depth of 45 m (Remec-Rekar and Bat 2004). It is a flow-through lake, and so its water is quickly replenished. It is mostly fed by karst springs; among the most important is the inflow of the Savica River, which flows out of the lake as the Sava

Fig. 4.3 Picturesque Lake Bohinj is among the most important and most visited tourist destinations in Slovenia. (Photo by Bojan Erhartič, GIAM ZRC SAZU Archive)

Bohinjka. Lake sedimentation is slow because of the karst catchment area, but because much of the surface is above the tree line, the influx of nutrients is moderate. Moreover, around 100 km^2 of the lake's watershed is part of Triglav National Park and has very few inhabitants, and so the lake is in excellent condition ecologically (Remec-Rekar 2016).

The opposite is true for the smaller Lake Bled, with an area of 1.44 km^2 and a maximum depth of 30.6 m. It does not have a large freshwater intake, and its catchment is significantly more urbanized, burdened by traffic, and exploited for agriculture and tourism (Remec-Rekar and Bat 2004). This is why eutrophication advanced quickly in the second half of the twentieth century, and the lake had to be saved from dying off by the addition of oxygen-rich water from the Radovna River, the use of siphons, and building a drainage and purification system (Kranjc et al. 2001). Phytoplankton levels used to assess the lake's ecological status show that it was in either moderate or good condition from 2006 to 2015 (Remec-Rekar 2016).

Lake Bohinj and Lake Bled are favorite destinations for tourism, excursions, and recreation. The swimming season in inland Slovenian waters is officially between June 15 and August 31, that is, 78 days. During this period the Slovenian Environment Agency regularly samples and assesses water conditions for swimming. Both lakes achieve excellent ratings (Kopalne vode 2017). The average monthly temperature of Lake Bled exceeds 22 °C in July and August, whereas in Lake Bohinj average temperatures are 2–3 °C lower (Bat 1997). Lake Bled is known for having Slovenia's only island, on which an ancient pilgrimage church stands, and also as the location of world-class rowing competitions. Its length of 2120 m is just enough to allow competition lanes to be marked out.

Due to its geological, hydrological, geomorphological, botanical, and zoological characteristics, intermittent Lake Cerknica has been considered a wonder of the world and special ecosystem in the Dinaric Karst region since as early as the seventeenth century (Valvasor 1689). In various seasons of the year, the same area allows boating, fishing, cutting hay, pasturing animals, or ice skating. During usual flooding it measures 21 km^2, but its total area can exceed 28 km^2. It is most often filled during autumn rains. From 1961 to 1990, it lasted an average of 285 days a year and was dry for 80 days (Kranjc 2002). It is classified as a wetland with characteristic fluctuations in the water surface and special marsh vegetation that works as a biological purification system during the wet periods. It is filled by numerous sources. The strongest ones are karst springs along the eastern and southeastern edges, such as Obrh Spring. The bottom is inclined toward the northwest, where there are sinks and swallow holes. When the lake drains, only the Stržen, a sinking stream, winds along the bottom, disappearing into the Karlovica Cave system. It is part of the Ljubljanica karst river system, which flows through the Inner Carniola Lowland. At high water levels, water from the lake flows underground toward Rakov Škocjan, and otherwise toward Planina Cave. In the summer most karst lakes, such as Pivka Lakes and those in the Cerkniško, Radensko, and Planinsko karst poljes, disappear. The exceptions are Lake Podpeč, which is Slovenia's deepest lake with an underground funnel outlet with a surface area of 1.25 hectares and depth of 47 m, and the Divje jezero (Wild Lake) near Idrija, which is a Vauclusian karst spring.

Wetlands, an environment at the transition from terrestrial to aquatic ecosystems, can be sea, coastal, continental, or underground and either natural or anthropogenic (Beltram 2004). The Slovenia Wetland Inventory of 2000 contains 3500 locations, of which only one-third exceed 0.15 hectares. These encompass around 350 km^2, or 1.74% of Slovenian territory (Bat 1997; Beltram 2004; Vreš et al. 2014). The best-known natural wetlands, which differ from one another by flora and fauna, are found in the Ljubljana Marsh (once covering 140 km^2 but now occupying only a few isolated patches, such as Mali Plac, due to peat cutting); fens and raised bogs on the Pokljuka Plateau (Šijec, Veliko Blejsko barje), the Jelovica Plateau, and the Pohorje Hills (the Lovrenc Lakes); fens on the Bloke Plateau; and the Jovsi wetland, reedbeds, saline habitats, coastal seawater shoals, and smaller lakes including intermittent ones in Cerknica, Planina, and Rača (sln. *Radensko*) karst poljes. Most wetlands have anthropogenic origins. Their area is nearly tripled if the wet meadows and flood meadows along the lower courses of the Mura, Drava, Sava, and Krka rivers are included. Other wetlands include Zelenci Springs, the source of the Sava Dolinka, and the underground Škocjan Cave system, which was added to the UNESCO World Heritage list in 1999 as the first underground wetland in the world (Beltram 2004).

Natural processes and intensive drainage led to the loss of 40% of Slovenian wetlands from 1950 to 1992 (Beltram 1999). Major water regulation in wetland areas was carried out on Pannonian streams such as the Ledava, Mura, Pesnica, Polskava, and Ščavnica, the lower course of the Krka, and the Vipava and Mirna in the Mediterranean or subalpine region. In 1990 Slovenian wetlands, including ponds and reedbeds, covered only 2200 hectares. The importance of wetlands in maintaining water balance and preserving biodiversity, their cleaning ability, positive microclimatic effects, and significance to education and research are the reasons wetlands were included in the Natura 2000 sites or in protected parks such as the nature parks in the Ljubljana Marsh, Rača Polje, Ljutomer Ponds and Jeruzalem Hills, Rače Ponds and Požeg, the Ormož Lagoons, the Planina Polje, and Škocjan Caves Regional Park.

Snowfields and glaciers are important but also very unstable elements in high-mountain regions. Their current status compared to various historical sources shows that the number and extent of formerly widespread, large mountain snowfields are declining. The glacier on Mount Triglav and the one below Mount Skuta have shrunk rapidly in recent decades.

The Triglav Glacier (Fig. 4.4) is located in the Julian Alps, on the northeastern face of the highest peak in Slovenia, Mount Triglav (2864 m). In the second half of the nineteenth

Fig. 4.4 Due to increased melting in recent decades, the Triglav Glacier has drastically shrunk and split into several parts. (Photo by Aljaž Hrvatin, GIAM ZRC SAZU Archive)

century, it still covered nearly 46 hectares and ranged across the rugged high-mountain terrain to the edge of Mount Triglav's north face. In 1946, when regular monitoring was started, the ice area was measured as 14.4 hectares, but by 2012 the glacier had shrunk to half a hectare. It no longer has all the characteristics of a glacier because it does not move and has no glacier crevasses. These processes halted by the end of the 1980s, and because the glacier is trapped in a concave part of the slope, no more glacial movement has been measured. It is now classified as a very small glacier, or a glacieret (Cogley et al. 2011). Its small size makes it very sensitive to climate change and it serves as a good indicator of this change. The nearby weather station on Mount Kredarica allows for accurate analysis of how weather conditions affect glacial fluctuation. The Triglav Glacier has also become much thinner in recent decades. In 2000 the ice thickness was measured with ground-penetrating radar (GPR), which indicated that the greatest thickness at twelve cross-sections was 9 m, but the average thickness was up to 3 m. Various measurements and records were used to determine that the glacier's volume shrank by a factor of 40 between 1992 and 2008, from around 400,000 m^3 to only 10,000 m^3 (Gabrovec et al. 2013). The most recent GPR measurements showed that the Triglav Glacier had a volume of only 7400 m^3 of ice (Del Gobbo et al. 2016).

The Skuta Glacier is located in the Kamnik–Savinja Alps at the northern foot of the ridge that connects Mount Skuta (2543 m) and Mount Kranjska Rinka (2453 m). It has lingered in the shady side of the cirque formed by the formerly extensive Jezersko Glacier, which crept from beneath Mount Skuta toward Jezersko during the Pleistocene, carving out a picturesque glacial trough called Ravenska Kočna. Systematic monitoring of the Skuta Glacier has been carried out since 1948. At that time the glacier measured three hectares but now it is less than one hectare. Even more concerning than its reductions in surface area is its thinning, because at the start of regular monitoring, its thickness was several dozen meters greater than it is now. Measurements in 2006 indicate an average thickness of 7 m and a volume of less than 80,000 m^3 (Pavšek 2007).

4.3 Groundwater

There is significantly more groundwater than surface water in Slovenia (Fig. 4.5). Its spatial distribution depends on hydrological conditions determined by the rock structure and its porosity and permeability. Unconsolidated deposits and porous rock beds that contain economically significant amounts of water are called aquifers.

Geological units of Slovenia that contain groundwater include aquifers with intergranular porosity (19.8%), karst fissure porosity (33.2%), and fissure porosity (14.2%). The rest of the land consists of layers with intergranular or fissure porosity with lower conductivity (25.2%) called aquitards and of almost impermeable rocks (7.6%) called aquicludes (Prestor et al. 2002; Uhan and Kranjc 2004).

Aquifers with intergranular porosity include tectonic basins and river valleys that are thickly covered with Quaternary and some Neogene gravel and sand deposits. The most important deposits are the Kranj–Sora, Ljubljana, Krško–Brežice, and Kamniška Bistrica plains and the Lower Savinja Valley in the Sava drainage basin; the Drava–Ptuj plain in the Drava drainage basin; the Apače, Mura, and Ljutomer plains in the Mura drainage basin; and the Vipava Valley and Soča plain in the Soča drainage basin (Kolbezen 1998). Despite the fact that the aquifers with intergranular porosity cover barely one-fifth of the country, they contribute 18.9 m^3/s, or over a third, of Slovenia's dynamic groundwater reserves. More than half of all reserves are in the Sava drainage basin, a good quarter in the Drava drainage basin, and less than one-tenth in the Mura drainage basin. The Savinja, Sotla, and Soča drainage basins together contribute less than one-tenth of the reserves (Brenčič 2009).

At the moment, aquifers with intergranular porosity supply more than half of Slovenia's drinking water. Because the plains are very densely populated, intersected by roads, and intensively cultivated, and at the same time polluted rivers are directly linked to groundwater, there is a great and constant threat of pollution hanging over of this important natural resource, either directly from the surface or indirectly from the rivers. The pollution of the groundwater could prohibit its use in the public water supply for years or even decades. The greatest threat of groundwater pollution occurs during droughts because the dropping level of the water table allows the penetration of polluted river water into the gravel and sand (Natek and Natek 1998).

Aquifers with karst fissure porosity are even more frequent and important than aquifers with intergranular porosity in Slovenia. They are characteristic for limestone areas, while aquifers with fissure porosity occur in dolomite areas. The intermittent occurrence of impermeable rocks significantly reduces their permeability (Uhan and Kranjc 2004).

In karst areas, rainwater drains into the ground through fissured and chemically soluble rocks. Here it joins various underground rivulets, streams, and rivers, is captured in underground lakes, and flows through deep cavities. It returns to the surface in karst springs at the periphery of the karst areas (Fig. 4.6; Habič 1991).

Karst terrain works like a sieve, and the interlaced water cavities allow harmful substances to flow through the underground, endangering cave habitats and drinking water. In many places sinking streams carry urban and industrial wastewater; these collect in cave watercourses and return to the surface at karst springs. Karst water requires special protection because waste material does not decay as quickly and

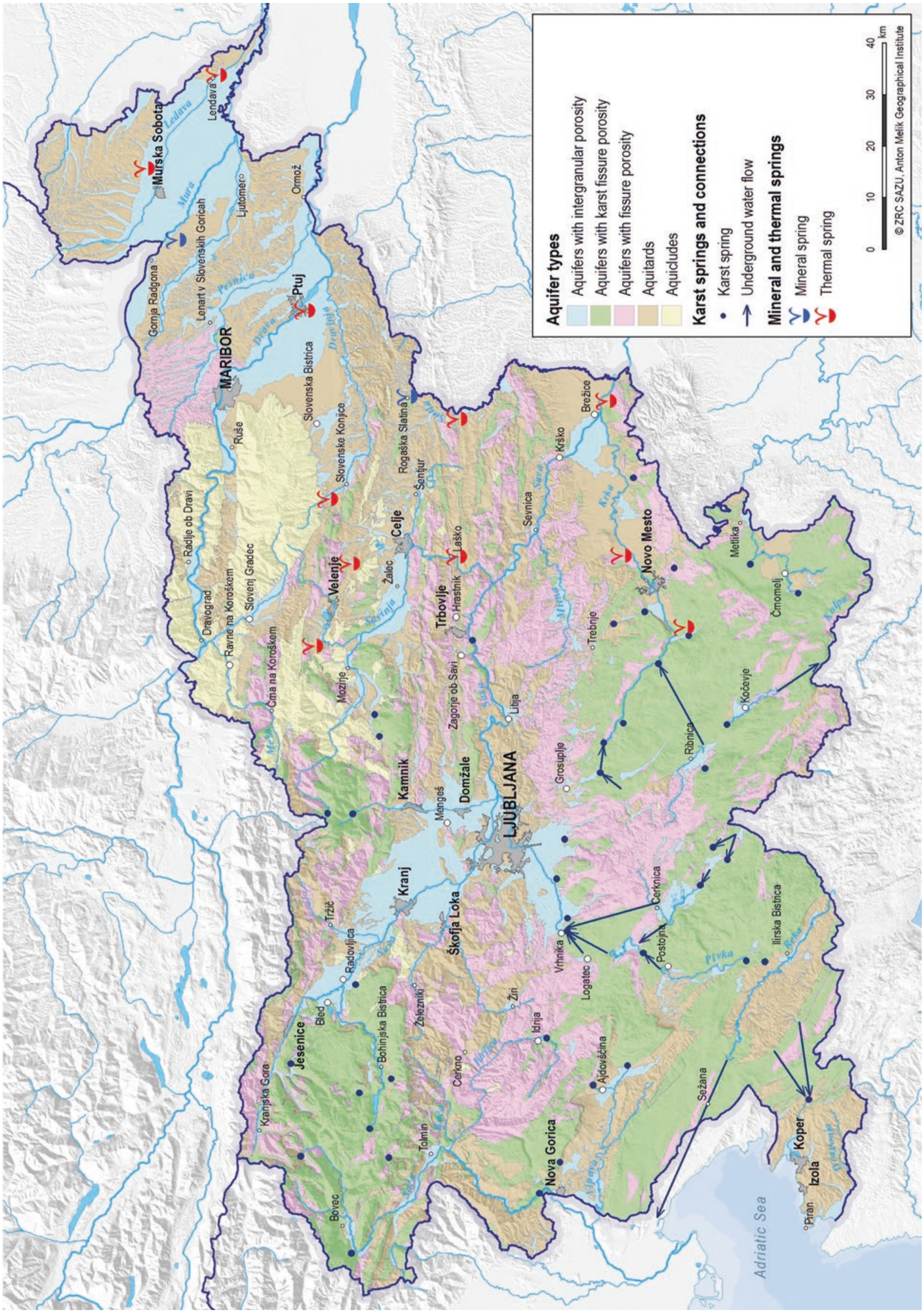

Fig. 4.5 Groundwater in Slovenia

Fig. 4.6 The Unica River, the penultimate segment of the karst Ljubljanica, originates in Planina Cave at the edge of the Planina Polje. (Photo by Aljaž Hrvatin, GIAM ZRC SAZU Archive)

effectively underground as on the surface (Habič 1991). Industrial pollution with polychlorinated biphenyls, for example, has made the karst Krupa Spring in White Carniola unusable as drinking water for many human generations (Kranjc 1998).

Aquifers with karst fissure porosity are frequent in Dinaric and Alpine regions. They feed the springs of Soča, Sava, Idrijca, Vipava, Ljubljanica, Kamnik Bistrica, Krka, and Kolpa rivers and many of their tributaries. Some karst springs, such as the Rižana, Hubelj, Malni, Podroteja, Mrzlek, Rakitnica, and Dobličica spring, are vital for the water supply of entire regions. During droughts, they represent three quarters of all the available water supplies (Kranjc 1998).

Numerous thermal and mineral springs represent a special treasure in eastern and northeastern Slovenia. Their distribution depends on geothermal heat flows, which increase from the west to the east of the country. The temperature at a depth of 1000 m is around 20 °C in western Slovenia, but it exceeds 70 °C in the northeast. The highest measured temperature at the mouth of the borehole was recorded in Ljutomer (148 °C), while the highest measured temperature in a borehole was recorded near Lendava (202 °C) at a depth of 3.7 km (Lapanje and Rman 2009). Around thirty natural thermal and mineral-thermal springs with temperatures from 18 to 38 °C and a joint output of around 180 l/s have been identified so far. Many thermal and mineral-thermal springs with temperatures from 20 to 72 °C come from deep boreholes; their joint output is 840 l/s (Ravnik 1999).

The sources of thermal water are deep-lying dolomite rock beds, whereas mineral water collects in porous tertiary sand and gravel, such as in Radenci, and in tectonic fissured igneous and metamorphic rocks, such as in Rogaška Slatina and Jezersko. Mineral and thermal water with dissolved CO_2 was found in northeastern Slovenia when looking for oil and natural gas at depths of 700 to 1300 m at Moravske Toplice, Lendava, and Banovci (Natek and Natek 2008).

Thermal water from boreholes is used at spas to heat swimming pools and as balneotherapy in Čatež, Dolenjske Toplice, Šmarješke Toplice, Podčetrtek (Fig. 4.7), Ptuj, Laško, Rimske Toplice, Topolšica, and Zreče (Lenarčič and Plut 1995). One-third of geothermal energy is used to heat buildings and hot water in Murska Sobota and Lendava and to heat greenhouses (Lapanje and Rman 2009). Mineral water is bottled for sale as table water in Rogaška Slatina and Radenci, both of which also offer mineral water for therapeutic purposes in their local spas (Žlebnik 1993).

Considering the rich natural potential of mineral and thermal water in Slovenia, it is relatively underutilized. There is still great potential for sustainably designed spa tourism and exploitation of environmentally friendly geothermal energy (Lenarčič and Plut 1995; Lapanje and Rman 2009).

Fig. 4.7 The Terme Olimia spa at Podčetrtek (Terme Olimia Archive)

4.4 The Adriatic Sea

Slovenia has a share of the Adriatic Sea: not quite one-third of the 551 km^2 Gulf of Trieste, which is the northernmost part of the Mediterranean Sea that extends into continental central Europe (Radinja 1990). Although the Slovenian share of sea area is small, its economic and geopolitical significance is disproportionately large. The Slovenian coast is 46.6 km long (Orožen Adamič and Rejec Brancelj 1998) and is severely fragmented because it traverses various geological structures. Its catchment area is only 450 km^2 and is made up partly of flysch and partly limestone. Three types of coastline appear in alternation. The first, accumulative type was formed by the outflows of rivers and streams. Koper Bay, Škocjanski zatok Lagoon, and the Strunjan, Portorož, and Piran bays are submerged river mouths that form ria-type coastlines. The second coastline type, which is connected with flysch in Istria, is abrasive and was formed through the action of sea waves. Steep walls or cliffs that are up to 70 m high and an abrasion terrace are characteristic of this type. The best example is the Strunjan cliff between Izola and Piran (Fig. 4.8). The third coastline type is calcareous and occurs only on one-tenth of the Slovenian coastline, around Izola.

The Slovenian sea is shallow and rarely exceeds a depth of 20 m. The underwater relief is characterized by an indistinct coastal "Roman" terrace 2 m beneath the surface and the edge of a steep slope some 10–100 m away, which begins 9 m beneath the surface. Then there is a sediment floor composed mostly of sludge and fine sand. The deepest point in the Slovenian sea lies in the depression by Piran (−37.25 m), which is dubbed the "submarine Triglav" (Orožen Adamič 1990). Because it is so shallow, the sea is characterized by considerable temperature fluctuation and ecological fragility. Despite this, the water in twenty-one Slovenian coastal swimming areas received excellent ratings from 2012 to 2015 (Turk 2016). The average annual temperature of the sea's surface layer is 15.8 °C, the lowest average monthly temperature (in February) is 8.1 °C, and the highest (in August) is 24.0 °C (Rejec Brancelj 2004). The swimming season is from June 1 to September 15. Due to the abundant influx of fresh water, the salinity is lower than the Adriatic average and fluctuates between 33‰ and 38‰. Tidal motion is weak because the tidal range averages only 66 cm. In addition to the astronomical positions of the sun and moon, weather conditions also affect it. The bora north wind reduces the sea level, whereas the highest sea level occurs with low air pressure and a south wind. At these times the lowest parts of the coastline are threatened by flooding (Bat 1997; Bernot 1990; Kolega 2006). The general rise in sea level is a consequence of coastline sinkage and global climate change (Kolega 2006; Trobec et al. 2017).

Due to its small size and enclosed nature, the Gulf of Trieste is one of the more polluted parts of the Adriatic Sea. Around 400,000 inhabitants live along the coast, and their waste is joined by industrial wastewater, coastal traffic, tourism, and to a small degree agriculture. A large influx of organic and inorganic matter comes from the Po River in Italy (Natek and Natek 1998). Human inhabitants have strongly

Fig. 4.8 Vertical cliffs and gentle, level floodplains alternate along the Slovenian coastline. (Photo by Marjan Garbajs, GIAM ZRC SAZU Archive)

shaped the coastal landscape in the past with water drainage, terracing, construction, arrangement of salt pans, and building ports, but in recent years there have been many attempts to reduce the negative environmental impacts. The coastal stretches in which preserving biodiversity is most important are protected in the Strunjan Landscape Park, the Sečovlje Salina Nature Park, and the Škocjanski zatok Nature Reserve.

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5 Climate and Weather of Slovenia

Blaž Komac, Miha Pavšek, and Maja Topole

Abstract

There are three main types of climate in Slovenia: a temperate humid climate with hot summers, a temperate continental climate, and a mountain climate, each of them with several subtypes. The average annual temperature is highest along the coast, where it exceeds 12 °C. In central Slovenia these values are between 8 and 10 °C, falling below freezing only on the highest peaks. Most temperature extremes have been recorded in the interior of Slovenia, where temperature inversions are frequent in the winter; in the spring damage is caused by frost and in the summer by drought. Slovenia is well supplied with solar energy and is fairly wet, with an average annual precipitation of 1750 mm. The highest amount of precipitation is in the northwest and the least is in the northeast. The greatest precipitation in the Julian Alps in the northwestern part of the country is three times greater than that in Pannonian northeastern Slovenia. In the winter snow regularly covers the entire country except for the coastal zone. Compared to the rest of Europe, Slovenia is record-setting for the annual number of thunderstorm days, and due to its varied relief, it is not as windy. It is characterized by an overall trend of rising temperatures, and the amount of precipitation is increasing particularly in the western half of the country, although in other parts no noticeable trend diverging from long-term averages has been observed.

Keywords

Physical geography · Climate · Solar radiation · Temperature · Precipitation · Weather extremes

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© Springer Nature Switzerland AG 2020

D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_5

5.1 Climate Types

Climate in Slovenia is affected by a number of factors, of which the following are the most significant: the country's location in the temperate zone, varied relief, proximity to the sea, and exposure to westerly to southerly air circulation. At the local level, especially in towns and cities, the climate is also affected by vegetation, water bodies, wind corridors, and the degree of urbanization (Komac et al. 2017). There are three main types of climate in Slovenia, each with several subtypes: *a temperate humid climate* with hot summers in western Slovenia, *a temperate continental climate* in central and eastern Slovenia, and *a mountain climate* in the mountain areas of northwestern, northern, and part of southern Slovenia (Ogrin 1996, 2002). Melik (1935) distinguished Mediterranean, Pannonian, and central European Alpine climates. Furlan (1960) divided Slovenia into maritime, transitional, and interior zones and, with regard to precipitation, distinguished a modified Mediterranean and a modified central European type. Ilešič (1970) distinguished Adriatic and temperate continental climate zones, and Gams (1972, 1998) proposed littoral, central Slovenian, and sub-Pannonian zones and, with respect to aridity, a dry and sunny climate of the littoral zone together with its immediate hinterland and the climate of continental Slovenia.

Here we follow the Ogrin's (1996) typology which is based on the Köppen climate classification system, according to which Slovenia is placed in climate groups C (temperate climate) and H (mountain climate; Fig. 5.1).

A temperate humid climate with hot summers (Cfa) is found in the region south and southwest of the barrier formed by the Alps and Dinaric Alps, where the land opens up toward the Adriatic Sea. Temperatures in the coldest month are above freezing and in the warmest one higher than 20 °C. The region has the greatest number of sunny days in Slovenia, with the sun shining on average 2350 h annually. January temperatures drop below 4 °C with distance from the sea, and the amount of precipitation increases (from 1000 to

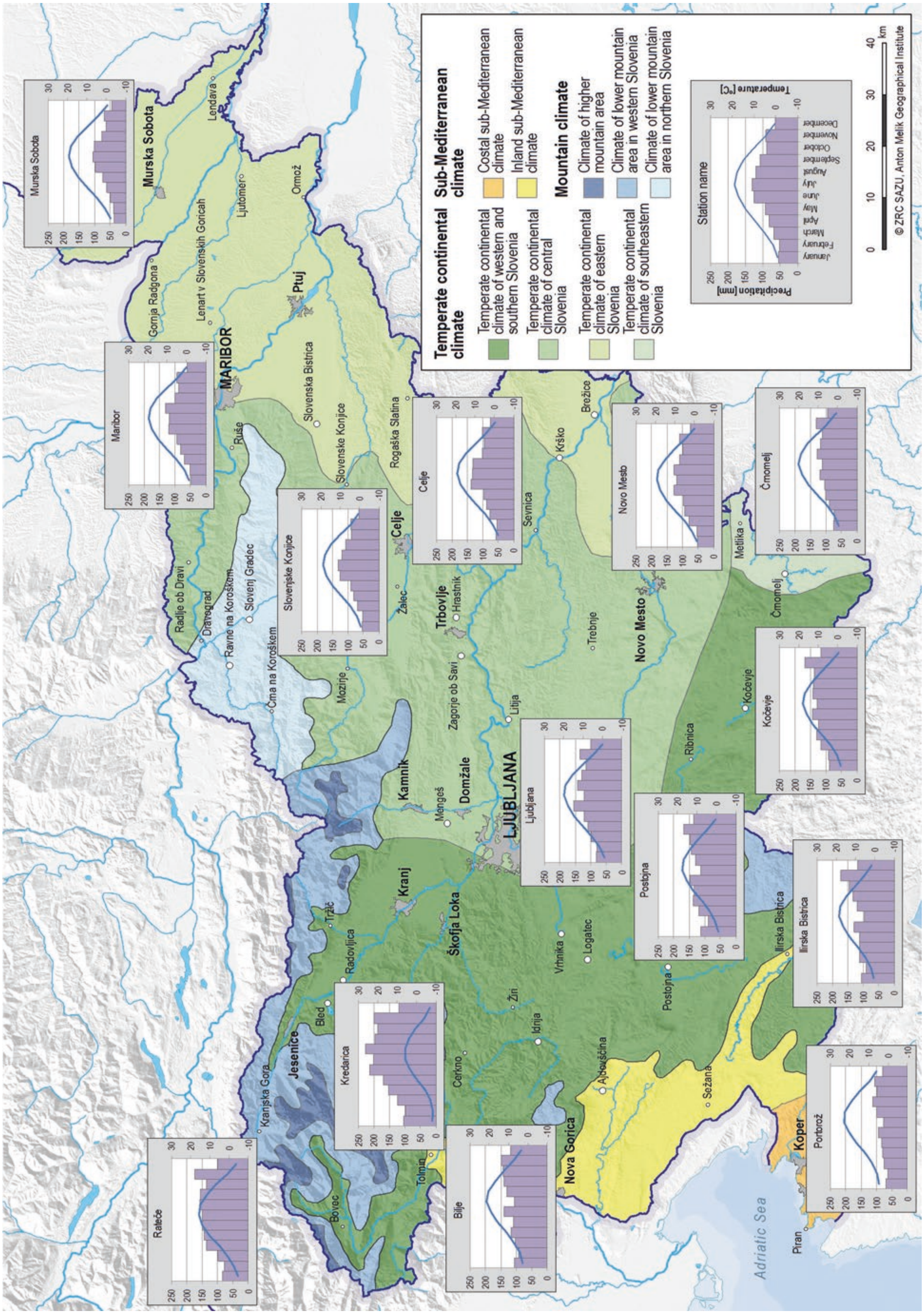

Fig. 5.1 Climate types in Slovenia. (Ogrin 2008)

1700 mm). Due to the proximity of the sea, October temperatures are higher than April ones (Ogrin 2004a).

The prevailing climate in Slovenia is *a temperate continental climate* (Cfb). Average January temperatures range from 0 to −3 °C and average July temperatures from 15 to 20 °C. Continentality increases toward the northeast and east. Based on differences in precipitation amounts, precipitation regime, and the ratios between October and April temperatures, a number of subtypes are found within this type. The temperate continental climate of western and southern Slovenia, also called premontane, is wetter (1300–2500 mm precipitation) due to the barrier of the Dinaric Mountains, but the precipitation and temperature regimes are still quite similar to the temperate humid climate with hot summers. The temperate continental climate of central Slovenia has October temperatures that are even higher than those of April but a lower average annual amount of precipitation (1000–1300 mm). The temperate continental climate of eastern Slovenia is found in the hills and lowlands of eastern and northeastern Slovenia, which open toward the Pannonian Basin, and is characterized by a continental precipitation regime. The amount of precipitation ranges from 800 to 1000 mm. October temperatures in the lowland areas are the same as those in April, whereas at higher elevations, April temperatures are even higher. The temperate continental climate of White Carniola in the southeast is quite specific: it has a temperature regime similar to the other parts of Slovenia, but due to the proximity of the Dinaric Alps, its precipitation regime is similar to the temperate humid climate with hot summers (1000–1300 mm; Ogrin 2004a).

A mountain climate (H) is found in the Alpine part of Slovenia, including the Pohorje Hills in the east, and in the highest parts of the Trnovo Forest Plateau and Mount Snežnik in the Dinaric region. Temperatures during the coldest month are below −3 °C, whereas those of the warmest month are above 10 °C but only up to the highest tree line, at an elevation of 1800–1900 m. Higher than that, summer temperatures are also below 10 °C. Temperatures of lower-lying areas of the mountain region, which also include mountain valleys, are comparable in summer to those of other lower-lying areas, whereas in winter they drop below −3 °C due to pronounced temperature inversions. Due to summer convections and winter inversions, the amount of sunshine in this region is among the lowest in Slovenia (1500–1800 h annually), whereas precipitation is high (1700–3000 mm annually; Ogrin 2004a).

5.2 Temperatures

Temperatures are subject to considerable daily, seasonal, and long-term variability. This is associated with Slovenia's location between the northern latitudes of 45° 25′ and 46° 52′ and four distinct seasons. Because of the seasons, the difference between the longest and shortest day lengths is more than 7 h in the case of Ljubljana, and the angle of incidence of the sun's rays is highly variable (from 67° 27′ to 22° 73′). The average annual temperature in Slovenia is 8.6 °C, and this decreases by an average of one degree Celsius for every 180 m of vertical ascent. The highest average annual temperature is found in the Slovenian Littoral around Koper, the Vipava Valley, and the Gorica Hills, where it is around 13 °C. Elsewhere in southwestern Slovenia and in parts of eastern Slovenia, it ranges from 10 to 12 °C (Fig. 5.2). The boundary of the temperate humid climate with hot summers corresponds roughly to the boundary between deciduous sub-Mediterranean and Alpine vegetation, where temperature plays an important role. Most of central Slovenia has average temperatures ranging from 8 to 11 °C, with an average annual temperature below freezing found only on the highest peaks (Mount Kredarica below Mount Triglav, 2514 m, −1.0 °C/1981–2010; Cegnar and Roškar 2004). The average air temperature in this region varies from year to year by a few tenths of a degree Celsius, and in a few cases, the variability can be even greater (Bertalanič et al. 2006a, b; Vertačnik and Bertalanič 2017; Klimatološka … 2018).

A similar distribution applies to January temperatures: the highest (4–6 °C) are along the coast; elsewhere they range from 2 to 4 °C, in the transitional zone toward the interior from 0 to 2 °C, and in the greatest part of the interior of Slovenia from −2 to 0 °C. Lower temperatures prevail in areas with the most pronounced temperature inversions and in the mountains where they drop to −8 °C.

July temperatures are the highest (20–22 °C) in the Koper Hills; on the Karst Plateau; in the Vipava Valley; in the eastern lowlands of the Mura, Drava, and Sava rivers; and in the low plain of White Carniola. They reach 18–20 °C in the Soča Valley, the lowest areas of the Dinaric region, and most of the lowland central Slovenia. Plateaus and lower hills of the interior of Slovenia warm up to 16–18 °C, whereas the mountainous parts of southern Slovenia and most of northern and northwestern Slovenia have July temperatures lower than 16 °C, dropping as low as 6 °C (Bertalanič et al. 2006a, b). Some local and microclimatic features of Slovenia should also be noted. The temperature difference between the coldest and warmest months depends on location and ranges from less than 15 °C in the high mountains to more than 20 °C in lowland and sheltered locations. The warmest month in the lowlands is July, and the coldest is January. Temperature extremes in mountain areas usually occur a month later: the lowest are in February and the highest are in July or August. Eastern Slovenia, with a continental climate, is characterized by the greatest daily and seasonal temperature fluctuations. In Mediterranean areas the climate is milder due to the influence of the sea (Bertalanič et al. 2006a, b; Vertačnik and Bertalanič 2017). Regarding to vertical

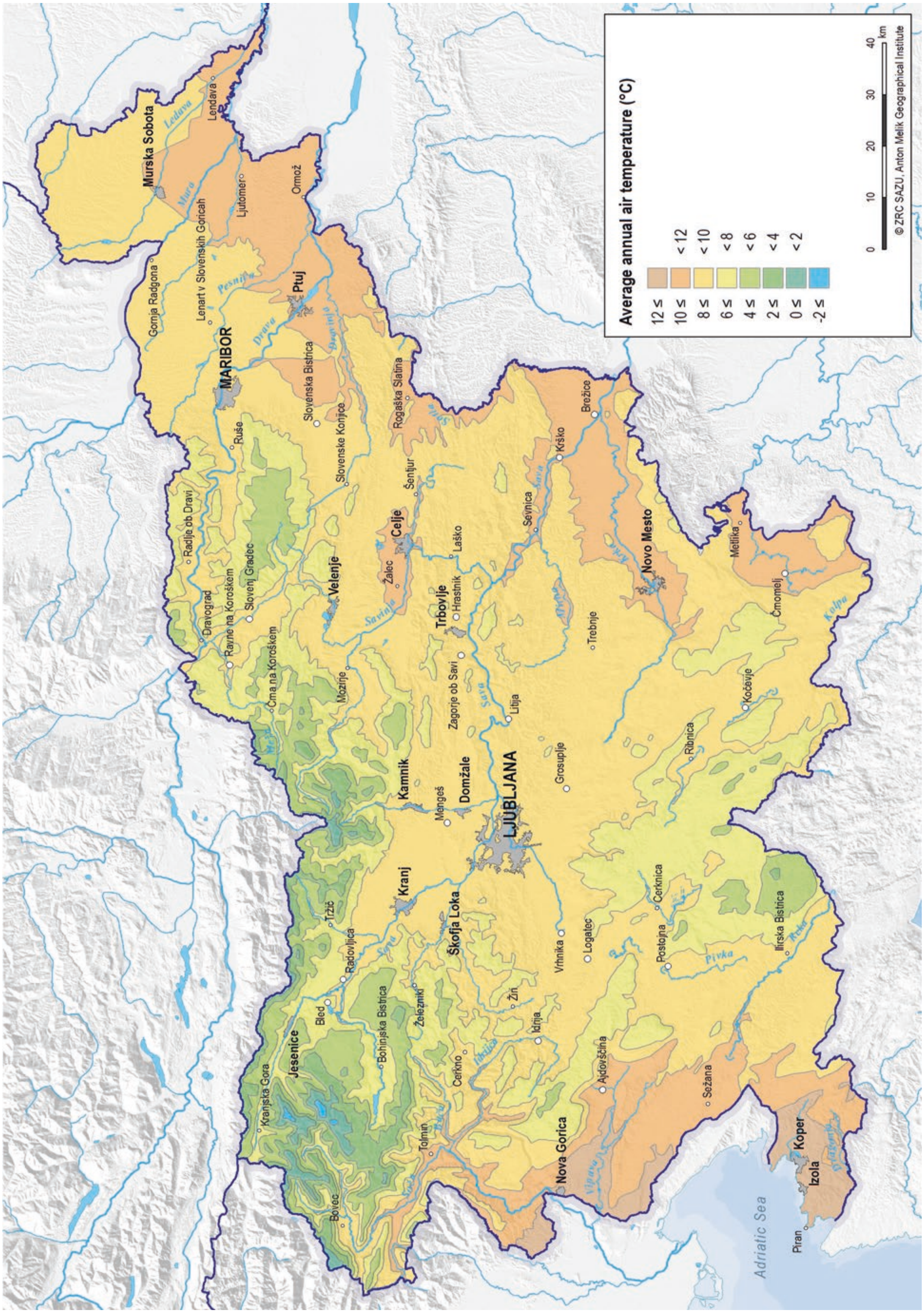

Fig. 5.2 Average annual air temperatures in Slovenia from 1961 to 1990. (Cegnar 2008)

Fig. 5.3 In Alpine valleys and basins (pictured is Tolmin in the central part of the Soča Valley), morning fog is common in fair weather in summer, although it dissipates quickly. The fog is more persistent in winter because the temperature inversions are much stronger, and a considerable part of the basin is shaded for most of the day. (Photo by Miha Pavšek, GIAM ZRC SAZU Archive)

zonation, Gams (1972) distinguished three climate zones: valley floors, the thermal or warm zone, and the mountain zone. In basins, valleys, and karst depressions, temperature inversions (Fig. 5.3) frequently occur during windless winter anticyclones. During these times a layer of cold air is trapped along the bottom, increasing days with fog and air pollution. Despite this, three-quarters of the Slovenian population live in these areas (Ogrin 2004a). The thermal zone, with widespread cultivation of orchards, vineyards, and olives, extends from a few dozen to 160 m above the floors of nearby valleys. During a strong inversion, it can be as much as 10 °C warmer than the lower-lying cold-air layer, but on average it is about 1 °C warmer. The hilly zone (elevation 800–850 m), where all agricultural crops can still be grown, is comparable to the temperature inversion zone. This is followed by the lower mountain zone, extending to the upper limit of agrarian settlement (1200–1250 m), the higher mountain zone (1550–1650, in the north 1800 m, a zone of conifers and mountain meadows), the subalpine zone (to the upper tree line at 1700–1900 m), and the Alpine zone (Gams 1986, 1996; Ogrin 2004a).

A special feature is the urban climate, where urban heat islands can be observed. Ljubljana and Maribor stand out in this respect, with average summer temperatures that are 1 °C (Fig. 5.4) and 0.5 °C higher, respectively, than those of the surrounding area (Ogrin 2004b; Komac et al. 2017). An urban heat island is also present in Celje and some other smaller Slovenian towns, such as Ljutomer, especially in lowland areas (Ivanjšič 2010).

Of particular interest from the standpoint of climate are karst areas. Karstified carbonate rocks slow the cooling of the ground in winter and its heating in summer, which has a local influence on the smaller annual temperature amplitudes of karst Dinaric regions. Karst depressions with temperature inversion are also frequent (Gams 2003).

5.3 Solar Radiation

Slovenia is well supplied with solar energy. Mediterranean areas receive the most sunshine, with an average of 2000–2350 h of solar radiation per year (Fig. 5.5). It is especially sunny there in summer because the sun shines over 10 h per day for more than half the time (Ogrin 2002). This region also stands out for the amount of energy received, on average 4400 MJ/m^2, and on sun-exposed slopes even more than 5300 MJ/m^2 (Gabrovec 1996). The mountain barriers in western Slovenia have the worst position; there the sun shines only 1500–1800 h due to frequent orographic and convective cloudiness. Stations in the interior, especially in

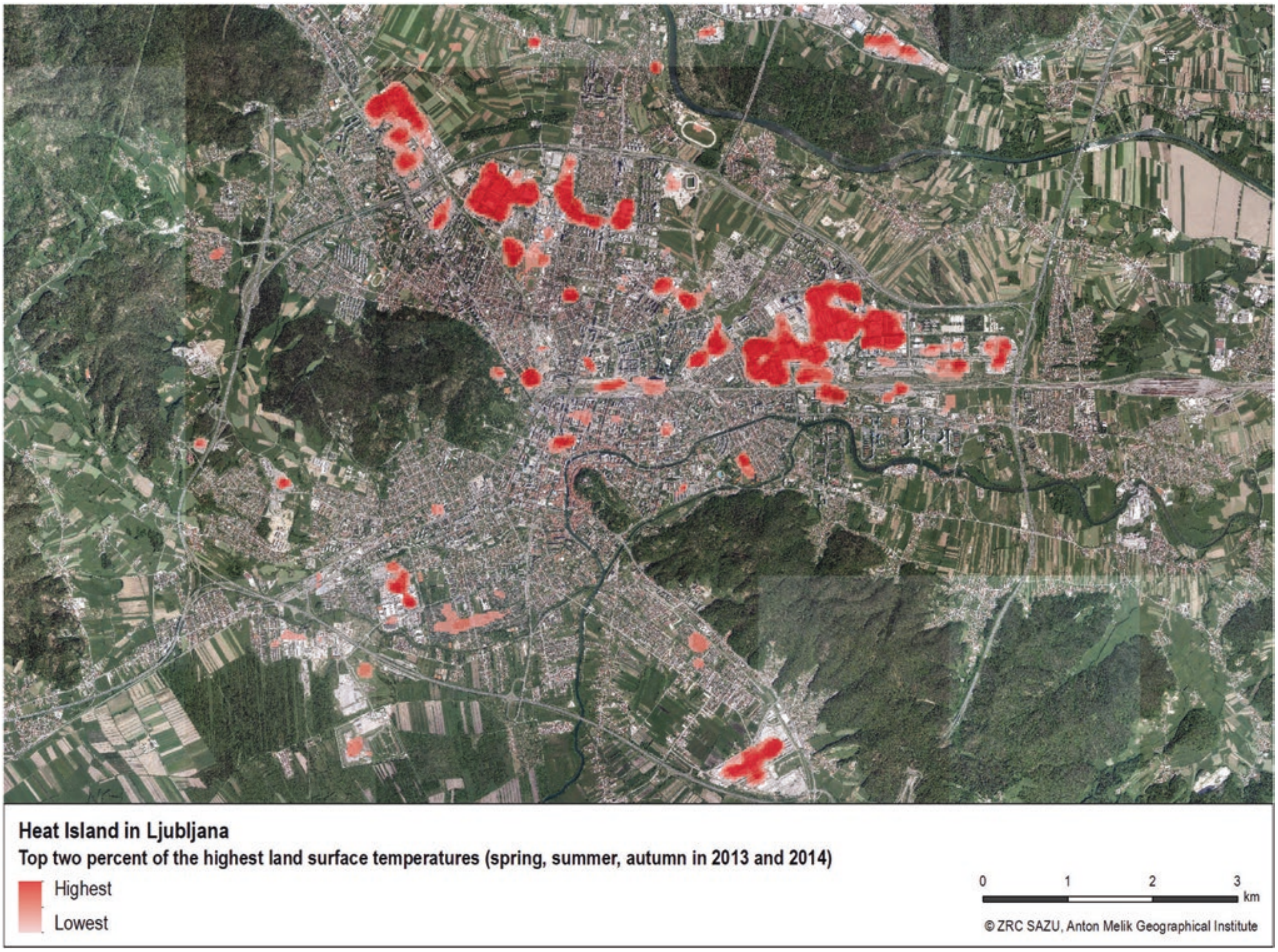

Fig. 5.4 A thermal image of Ljubljana shows particular hot spots in the city, corresponding to heat islands. (Komac et al. 2017)

basins and valleys, are deprived of sun due to wintertime low cloud cover and radiation fog, which accompanies temperature inversions (1650–1850 h; Ogrin 2002). Differences in insolation are greater during times of stable weather, when temperature inversion is frequent (Gabrovec 1996; Rakovec et al. 2003; Zakšek et al. 2005; Ovsenik-Jeglič 2006).

Annual amounts of hours of solar radiation from 1981 to 2010 were as follows: 2050 h in the northwest (Rateče, 864 m), 2019 h in the northeast (Murska Sobota, 187 m), 1974 h in central Slovenia (Ljubljana, 299 m), and 2300 h in the southwest (Portorož, 95 m; Vertačnik and Bertalanič 2017). Over this period there was a general trend observed of an increase in solar radiation for all seasons except fall (Bertalanič et al. 2006a, b).

5.4 Precipitation

The precipitation level in Slovenia is a spatially and temporally highly changeable meteorological variable (Vertačnik and Bertalanič 2017). Slovenia receives an average of 1750 mm of precipitation. The distribution of precipitation is primarily influenced by relief and distance from the Adriatic Sea and, more widely, from the Mediterranean Sea. In general, the annual amount of precipitation increases going from the sea toward the Alpine–Dinaric mountain barrier, whereas east of it, the amount gradually decreases; distinct peaks are found only in the Kamnik–Savinja Alps and the Pohorje Hills. In a year with average precipitation in Slovenia, the values range from 700 mm of precipitation in part of Prekmurje to more than 3000 mm, or four times more, in the Julian Alps and in some places along the aforementioned barrier (Vertačnik and Bertalanič 2017). Central Slovenia receives from 1200 to 1800 mm of precipitation (Bertalanič et al. 2006a, b).

The distribution of precipitation is dependent on the climate type. The region with a temperate humid climate with hot summers is characterized by spring and fall peaks. In the region with a mountain climate, most of the precipitation occurs in the fall, when Mediterranean cyclones are frequent, with a secondary peak in the late spring or at the beginning of summer. In the eastern part of the country, under the influ-

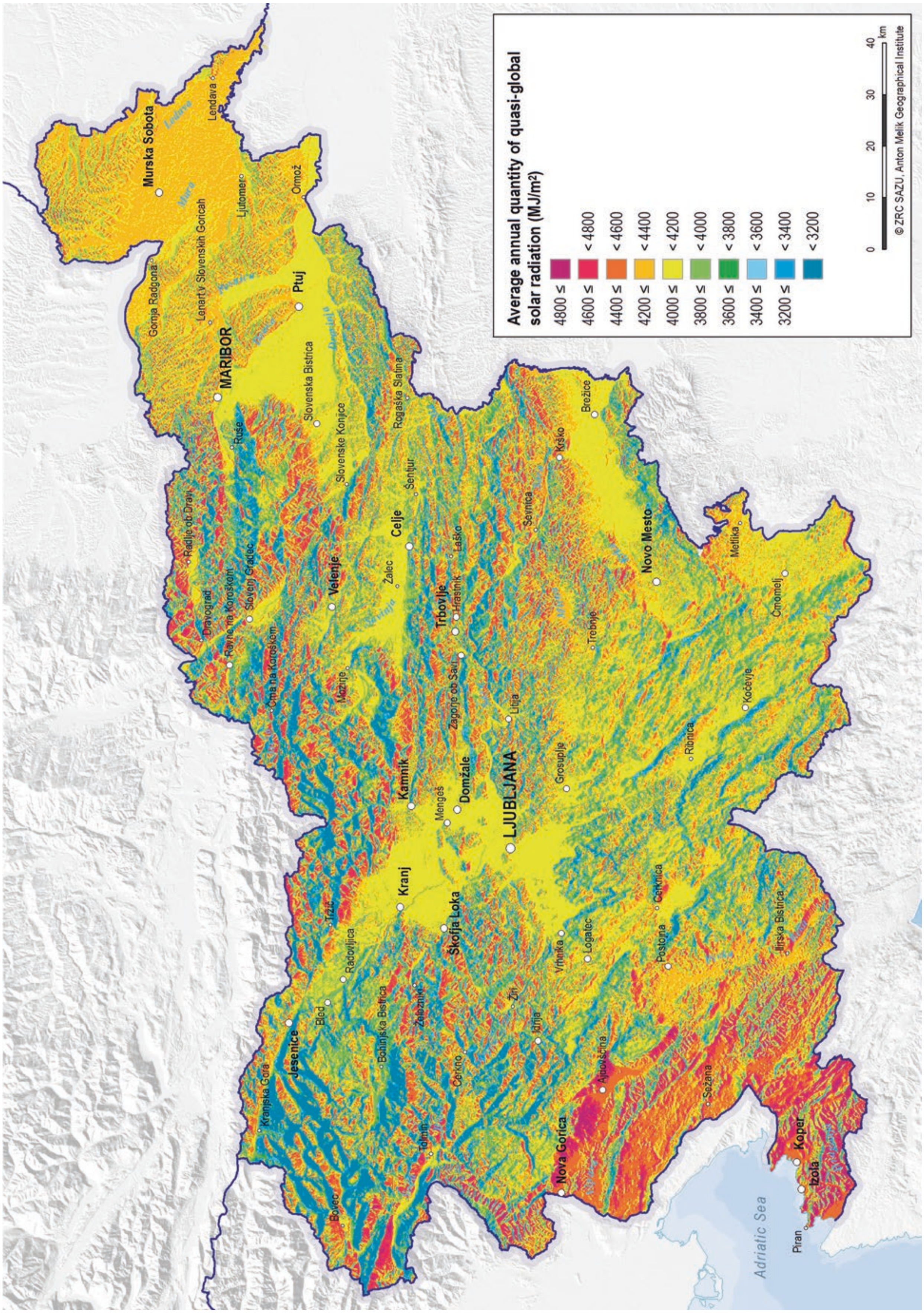

Fig. 5.5 Solar radiation. (Gabrovec and Kastelec 2008)

ence of a continental climate, precipitation is most abundant in the summer in the form of showers and thunderstorms caused by overheating of the atmosphere and the resulting strong convections. Winter months there are rather dry (Vertačnik and Bertalanič 2017).

With regard to the regional distribution of precipitation, along the Gulf of Trieste, it is between 1100 and 1200 mm. The greatest barrier to moisture-bearing air masses carried by southwesterly winds is the Alpine–Dinaric mountain barrier in western Slovenia that runs in the Dinaric direction from the northwest toward the southeast. This is the wettest region in the Alps and among the wettest in Europe. The most exposed parts of the Julian Alps receive from 1800 to more than 4000 mm annually along the Bohinj–Tolmin ridge (Mount Vogel, 1500 m) and in the Kanin Mountains (reaching 2587 m) in the western Julian Alps, with peaks from 5000 to 6000 mm and even more (Slovenski … 2018).

Due to orographic effects, the mountain ridges of the Karawanks and Kamnik–Savinja Alps in the north, which run in the Alpine direction from east to west, also receive above-average precipitation. Potential evapotranspiration does not exceed the amount of precipitation anywhere in Slovenia, which is advantageous for agriculture (Bertalanič et al. 2006a, b).

Snow regularly covers the entire country in winter, with the exception of the Koper Hills and the Vipava Valley. The high mountain area of the Julian Alps receives the most snow (the greatest seasonal accumulated depth of snow cover), almost 4 m and most often in April, and the peaks of the Karawanks and Kamnik–Savinja Alps receive only a little less (Vertačnik and Bertalanič 2017). Alpine valleys and basins receive only a fraction of this amount of snow and the lowlands in the interior of Slovenia even less (Fig. 5.6). Abundant snowfall often causes damage to buildings and to agriculture and forests in the spring (Ogrin and Ortar 2007). In central Slovenia snow cover is common in January, and it snows the most in February. During the season, this part of the country receives on average a total (the sum of the daily depths of new snow) of 60–100 cm of snow, and the snow cover lasts from 20 to 60 days (in comparison, in the Julian Alps, the total is more than 10 m and the snow cover lasts more than 250 days). The greatest depth of the snow cover with a return period of 50 years is up to 300 cm in Alpine valleys, from 100 to 150 cm in central Slovenia, and from only 50 to 75 cm in the eastern part of the country. In Rateče (northwest Slovenia) the snow cover was deepest in 1978 (190 cm), in Ljubljana (central Slovenia) in 1952 (146 cm), in Novo Mesto (southeast Slovenia) in 1999 (65 cm), and in Murska Sobota (northeast Slovenia) in 1986 (61 cm). The average total depth of seasonal snow cover in the high mountains is 375 cm of snow (Vertačnik and Bertalanič 2017); in some places, in shady areas, it can last all year long. At Mount Kredarica (2514 m), a record depth of 7 m was measured in April 2001 (Bertalanič et al. 2006a, b). Locally the intensity of snowfall is also very great: in the mountainous west, there can be as much as a meter and half or more of new snow per day (24 h; the Kanin Mountains and Komna Plateau in the Julian Alps) and about a meter in the Bloke area in southern Slovenia and below Mount Krvavec in the Kamnik–Savinja Alps (Fig. 5.7).

The amount of precipitation in all climate regions of Slovenia varies greatly from year to year; regional variability is dependent on the average annual amount of precipitation; very dry and extremely wet years can alternate, but the long-term averages are quite similar to one another. From 1971 to 2005, an increase in the amount of fall precipitation could be observed for almost all of Slovenia, whereas the amount in winter and spring decreased everywhere except in the east (Bertalanič et al. 2006a, b).

Fig. 5.6 Snowfall in the Tamar Valley in the Julian Alps, northwest Slovenia. (Photo by Miha Pavšek, GIAM ZRC SAZU Archive)

Fig. 5.7 Among the regions with the abundance of snow is the Komna Plateau in the western Julian Alps; pictured is the mountain lodge below Mount Bogatin (1977 m). (Photo by Miha Pavšek, GIAM ZRC SAZU Archive)

5.5 Wind

Slovenia is under the influence of westerly air circulation and Mediterranean cyclones, but in comparison to the rest of Europe, there is less wind due to the diverse relief and the country's location south of the Alps. In lowland areas there are calms 30–40% of the time, and the average wind speed is less than 2 m/s. This is only a third of the speed reached by winds above the plains of western Europe. Variability of wind speed is highest at the beginning and end of the year and lowest in the summer (Vertačnik and Bertalanič 2017). The windiest regions are the Mediterranean and Dinaric macroregions and exposed areas at higher elevations (Ogrin 2002). The greatest long-term average wind speeds (from 3.9 to 5.2 m/s) have been recorded (Vertačnik and Bertalanič 2017) at high-elevation stations (Mount Rogla in the Pohorje Hills and Mount Kredarica in the Julian Alps). The average wind speed increases by about 1.5 m/s for every 1000 m increase in elevation.

The prevailing wind direction is northerly at higher elevations, easterly to southeasterly along the coast, and following the orientation of Alpine valleys in these places (Vetačnik and Bertalanič 2017). Stronger winds are generally associated with extreme weather events and less so with daily temperature fluctuations and local, usually thermal, winds. As cyclones move in to the Mediterranean, there are southwesterly winds (called the *široko* or *jugo* by coastal Slovenians), which acquire a southwesterly direction with the creation of a secondary Genoa cyclone, and after the arrival of a cold front, there are cold, dry, and gusty winds from the north, northwest, or northeast. In Slovenia the best-known and strongest wind of this kind is the bora (Sln. *burja*), which makes up a 30–40% share of all the winds in the Mediterranean macroregion and blows in all seasons, but especially in winter, when gusts can exceed 200 km/h (Mihevc 1998; Ogrin 2000; Rakovec et al. 2009). It is best known below long and steep slopes, for example, in the Vipava Valley below the Trnovo Forest Plateau and Nanos Plateau, on the Karst Plateau, and on the Podgorje Karst Plateau (Fig. 5.8). The recurrence of the bora is reflected in the shape of treetops and adaptations in architecture (among them, the direction of roof ridges and weighting of roof tiles with stones called *golobice* "pigeons" in Slovenian) and in land use (rows of trees planted along borders of fields as windbreaks). The bora causes great problems in road (Vipava Valley), rail (Karst), maritime, and recreational air transport at the airports at Ajdovščina in the Vipava Valley, Rakitnik near Postojna, Bovec in the Soča Valley, and Portorož on the Adriatic coast (Honzak et al. 2017). Particularly in the Vipava Valley and the Karst Plateau, the bora also influences settlement (Fig. 5.9). The average speed of the bora on part of the Slovenian coast and in the most exposed places in the interior

Fig. 5.8 The crowns of trees and bushes in places such as Velika Vremščica Mountain (1027 m), with Mount Nanos in the background (1313 m), that are most exposed to the bora are asymmetrical. (Photo by Miha Pavšek, GIAM ZRC SAZU Archive)

exceeds 4 m/s (Vertačnik and Bertalanič 2017). The prevailing direction of strong winds is predominantly easterly in southwestern Slovenia and southerly to westerly in the eastern half of Slovenia, but in many places, it follows the topography of the land and blows in the direction of valleys, for example, in Alpine valleys, in the northern part of the Ljubljana Basin, in the Celje Basin, and in Carinthia.

There is another northerly wind with the destructive power to blow off roofing and uproot trees and poles, but it is considerably rarer. This is the *foehn*, which blasts south across the Karavanke Mountains and Kamnik–Savinja Alps.

There is also the southerly *foehn* that a southwesterly wind can turn into. First it causes precipitation on the windward side of the high Dinaric plateaus, and then the dry and warm air descends as a *foehn* over the northern, leeward slope of the Dinaric–Alpine mountain barrier, for example, the Krka River Valley, the Gorjanci Hills, Mount Vogel, and Mount Snežnik. In northeastern Slovenia a wind called a *krivec*, bearing cold air from the northeastern and eastern parts of the Pannonian Plain, can blow in winter for several weeks at a time during a stable eastern European polar anticyclone.

Of note are also local winds, which are weaker but recurrent. They arise due to differences in temperature or in the air pressure between uplands and lowlands and between the sea and the land. A nocturnal wind (*nočnik*), also known as a downvalley or katabatic wind (*gornik*), blows down from the cooled mountains along valleys at night, whereas an upvalley or anabatic wind (*dolnik*) blows in the opposite direction during the day, especially in summer. Similarly, a land wind (*burin*, *sušnik*) blows from the mainland toward the sea at night, whereas during the day, a mild sea wind (*maestral*) blows in the opposite direction.

5.6 Climate Extremes

The diversity of Slovenian Mediterranean, Dinaric, Alpine, and Pannonian landscapes, the varied topography, and the variety of climate types (Dolinar et al. 2017) are also reflected in records of climate extremes based on selected weather indicators (Fig. 5.10).

Meteorological measurements first began being recorded in what is now Slovenia as long ago as 1784 (Bertalanič et al. 2006a, b). There were still very few meteorological stations by the end of the nineteenth century; in the 1960s and 1970s, the network of stations was most extensive, but later on it was cut back until automatic stations were set up in the last decade. For this reason, the most significant extremes were recorded after 1950. It is likely that extreme low temperatures were in fact observed even earlier. Among the stations with the most extremes is the high mountain one on Mount Kredarica below Mount Triglav at an elevation of 2514 m (Fig. 5.11).

Most temperature extremes have been recorded in the interior of Slovenia (Bertalanič et al. 2006a, b). Cold weather in winter is brought by polar air masses moving in from the anticyclone above northern Europe and Asia. Heat is caused

Fig. 5.9 The most suitable roofing materials in regions affected by the bora are tiles; in the windiest areas, local residents weight them with stones called *golobice* "pigeons". (Photo by Miha Pavšek, GIAM ZRC SAZU Archive)

by the inflow of subtropical air masses, also in an anticyclone, from above North Africa and further across the western Mediterranean. Most monthly record lows are recorded in Babno Polje (January–March and November) and on Mount Kredarica in the Julian Alps (May–October) but have occurred in April at the Rudno Polje in the Julian Alps and in December at Slovenj Gradec below the Pohorje Mountain. Record monthly highs occur repeatedly (April, May, and October) only at the station at Slap in the Vipava Valley.

The spatial variability of precipitation is very high, with the majority of precipitation peaks in the Julian Alps in the northwest of the country, related to successive passages of weather fronts, the creation of secondary (Genoa) cyclones above the northern Mediterranean, and summer atmospheric instability. The greatest 24-h precipitation intensity in the Julian Alps is three times higher than that in northeastern Slovenia. Slovenia is also record-setting according to the annual number of thunderstorm days: in some places in the west, these can be more than 60. Additional precipitation is contributed by orographic effects, but recordings from windy high-elevation stations and areas where the bora blows are often underestimated (Ogrin 2005; Bertalanič et al. 2006a, b).

The duration of solar radiation is longest along the coast and areas in its immediate hinterland, whereas some valleys and basins in northwestern and central Slovenia receive the least amount of sunshine. Consequently these areas experience frequent and at times daylong periods of fog.

The strongest gusts of wind are observed at high-elevation stations (Bertalanič et al. 2006a, b) and places subjected to the bora or *foehn*. The bora is strongest in the eastern part of the Vipava Valley, on the Karst Plateau, and along the coast, and the *foehn* is strongest along the southern foothills of the high mountain areas of the Karawanks and Kamnik–Savinja Alps (Table 5.1).

5.7 Climate Change

Compared to the global average and the average for the Alps (Gabrovec et al. 2014), the average air temperature in Slovenia is rising more quickly; the precipitation regime and intensity of precipitation are also changing. Thunderstorms with strong winds, heavy rain, and hail are increasingly frequent. Intense but brief precipitation events causing landslides and floods are also becoming more frequent (Fig. 5.12). The number of hot days is growing, drought is increasingly common, and heat waves are more pronounced and of longer duration (Sušnik 2004; Bernard Vukadin et al. 2014). The extended growing season increases crop yields and makes possible the cultivation of new plant varieties, but heat stress also damages plants. The changing climate is conducive to the rapid expansion of weeds (including invasive species), pests, and plant diseases. Climate change also adversely affects people's health, most notably due to the effects of heat waves (Bergant et al. 2004; Bertalanič et al. 2010).

A general trend of increasing temperatures (Table 5.2) is further evidence that the region with an average annual temperature between 10 and 12 °C has been expanding in recent decades, from eastern Slovenia to the entire eastern half of the country and the Ljubljana Basin. Changes that are the result of global warming are mitigated by the sea. There was a rise in average annual temperatures by 1.5–1.7 °C at stations in the interior of Slovenia from 1971 to 2000, whereas stations near the sea show less warming than in the interior. Overall warming is primarily reflected in higher summer temperatures and a greater number of hot and warm days, whereas the number of cool and cold days in winter is declining (Ogrin 2004b). The change in average air temperature from 1872 to 2008 (Auer et al. 2007) shows clear differences among particular seasons.

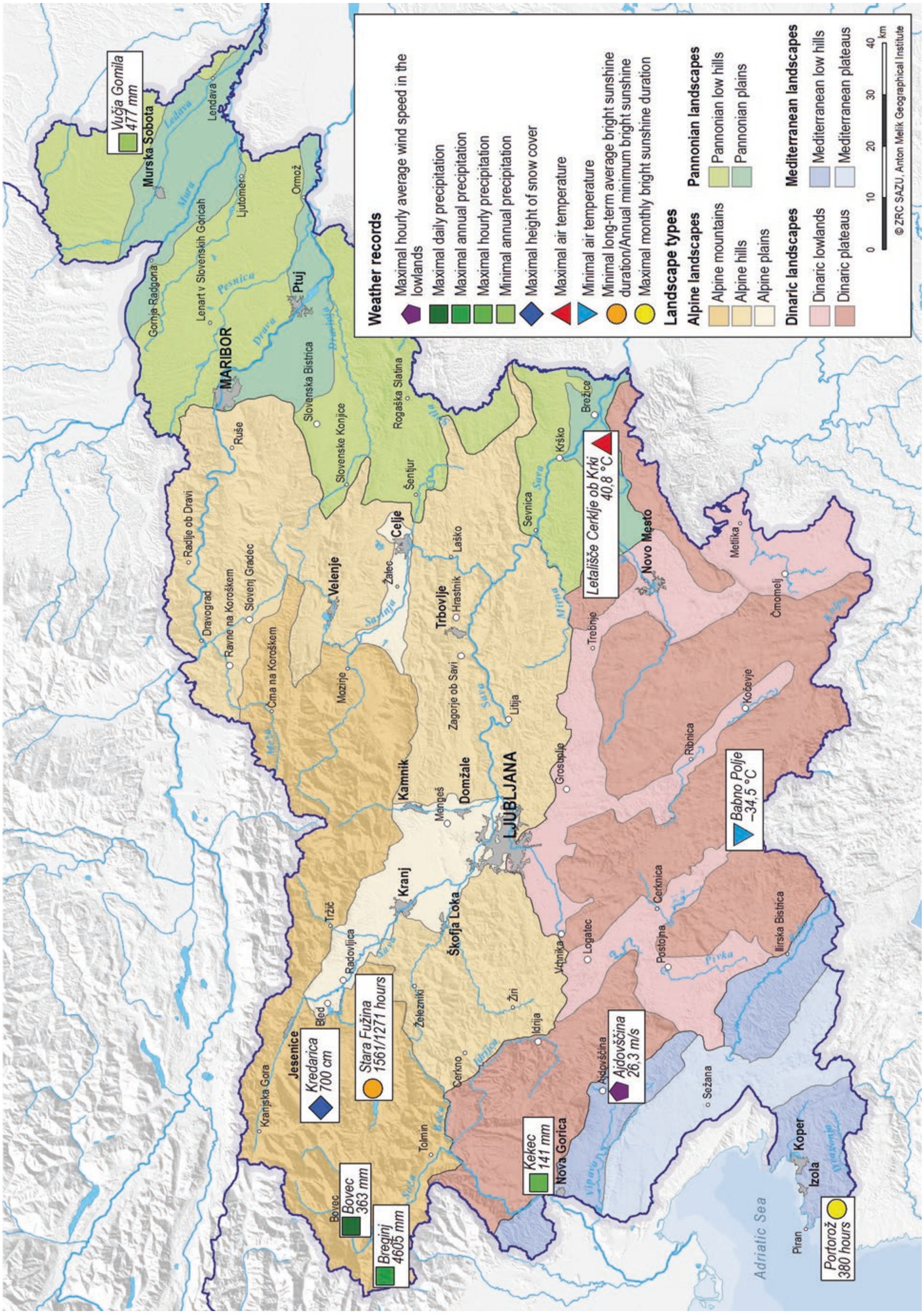

Fig. 5.10 Topographic map of Slovenian regions with the locations of meteorological stations marked where particular extreme values have been recorded

Fig. 5.11 One of every five extreme values for weather variables has been recorded to date at the high-altitude station on Mount Kredarica (2514 m) in western Julian Alps, which has been in operation since August 1954 and stands northeast of Mount Triglav (2864 m; in the background), Slovenia's highest mountain. (Photo by Miha Pavšek, GIAM ZRC SAZU Archive)

Consequently, the growing season is lengthening (Bernard Vukadin et al. 2014), particularly in the continental part of the country. Most of the warmest years in long-term meteorological statistical records date from the last few decades. Temperature extremes are more frequent than in the past, and hence a greater number of hot days with a high temperature over 30 °C and a smaller number of cold days with temperatures below freezing are being observed throughout the country. Heat waves are more frequent and last longer. Between 1951 and 2007 (ClimateChangePost … 2018), mean air temperatures increased by 0.15–0.29 °C/decade and even more so from 1961 to 2011 (from 0.3 to 0.4 °C/decade). The greatest increase, twice that of neighboring countries, was recorded in the meteorological spring (March–May) and summer (June–August), especially in central and northeastern Slovenia. More intense spring and summer warming is also likely a contributing factor in drying of the soil due to a decrease in the amount of precipitation in the meteorological winter.

The amount of precipitation is increasing in some places and decreasing in others. Everywhere except in the northeast, the amount of spring precipitation is decreasing, whereas the amount of fall precipitation is increasing everywhere. In winter the amount of precipitation is decreasing in western Slovenia, but elsewhere there is no change. Fall precipitation peaks are becoming more pronounced, whereas during the rest of the year, the amount of precipitation is decreasing (Bertalanič et al. 2006a, b). Noticeable differences in precipitation patterns have been recorded only in northwestern Slovenia, where over the period between 1971 and 2000, the amount of precipitation decreased by 3–6% per decade and winter precipitation by even more (3–12%). In the last century and a half, there has also been an observable trend of a decrease in the greatest seasonal total depth of the snow cover (Fig. 5.13). Decreasing total depth and reduction in the number of days with snow cover are two of the most noticeable indicators of climate change (Vertačnik and Bertalanič 2017), which are also reflected in increasing spatial and temporal variability, specifically in the inconsistency of snow conditions.

Among the most visible consequences of climate change is shrinking of glaciers (i.e., decrease in their area and volume). In Slovenia there are only two small glaciers below Mount Triglav (2864 m, Julian Alps, northwest Slovenia; Fig. 5.14) and Mount Skuta (2532 m, Kamnik–Savinja Alps, northern Slovenia). Their dynamics have been observed since 1946; at the beginning of measurements, the melting period was somewhat shorter than the growing period, but in recent decades, the reverse is more often the case (Gabrovec 1998; Gabrovec et al. 2013, 2014). Both glacierets, now only about a hectare in area, persist in borderline climatic conditions at the edge of the southeastern Alps because the snow line in this area is well above the highest peaks. Their continued existence is made possible by their shaded location and ongoing accumulation of snow from avalanches and drifts. Of the 10 warmest melting seasons (May–October; Fig. 5.15)

Table 5.1 Selected indicators for weather extremes for Slovenia (Slovenski … 2018)

Indicator	Type of record (minimum/maximum value)	Value [unit]	Station	Elevation (m. a. s. l.)	Region	Date
Air temperature	Maximum	40.8 °C	Cerklje ob Krki Airport	153	Krka Plain	August 8, 2013
Air temperature	Minimum	−34.5 °C	Babno Polje	756	Dinaric lowlands	February 15 and 16, 1956, January 13, 1968
Air temperature (unofficial measurement; Vertačnik 2009)	Minimum	−49.1 °C	Mrzla Komna mountain plateau (occasional measurements in a collapse doline)	1600	Julian Alps	January 9, 2009
Air temperature	Maximum monthly average	26.1 °C	Portorož Airport	2	Koper Hills	August 2003
Air temperature	Minimum monthly average	−17.2 °C	Kredarica	2514	Julian Alps	February 1956
Air temperature	Maximum long-term average	14.4 °C	Koper	4	Gulf of Trieste	1981–2010
Air temperature	Minimum long-term average	−1.0 °C	Kredarica	2514	Julian Alps	1981–2010
Air temperature	Maximum annual average	14.9 °C	Portorož Airport	2	Gulf of Trieste	2014
Air temperature	Minimum annual average	−2.6 °C	Kredarica	2514	Julian Alps	1956, 1962
Air temperature	Maximum annual number of hot days (daily high >30 °C)	79 days	Slap (Vipava), Bilje (Nova Gorica)	103 55	Vipava Valley	2003
Air temperature	Maximum annual number of cold days (daily high <0 °C)	281 days	Kredarica	2514	Julian Alps	1972
Precipitation	Maximum annual amount	4605 mm	Breginj	546	Julian Alps	1960
Precipitation	Minimum annual amount	477 mm	Vučja Gomila	260	Goričko Hills	1971
Precipitation	Maximum long-term average of annual amount	2941 mm	Žaga (Bovec)	350	Julian Alps	1981–2010
Precipitation	Minimum long-term average of annual amount	723 mm	Šalovci (Dolenci)	210	Goričko Hills	1981–2010
Precipitation	Maximum monthly amount of precipitation	1494 mm	Soča	485	Julian Alps	November 2000
Precipitation	Maximum daily amount of precipitation/annual record	363 mm	Bovec	450	Julian Alps	November 13–14, 1969 (7 am–7 am)
Precipitation	Maximum hourly amount of precipitation	141 mm	Kekec (Nova Gorica)	320	Vipava Valley	August 21, 1988 (8:50–9:50 am)
Precipitation	Maximum 10 min amount of precipitation	51 mm	Lisca	943	Eastern Sava Hills	May 19, 2009 (10:45–10:55 pm)
Snow cover	Greatest depth	700 cm	Kredarica	2514	Julian Alps	April 22, 2001
Snow cover: uplands	Maximum depth of new snow over a 24-h period	130 cm	Kredarica	2514	Julian Alps	December 12, 2017
Snow cover: uplands	Maximum sum total of new snow in the snow season	1662 cm	Kredarica	2514	Julian Alps	2000/2001

(continued)

Table 5.1 (continued)

Indicator	Type of record (minimum/maximum value)	Value [unit]	Station	Elevation (m. a. s. l.)	Region	Date
Snow cover: uplands	Maximum depth of new snow over a 24-h period	105 cm	Soča	485	Julian Alps	March 4, 1970
Snow cover	Average/longest duration of seasonal snow cover	251/290 days	Kredarica	2514	Julian Alps	1984/1985–2010/2011/1976/1977
Duration of solar radiation	Maximum long-term average/annual duration	2375/2730 h	Portorož	2	Gulf of Trieste	1981–2010/2011
Duration of solar radiation	Minimum long-term average/annual duration	1561/1271 h	Stara Fužina	550	Julian Alps	1981–2010/1972
Duration of solar radiation	Longest monthly	380 h	Portorož Airport	299	Gulf of Trieste	July 2007
Duration of solar radiation	Shortest monthly	4 h	Ljubljana Bežigrad	299	Ljubljana Basin	January 1970
Wind speed	Maximum long-term average: uplands	5.1 m/s	Kredarica	2514	Julian Alps	1995–2012
Wind speed	Maximum long-term average: lowlands	4.5 m/s	Piran (marine buoy)	0	Gulf of Trieste	2004–2012
Wind speed	Maximum half-hourly average speed: uplands	35.8 m/s	Kredarica	2514	Julian Alps	January 10, 2015/ 2:30–3:00 am
Wind speed	Maximum hourly average speed: lowlands	26.3 m/s	Ajdovščina	110	Vipava Valley	December 19, 1978 5:00–6:00 am
Wind speed	Maximum recorded speed: uplands	61.4 m/s	Kredarica	2514	Julian Alps	January 10, 2015 at 2:41 am
Wind speed	Maximum recorded speed: lowlands	49.6 m/s	Bovec	450	Julian Alps	November 16, 2002 at 7 pm

from 1955 to 2017, 9 occurred after 2000. Changes in both glaciers are closely connected with high mountain weather and climate conditions (Gabrovec et al. 2013); hence both are valuable direct indicators of climate change over a broader area (Kušar et al. 2014).

Mean air temperatures in Slovenia are expected to rise by one to four degrees Celsius relative to the average for 1961–1990 up until the mid-twenty-first century and from 3.5 to as much as 8 °C by the end of the century. More than increased wetness, one can expect warmer and drier summers and milder and up to a third wetter winters and overall a greater number of extreme weather events. Due to the further increased elevation of the snow line, stores of water will decrease (estimates are based on the snow water equivalent), which will drop by 10–60% by the middle of the twenty-first century and by 30–80% by the end of the century (ClimateChangePost … 2018).

Climate change according to seasons (Vertačnik and Bertalanič 2017) shows a characteristic increase in air temperature and the duration of solar radiation and a decrease in the amount of precipitation (and consequently also a decrease in the depth of the snow cover). The rise in air temperatures is most pronounced in summer, and this time of year is warmer, sunnier, and drier particularly in the south and southwest of Slovenia. Of all the seasons, fall shows the least pronounced effects of climate change. It is therefore all the more noticeable for winter, when the trend of increasing air temperatures is quite pronounced. Decreased precipitation in the northern half of Slovenia along with increased air temperature is also reflected in a reduction in the depth of the snow cover; the findings for part of southern Slovenia are similar.

Climate change also has an impact on the development of tourism, and so changes in strategies are now needed to

Fig. 5.12 Torrential rains are also becoming increasingly frequent in Mediterranean Slovenia; here along one of the narrow lanes in Piran. (Photo by Primož Pipan, GIAM ZRC SAZU Archive)

Table 5.2 Increase in average annual temperature (in °C) during three periods in four regions of the Alps from 1850 to 2007 (Gabrovec et al. 2014)

Region	1850–2007	1850–1975	1975–2007
Northwest	1.71	0.84	1.63
Northeast	1.52	0.77	1.50
Southwest	1.51	0.75	1.53
Southeast	1.37	0.73	1.62

reduce their dependence on seasons (Urbanc and Pipan 2011). Mountain tourism areas in particular should reduce their dependence on traditional winter and summer activities (skiing and hiking) and focus on activities and amenities in line with adjusted programs in the framework of long-term planning.

5.8 Conclusion

Climatic conditions in Slovenia, like Slovenian landscapes, are highly diverse and for the most part of a transitional nature. The slopes of mountains and ridges of high mountains, dissected in places by deeply cut river valleys, represent a sharp dividing line. Across the gradual transitions in the karst lowlands, there is an exchange of air masses from neighboring climate regions. A particular zone is the north side of the Julian Alps and the valleys there (the Upper and Lower Bohinj Valley, and the Upper Sava Valley), where it is colder and more sheltered from the wind than one would expect based on elevation because the mountains block the immediate or greater inflow of wet, warm air masses from above the Mediterranean. At the same time, after crossing central Slovenia, these air masses descend and become drier and warmer in northeastern Slovenia.

Only rarely does such a small land area display so many different types of weather and climate types and phenomena as occur across Slovenia. The transitional nature of the climate over short distances is on the one hand advantageous for a country's development, but on the other hand, it also fosters the creation of extreme weather phenomena that can lead to natural disasters. Most frequent among these are summer droughts, followed by floods (most often in the fall) as a result of intense precipitation from the crossing of cyclones associated with areas of low atmospheric pressure. Strong winds frequently cause damage particularly in areas where buildings and infrastructure are not adapted to the conditions, such as the regions where the foehn blows from the Karavanke Mountains or in northeastern Slovenia. Hail is

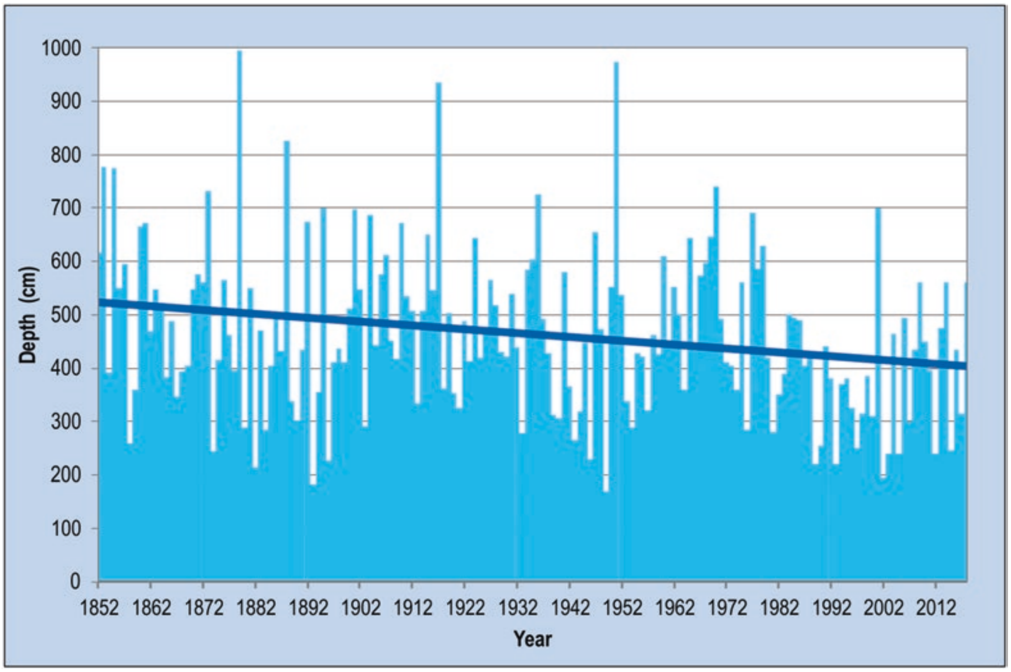

Fig. 5.13 Reconstruction of the seasonal maximum snow cover depth at the edge of the Triglav Glacier for the period winter 1813 – winter 2018 and linear trend estimation (Gabrovec et al. 2014)

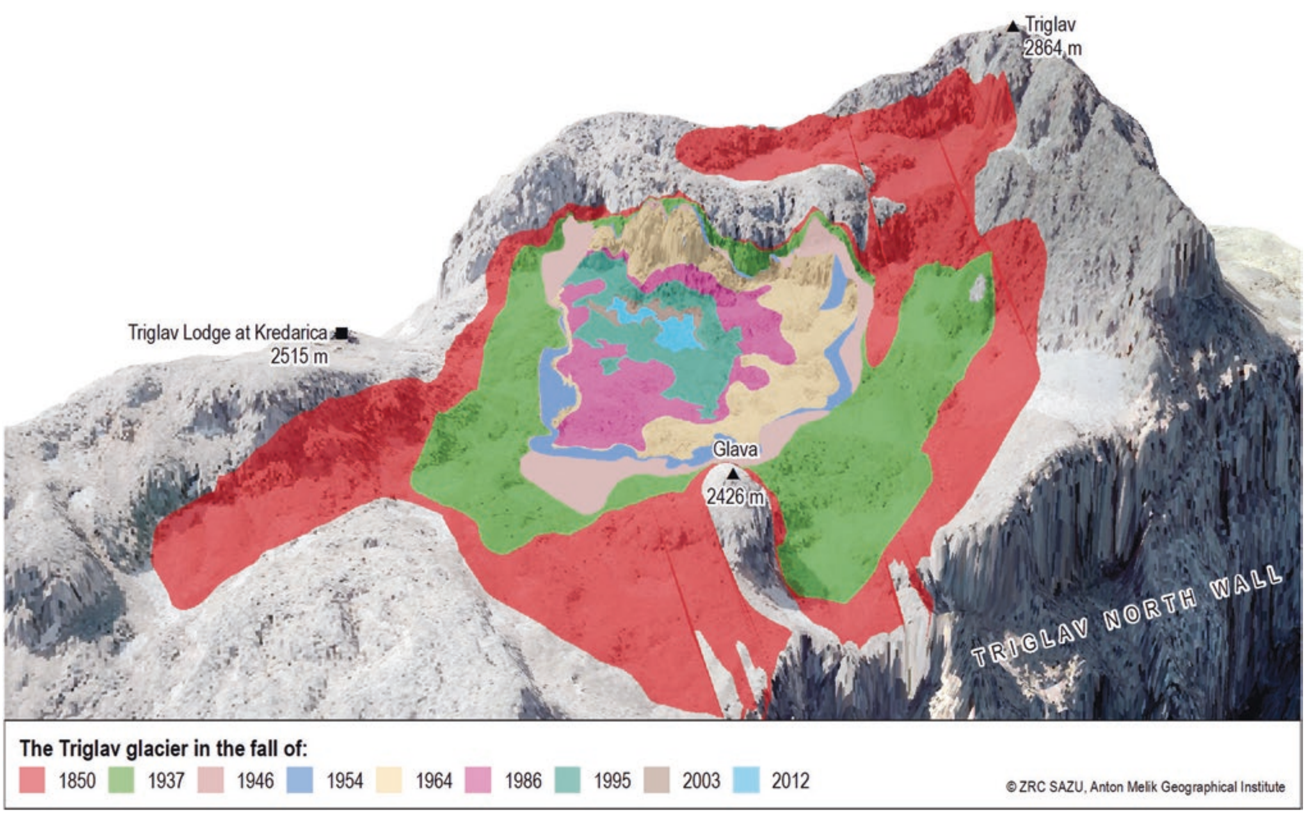

Fig. 5.14 In the last century, climate change has caused the area of the Triglav Glacier to shrink to less than 1% of its former area (Gabrovec et al. 2014)

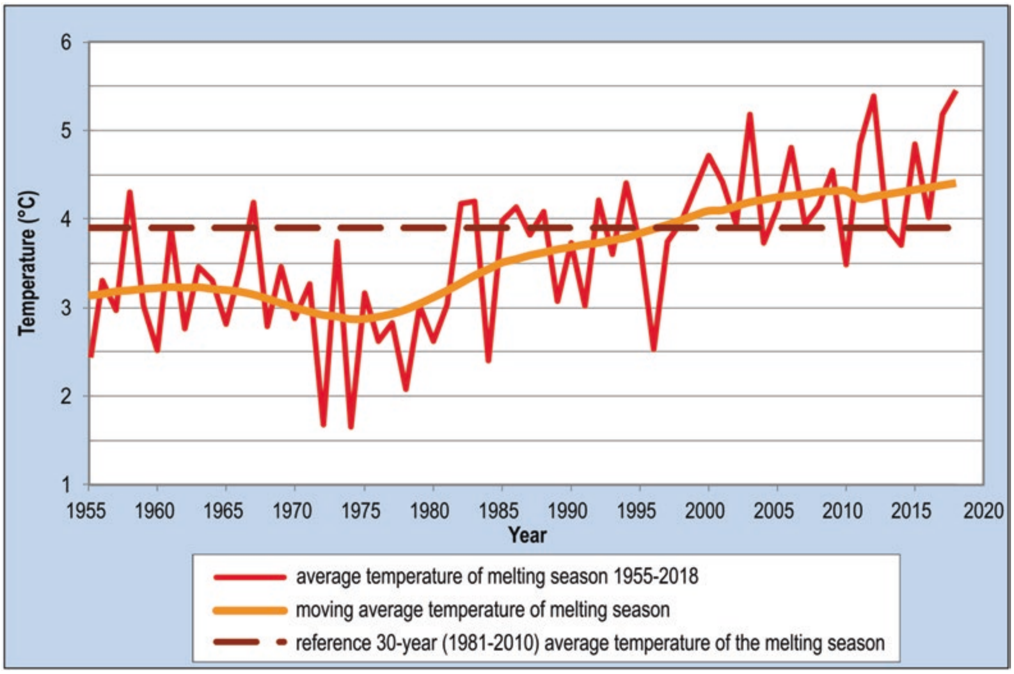

Fig. 5.15 Average temperature of the melting season (May–October) on Mount Kredarica from 1955 to 2018 (Gabrovec et al. 2014; data source: Slovenian Environment Agency 2018). The nine warmest melting seasons (November–October) of this period were all after 2000, and the warmest was 2017/2018

a fairly frequent occurrence, and the occurrence of frost is associated with specific weather conditions. Nevertheless, this land on the "sunny and shady" side of the Alps and its foothills and the Dinaric mountain barrier, compared to its neighbors, is sheltered from the harshest of these kinds of weather-related natural disasters.

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6 Soils of Slovenia

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Abstract

The diverse physical geographical characteristics of Slovenia result in diverse soil types. Due to widespread karst landscapes, the basic division of soils is carbonate and non-carbonate. However, the pedogeographical classification of Slovenian soils is based on topography and has three groups of soil types: soils of plains and valleys, soils of hills and mountains, and soils of karst plains and plateaus. The most common soil types are Chromic Cambisol and Rendzina alternation (33.6%), followed by Dystric Cambisol (24.2%) and Eutric Cambisol (13.3%). Most Slovenian soils formed during the Quaternary and are relatively rich in humus. Soil sealing, soil contamination, and soil erosion are the main forms of soil degradation in Slovenia.

Keywords

Physical geography · Soil geography · Soil types · Soil classification · Soil degradation

6.1 Pedogeographical Soil Types

Slovenia, as a landscape hot-spot of Europe (Perko and Ciglič 2015), has a diverse geology and geomorphology, both of which are among the most important soil forming factors (Grčman et al. 2015). This is followed by the overall diversity of the environment (Perko et al. 2017) as well as water, climate, vegetation, and anthropogenic influences (Lovrenčak 1998; Vrščaj et al. 2017).

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The widespread karst landscapes in Slovenia result in basic soil classification as carbonate and non-carbonate (Repe 2004). The pedogeographical map reflects the geology of Slovenia, in particular the areas of carbonate rocks (Lovrenčak 1998; Repe 2004) including the related geomorphology. The pedogeographical map (Fig. 6.1) shows three groups of pedogeographical soil types: (1) soils of plains and valleys, mostly occurring up to 400 m in elevation, (2) soils of hills and mountains, and (3) soils of karst plains and plateaus, mostly occurring above 400 m. Depending on the influence of water, soils can be automorphic or hydromorphic.

Two pedogeographical soil types with automorphic properties are part of the first group:

– 1a) Rendzina, Cambisol, and Luvisol on carbonate gravel and sand on Pleistocene and Holocene river terraces, alluvial fans, and moraines;
– 1b) Ranker, Cambisol, and Luvisol on non-carbonate (silicate) gravel and sand, mostly along large allochtonous rivers such as the Drava and Mura in northeastern Slovenia.

The first group also includes four types with hydromorphic properties:

– 1c) Fluvisol and Gleysol on gravel and sand along the watercourses;
– 1d) Gleysol and Fluvisol on less permeable clay and sand;
– 1e) Planosol on clay and sand;
– 1f) Histosol and Humic Gleysol on clay.

The second group of pedogeographical soil types (with only automorphic properties) consists of:

– 2a) Lithosol on carbonate rocks, soils in their early stage of genesis on slopes, ridgelines, screes, or alluvial fans;

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D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_6

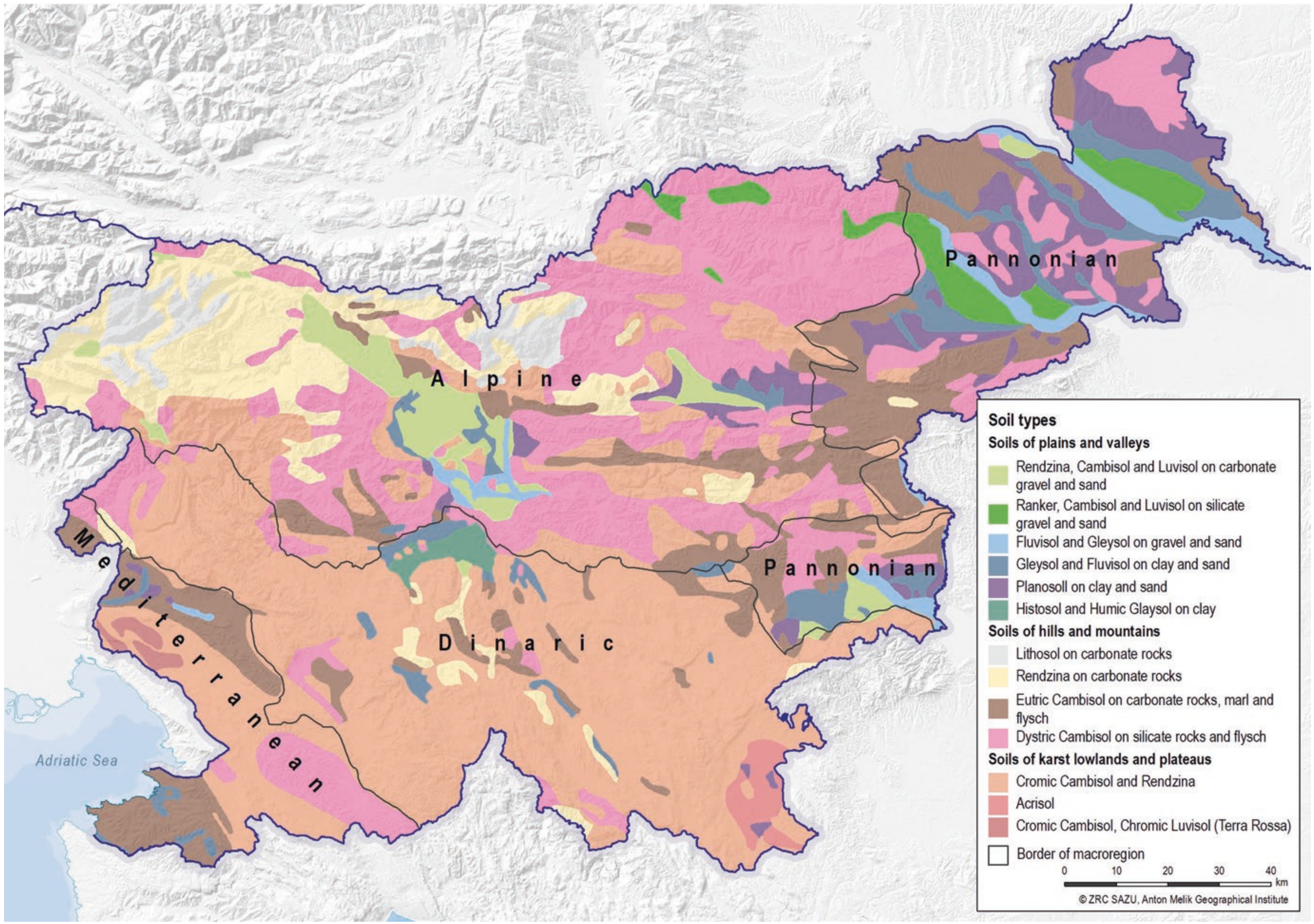

Fig. 6.1 Pedogeographical map of Slovenia. (Adapted from Lovrenčak 1998)

– 2b) Rendzina on carbonate rocks with more mature soils on carbonate bedrock;
– 2c) Eutric Cambisol on carbonate rocks, marl, and flysch, characteristic for Mediterranean flysch hills, Pannonian marl hills, and some carbonate hills;
– 2d) Dystric Cambisol on non-carbonate (silicate) rocks and flysch, mostly in pre-Alpine mountains and in places in the Mediterranean and Pannonian hills.

The shared soil characteristics in hilly regions are that the soils are shallower and more skeleton-rich due to the slope inclination and more intensive geomorphic processes (Ogrin and Plut 2009).

The third group of pedogeographical soil types (with only automorphic properties) includes:

– 3a) Chromic Cambisol and Rendzina, depending on the stage of weathering of limestone or dolomite bedrock, which results in short alternation in distances between both types of soils, covering 33.6% of Slovenia;
– 3b) Acrisol, formed on limestone and dolomite in the sub-Pannonian climate, for example, White Carniola in southeastern Slovenia.
– 3c) Chromic Cambisol and Chromic Luvisol with a characteristic reddish color, both occurring in Mediterranean karst landscapes (e.g., the Karst Plateau).

For basic soil characteristics of pedogeographical soil types see Table 6.2.

The dominant pedogeographical soil types in Slovenia are Chromic Cambisol and Rendzina (33.6%), followed by Dystric Cambisol (24.2%) and Eutric Cambisol (13.3%; Table 6.1; Fig. 6.2). According to the FAO classification (Table 6.3; Figs. 6.3 and 6.4), the most widespread are Rendzic Leptosol (25.3%), Dystric Cambisol (20.7%), Eutric Cambisol (15.9%), and Chromic Cambisol (12.2%).

The Alpine mountains in northern and northwestern Slovenia as well as the Alpine hills in the west are characterized by soils on carbonate bedrock, whereas the hills in eastern and northeastern Slovenia are characterized by soils on non-carbonate bedrock. Pedogeographical soil types on carbonate bedrock covering more than 10% of the surface of the Alpine macroregion (Table 6.1; Fig. 6.2) include Rendzina (17.1%) and a combination of Chromic Cambisol and Rendzina (17.4%). Pedogeographical soil types that cover more than a tenth of the surface on non-carbonate bedrock include Dystric Cambisol at 40.9%. According to the FAO classification (Table 6.3; Figs. 6.3 and 6.4), Dystric Cambisol (34.6%), Rendzic Leptosol (24.7%), and Eutric Cambisol (13%) prevail in the Alpine macroregion.

The most widespread pedogeographical soil type in the Dinaric (karst) macroregion of southern Slovenia is Chromic Cambisol and Rendzina (79%; Table 6.1; Fig. 6.3), alternating at short distances. According to the FAO classification (Table 6.3; Figs. 6.3 and 6.4), Rendzic Leptosol is the most dominant (41.4%), followed by Chromic Cambisol (29.7%) and Eutric Cambisol (10.7%).

The most widespread pedogeographical soil types on the carbonate bedrock in the Mediterranean macroregion are Eutric Cambisol (32.9%) and alternating Chromic Cambisol and Rendzina (39%), whereas on flysch bedrock, the most widespread soil type is Dystric Cambisol (18.6%; Table 6.1; Fig. 6.2). According to the FAO classification (Table 6.3; Figs. 6.3 and 6.4), Rendzic Leptosol (32.2%), Eutric Cambisol (22.8%), Dystric Cambisol (13.3%), and Chromic Cambisol (10%) are the most widespread.

The only macroregion where the hydromorphic soils cover more than 10% of the surface is the Pannonian macroregion (Table 6.1; Fig. 6.2). Gleysol and Fluvisol cover 11.7% of the surface, and Planosol covers 19.6%. Common pedogeographical soil types are also Eutric Cambisol (29.3%) on carbonate bedrock and Dystric Cambisol (18%) on non-carbonate bedrock. According to FAO classification (Table 6.3; Figs. 6.3 and 6.4), the most widespread are Eutric Cambisol (25.6%) and Dystric Cambisol (19.1%), followed by various forms of Fluvisols (14.5%), Planosols (14%), and Gleysols (12.3%).

Most Slovenian soils formed during the Quaternary; however, some soils in karst areas could have a relict origin (Grčman et al. 2015). In comparison to the soils of many other climate belts, Slovenian soils are relatively rich in humus and often contain more than 5% organic matter in the epipedon. In southwestern Slovenia, where there is a Mediterranean influence, mineralization of organic matter is faster, and therefore soils contain lower levels of organic matter. In eastern Slovenia, where precipitation levels are low, leaching and down-profile migration are less intense (Grčman et al. 2015). Average organic matter content in the topsoil (0–25 cm) of all agricultural soils in Slovenia is 4.3% but varies significantly, from 0.3% in sandy soils in vineyards up to 66% in bog meadows and fields (Vrščaj et al. 2017).

6.2 Slovenian Soil Classification

Soil science in Slovenia can be dated back to the late nineteenth century when the first soil map was published around 1873 (Vrščaj et al. 2017), but the beginnings of pedogeography were outlined in the 1950s (Repe 2018). Geographers tend to use a pedogeographical classification (see Sect. 6.1; Lovrenčak 1998), whereas pedologists mostly use the Slovenian Soil Classification, which is a modification of an older Yugoslav classification from the 1970s (Grčman et al. 2015; Repe 2010; Vrščaj et al. 2017). In addition to the old

Table 6.1 Pedogeographical soil types in Slovenian physical-geographical macroregions (Perko 1998) based on the pedogeographical map of Slovenia (Lovrenčak 1998; Fridl et al. 2001)

ID	Groups of pedogeographical soil types	Pedogeographical soil type	Alpine macroregion (km^2)	Alpine macroregion (%)	Dinaric macroregion (km^2)	Dinaric macroregion (%)	Mediterranean macroregion (km^2)	Mediterranean macroregion (%)	Pannonian macroregion (km^2)	Pannonian macroregion (%)	Slovenia (km^2)	Slovenia (%)
1a	Soils of plains and valleys	Rendzina, Cambisol, and Luvisol on carbonate gravel and sand	544.6	6.4	17.4	0.3	0.0	0.0	78.6	1.8	640.6	3.2
1b	Soils of plains and valleys	Ranker, Cambisol, and Luvisol on silicate gravel and sand	107.3	1.3	0.0	0.0	0.0	0.0	336.1	7.8	443.4	2.2
1c	Soils of plains and valleys	Fluvisol and Gleysol on gravel and sand	77.9	0.9	0.9	0.0	10.2	0.6	348.6	8.1	437.5	2.2
1d	Soils of plains and valleys	Gleysol and Fluvisol on clay and sand	108.7	1.3	138.6	2.4	57.5	3.3	500.6	**11.7**	805.5	4.0
1e	Soils of plains and valleys	Planosol on clay and sand	156.3	1.8	17.7	0.3	15.7	0.9	840.7	**19.6**	1030.3	5.1
1f	Soils of plains and valleys	Histosol and Humic Gleysol on clay	0.0	0.0	105.1	1.8	0.0	0.0	0.0	0.0	105.1	0.5
2a	Soils of hills and mountains	Lithosol on carbonate rocks	492.0	5.8	0.0	0.0	0.0	0.0	0.0	0.0	492.0	2.4
2b	Soils of hills and mountains	Rendzina on carbonate rocks	1463.0	**17.1**	170.6	3.0	13.4	0.8	9.5	0.2	1656.5	8.2
2c	Soils of hills and mountains	Eutric Cambisol on carbonate rocks, marl, and flysch	615.9	7.2	263.0	4.6	569.6	**32.9**	1257.3	**29.3**	2705.9	**13.3**
2d	Soils of hills and mountains	Dystric Cambisol on silicate rocks and flysch	3491.2	**40.9**	330.5	5.8	321.5	**18.6**	771.1	**18.0**	4914.3	**24.2**
3a	Soils of karst plains and plateaus	Chromic Cambisol and Rendzina	1483.5	**17.4**	4507.7	**79.0**	676.2	**39.0**	147.2	3.4	6814.6	**33.6**
3b	Soils of karst plains and plateaus	Acrisol	0.0	0.0	155.4	2.7	0.0	0.0	0.0	0.0	155.4	0.8
3c	Soils of karst plains and plateaus	Chromic Cambisol, Chromic Luvisol (terra rossa)	0.0	0.0	0.0	0.0	69.1	4.0	0.0	0.0	69.1	0.3

Those covering more than 10% of the macroregion (or entire country) are in bold

Table 6.2 Basic soil characteristics

Groups of pedogeographical soil types	ID	Pedogeographical soil type	Basic characteristics
Soils of plains and wider valleys	1a	Rendzina/Rendzic Leptosols (Calcaric)	**Horizons**: A-C, A-(Bv)-C
			Texture: silty loam-sandy loam
			pH: 5.5–7.0
			Parent material: carbonate gravel and sand
			Land use: arable, meadow in higher rainfall regions
			Comments: shallow soil, possible water deficiency, risk of fertilizer and phytopharmaceutical substances leaching
	1a	Cambisol (Eutric)	**Horizons**: Ap-Bv-C
			Texture: loam-silty loam
			pH: 5.5–7
			Parent material: fluvioglacial sandy gravel
			Land use: intensive arable land, hop cultivation and other agricultural land use without significant limitations
			Comments: intensive agricultural land use can endanger groundwater quality
	1a	Luvisols	**Horizons**: A-E-Bt-C, A-E-Bt-Bg-C
			Texture: silty loam-silty clay loam
			pH: 4–5
			Parent material: conglomerate
			Land use: arable, meadow, forest
			Comments: liming required
	1b	Ranker/Dystric Leptosols	**Horizons**: A-Bv-C
			Texture: loam, sandy loam
			pH: 4.55–5
			Parent material: siliceous sand and gravel river deposits
			Land use: arable, meadow
			Comments: possible water deficiency, risk of phytopharmaceutical substances and nitrogen fertilizer leaching
	1b	Cambisol (Dystric)	**Horizons**: A-Bv-C
			Texture: silty loam
			pH: 4–5
			Parent material: non calcareous (siliceous) sandy gravel sediments
			Land use: arable, less favorite meadow
			Comments: liming required due to low pH, shallower soils exposed to water deficiency, risk of phytopharmaceutical substances and fertilizer leaching
	1b	Luvisols	**Horizons**: A-E-Bt-C
			Texture: sandy clay loam-clay
			pH: 4.5–5.5
			Parent material: Pliocene deposits, siliceous substrates
			Land use: grassland, forest
			Comments: grassland use conditional due to heavy soil texture
	1c–1d	Gleysol and Fluvisol/Gleyic Fluvisols (Eutric)	**Horizons**: A_1-A_2-Go-C
			Texture: loam-silty loam
			pH: 6.5–7.5
			Parent material: loamy-clay alluvium
			Land use: arable, meadow, plantations of fast-growing foliage trees
			Comments: ameliorations required for agricultural land use
	1c–1d	Gleysol and Fluvisol/Gleyic Fluvisols (Dystric)	**Horizons**: A_1-A_2-Go-C
			Texture: clay loam
			pH: 4.5–5

(continued)

Table 6.2 (continued)

Groups of pedogeographical soil types	ID	Pedogeographical soil type	Basic characteristics
			Parent material: clayloamy alluvium
			Land use: arable, meadow, plantations of fast-growing foliage trees
			Comments: ameliorations and liming required for agricultural land use
	1e	Planosols (Eutric)	**Horizons**: A-g-Bg-C
			Texture: silty loam-silty clay loam
			pH: 5–6.5
			Parent material: Pleistocene and Pliocene deposits
			Land use: meadow, arable, forest
			Comments: Land use conditioned depend on climatic conditions (e.g., amount of rainfall)
	1e	Planosols (Dystric)	**Horizons**: A-g-Bg-C
			Texture: silty loam-silty clay loam
			pH: 4–5
			Parent material: Pleistocene and Pliocene deposits
			Land use: meadow, arable, forest
			Comments: Land use conditioned due to climatic circumstances (rainfall), liming required
	1f	Histosols	**Horizons**: H_1-H_2-Gy-G_{Ca} (Rheic), H_1-H_2-H_3 (Ombric)
			Texture: /
			pH: 4–5.5
			Parent material: peat
			Land use: marshy grassland, natural wetland
			Comments: high water table, unsuitable for agriculture
Soils of hills and mountains	2a	Lithosol/Lithic Leptosols (Calcaric)	**Horizons**: (A)-R
			Texture: /
			pH: 7–8
			Parent material: limestone and dolomite
			Land use: not suitable for agriculture and forestry
			Comments: incipient soil development
	2b	Rendzina/Rendzic Leptosols	**Horizons**: Ah-R
			Texture: silty loam
			pH: 5.5–7.0
			Parent material: limestone and dolomite
			Land use: forest, alpine pasture
			Comments: grassland above the forest limit
	2c	Eutric Cambisol	**Horizons**: A-Bv-C
			Texture: silty clay-clay
			pH: 5.5–6.5
			Parent material: marly limestone
			Land use: arable, orchard, vineyard, meadow, forest
			Comments: limitation in soil workability can be expected due to high clay content
			Horizons: A-Bv-C, A-BCa-C
			Texture: silty clay loam-silty clay
			pH: 5.5–8
			Parent material: Eocene flysch
			Land use: vineyard, orchard, arable, meadow, forest
			Comments: land use adapted to Mediterranean and sub-Mediterranean conditions
	2d	Dystric Cambisol	**Horizons**: A-Bv-C
			Texture: sandy loam

(continued)

Table 6.2 (continued)

Groups of pedogeographical soil types	ID	Pedogeographical soil type	Basic characteristics
			pH: 4–5
			Parent material: igneous rocks
			Land use: forest, grassland, arable
			Comments: arable land limited due to slope conditions, liming required
			Horizons: A-Bv-C
			Texture: silty clay loam-silty clay
			pH: 4.5–5.5
			Parent material: non-calcareous and low calcareous flysch and decalcificated marlstone
			Land use: grassland, arable, forest
			Comments: limitation in soil workability can be expected due to texture, liming required
Soils of karst plains and plateaus	3a	Chromic Cambisol and Rendzina/ Chromic Cambisol and Rendzic Leptosols	**Horizons**: Ah-C, A-Brz-C
			Texture: silty loam, silty clay loam, silty clay
			pH: 5.5–7
			Parent material: limestone and dolomite
			Land use: forest, meadow
			Comments: possible surface rockiness, possible soil water deficiency
	3b	Acrisol	**Horizons**: A-E-Bt-C
			Texture: silt-silty clay loam
			pH: 3.5–4.2
			Parent material: limestone
			Land use: forest, grassland, arable
			Comments: abundant liming is required as well as the selection of acid-tolerant plants
	3c	Chromic Cambisol (terra rossa)	**Horizons**: A-Brz-C, A-E-Bt-C
			Texture: silty loam-clay loam
			pH: 4.5–6
			Parent material: limestone
			Land use: vineyards, grassland, forest
			Comments: limitations in vineyard land use due to the variable solum thickness on the Karst plateau (SW Slovenia)
			Horizons: A-Brz-C
			Texture: clay loam-silty clay loam
			pH: 5–6
			Parent material: limestone with chert
			Land use: vineyard, grassland, forest
			Comments: limitations in vineyard land use due to the variable solum thickness and the amount of skeleton on Karst plateau (SW Slovenia)
	3c	Luvisol	**Horizons**: A-E-Bt-C
			Texture: silty loam-silty clay loam
			pH: 4–5.5
			Parent material: limestone and dolomite
			Land use: grassland, forest, arable
			Comments: abundant liming is required, tillage limitations due to variable solum thickness

Adapted from Grčman et al. (2015) of pedogeographical soil types on the pedogeographical map of Slovenia (Fig. 6.1)

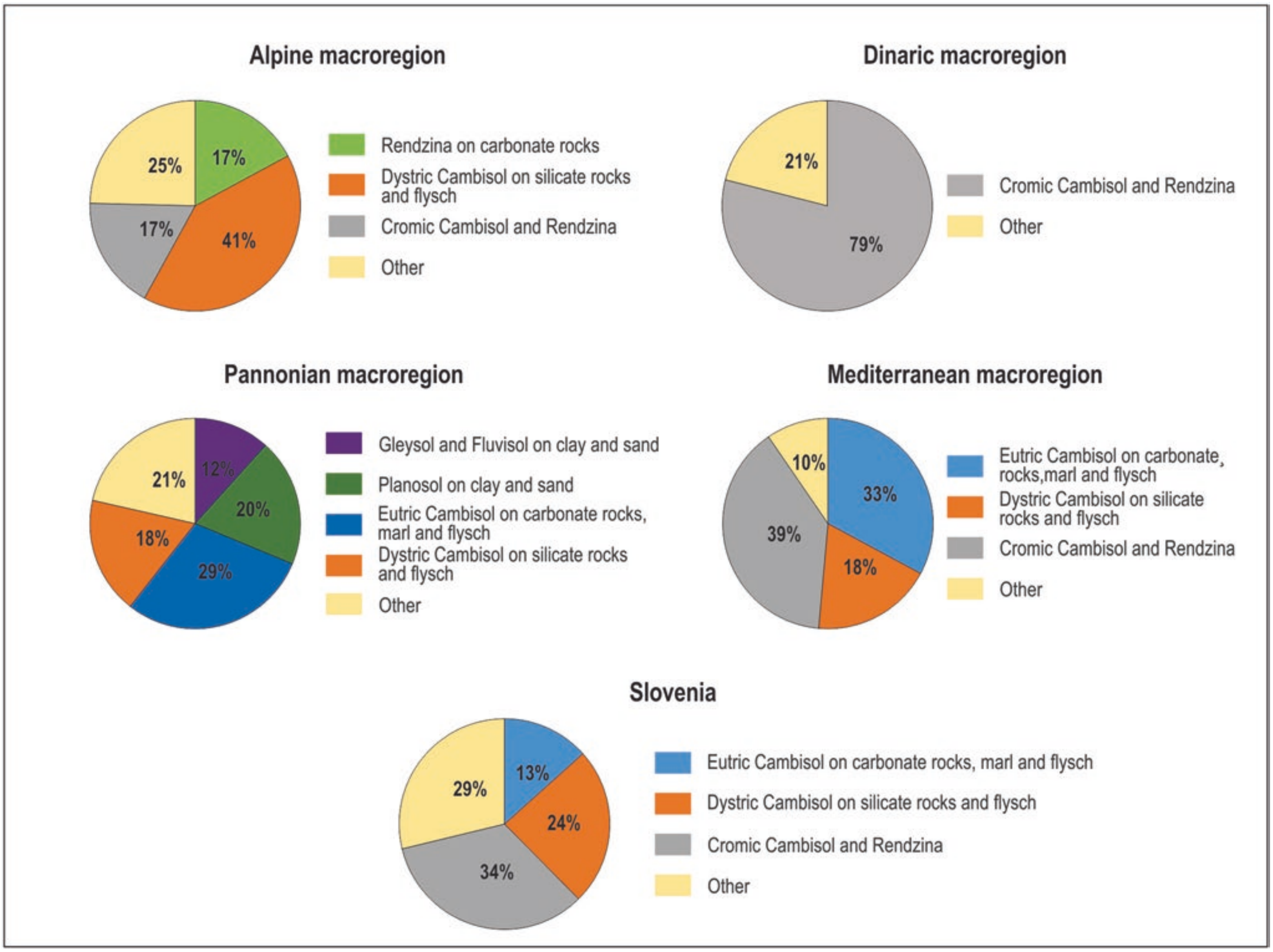

Fig. 6.2 Pedogeographical soil types covering more than 10% of the macroregion or entire country

Yugoslav classification, one more classification with pedosequences was constructed based on geology: (1) pedosequences on gravel and sand, (2) pedosequences on clays and loams, (3) pedosequences on soft carbonate rocks, (4) pedosequences on hard carbonate rocks, and (5) pedosequences on non-carbonate rocks (Stritar 1991).

The Slovenian Soil Classification classifies soils into four sets (divisions): (1) automorphic soils, which form under the influence of freely draining meteoric water; (2) hydromorphic soils, with stagnating meteoric or groundwater within the soil profile; (3) saline soils, with salt accumulation; and (4) subaquatic soils, which form at the bottom of standing water bodies (Grčman et al. 2015). These sets are further divided into classes, which are furthermore divided into 27 soil types (Vrščaj et al. 2017). The classification is based on the soil genesis principle (Repe 2010; Vrščaj et al. 2017). The last two sets are important for the formation of special habitats, but they cover only a small fraction of Slovenia (Grčman et al. 2015). The Slovenian Soil Classification produced a basic 1:25,000 soil map and generalized 1:250,000 soil map (Grčman et al. 2015). A diversity of soil types is reflected in 930 pedosystematic units on a 1:25,000 map (Grčman et al. 2015). However, the Slovenian Soil Classification is not completely aligned with the international classification World Reference Base (WRB) in soil taxonomy, which followed the FAO soil classification, and so frequently only reference WRB soil groups can be defined (Vrščaj et al. 2017; Mednarodni … 2018).

6.3 Soils and Cultural Landscapes on Karst Terrain

Soils in Slovenia are a natural resource deficit due to mountainous or karst topography, resulting in shallow or less fertile soils. Restricted farming opportunities are present in 86.3% of Slovenian territory (Program … 2017; Ciglič et al. 2012). From the pedodiversity point of view and the importance of the cultural landscape, the soils that cover a rather small percentage of Slovenian territory are the most impor-

Table 6.3 Soils in Slovenian physical-geographical macroregions (Perko 1998), based on the FAO soil classification (Grafični … 2007)

Soil type	Alpine macroregion (km^2)	Alpine macroregion (%)	Dinaric macroregion (km^2)	Dinaric macroregion (%)	Mediterranean macroregion (km^2)	Mediterranean macroregion (%)	Pannonian macroregion (km^2)	Pannonian macroregion (%)	Slovenia (km^2)	Slovenia (%)
Aric Anthrosol	10.48	0.12	12.91	0.23	29.80	1.72	139.56	3.25	192.75	1.0
Calcaric Cambisol	0	0.00	0	0.00	132.64	7.66	0	0.00	132.64	0.7
Calcaric Fluvisol	91.60	1.07	1.61	0.03	0	0.00	121.77	2.84	214.98	1.1
Calcaric Regosol	0.59	0.01	0.00	0.00	0.08	0.00	0.00	0.00	0.67	0.0
Chromic Cambisol	583.34	6.83	1694.83	**29.71**	172.56	**9.96**	26.02	0.61	2476.75	**12.2**
Dystric Cambisol	2958.10	**34.64**	181.84	3.19	230.55	**13.31**	820.94	**19.14**	4191.42	**20.7**
Dystric Fluvisol	20.34	0.24	0.27	0.00	0.00	0.00	289.08	6.74	309.69	1.5
Dystric Gleysol	14.53	0.17	3.66	0.06	0.00	0.00	286.29	6.68	304.5	1.5
Dystric Leptosol	327.22	3.83	7.45	0.13	0.00	0.00	76.22	1.78	410.90	2.0
Dystric Planosol	92.77	1.09	1.49	0.03	3.16	0.18	323.55	7.54	420.97	2.1
Eutric Cambisol	1108.40	**12.98**	612.72	**10.74**	395.45	**22.83**	1098.63	**25.62**	3215.20	**15.9**
Eutric Fluvisol	176.11	2.06	57.56	1.01	52.62	3.04	208.97	4.87	495.26	2.4
Eutric Gleysol	96.95	1.14	124.20	2.18	43.95	2.54	239.33	5.58	504.42	2.5
Eutric Leptosol	5.81	0.07	2.32	0.04	0.00	0.00	9.54	0.22	17.67	0.1
Eutric Planosol	22.03	0.26	18.41	0.32	20.14	1.16	278.22	6.49	338.80	1.7
Eutric Regosol	0.00	0.00	1.02	0.02	0.00	0.00	0.52	0.01	1.54	0.0
Ferric Podzol	0.61	0.01	0.83	0.01	0.00	0.00	0.00	0.00	1.45	0.0
Fibric Histosol	6.83	0.08	0.00	0.00	0.00	0.00	0.00	0.00	6.83	0.0
Haplic Luvisol	69.61	0.82	411.84	7.22	0.00	0.00	1.29	0.03	482.74	2.4
Lithic Leptosol	244.51	2.86	8.51	0.15	9.02	0.52	0.00	0.00	262.03	1.3
Mollic Gleysol	0.00	0.00	78.48	1.38	0.00	0.00	0.00	0.00	78.48	0.4
Mollic Leptosol	447.53	5.24	27.99	0.49	45.04	2.60	180.77	4.22	701.33	3.5
Rendzic Leptosol	2112.16	**24.73**	2360.16	**41.37**	558.37	**32.23**	90.13	2.10	5120.83	**25.3**
Terric Histosol	0.00	0.00	43.24	0.76	0.00	0.00	0.00	0.00	43.24	0.2
Urban and degraded areas	127.14	1.49	47.25	0.83	37.22	2.15	75.54	1.76	287.16	1.4
Urbic Anthrosol	2.54	0.03	0.00	0.00	0.00	0.00	0.30	0.01	2.84	0.0
Water bodies	21.08	0.25	6.05	0.11	1.76	0.10	21.75	0.51	50.64	0.2

Those covering more than 10% of the macroregion (or entire country) are in bold

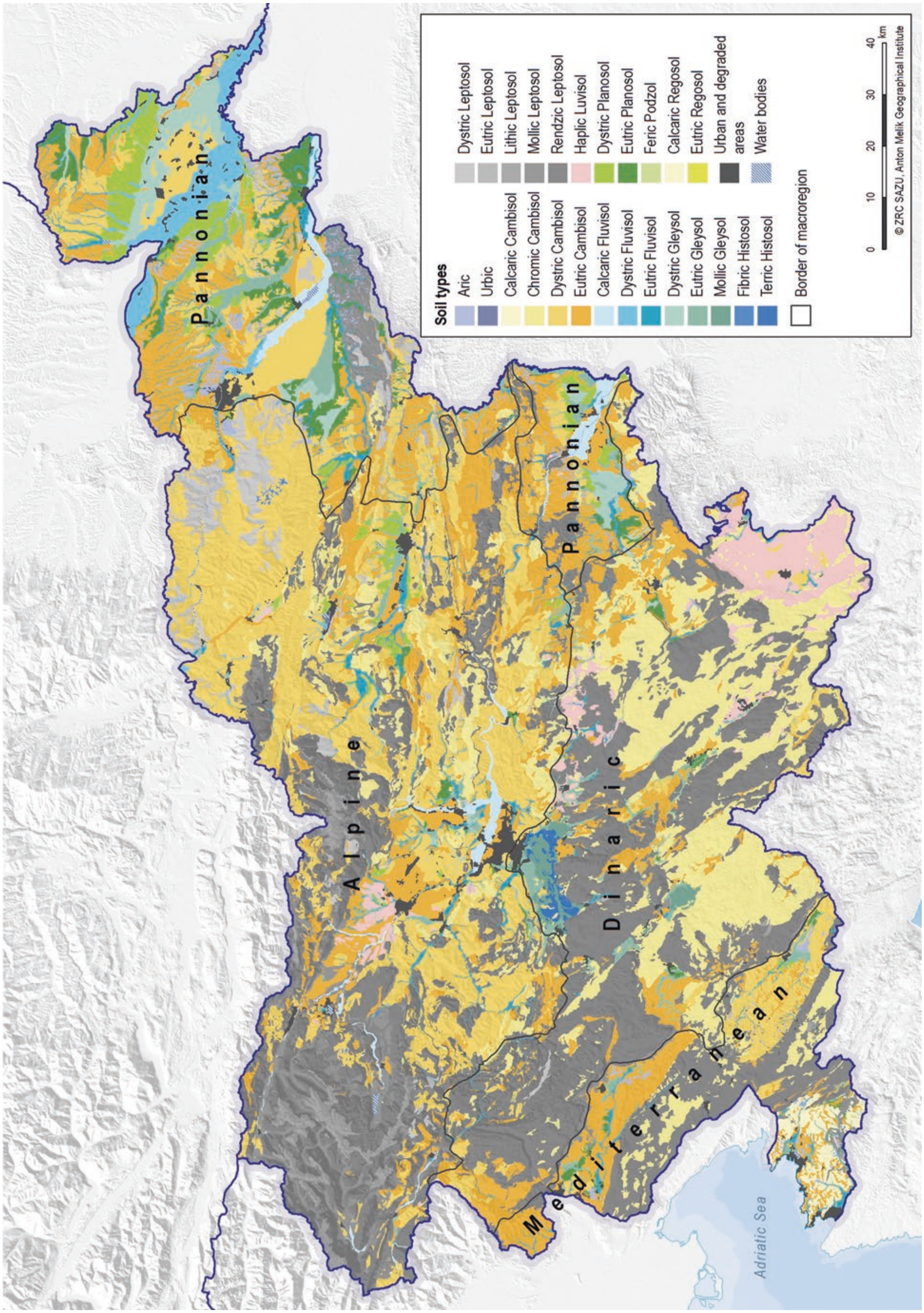

Fig. 6.3 Soils in Slovenia according to the FAO soil classification. (Grafični … 2007)

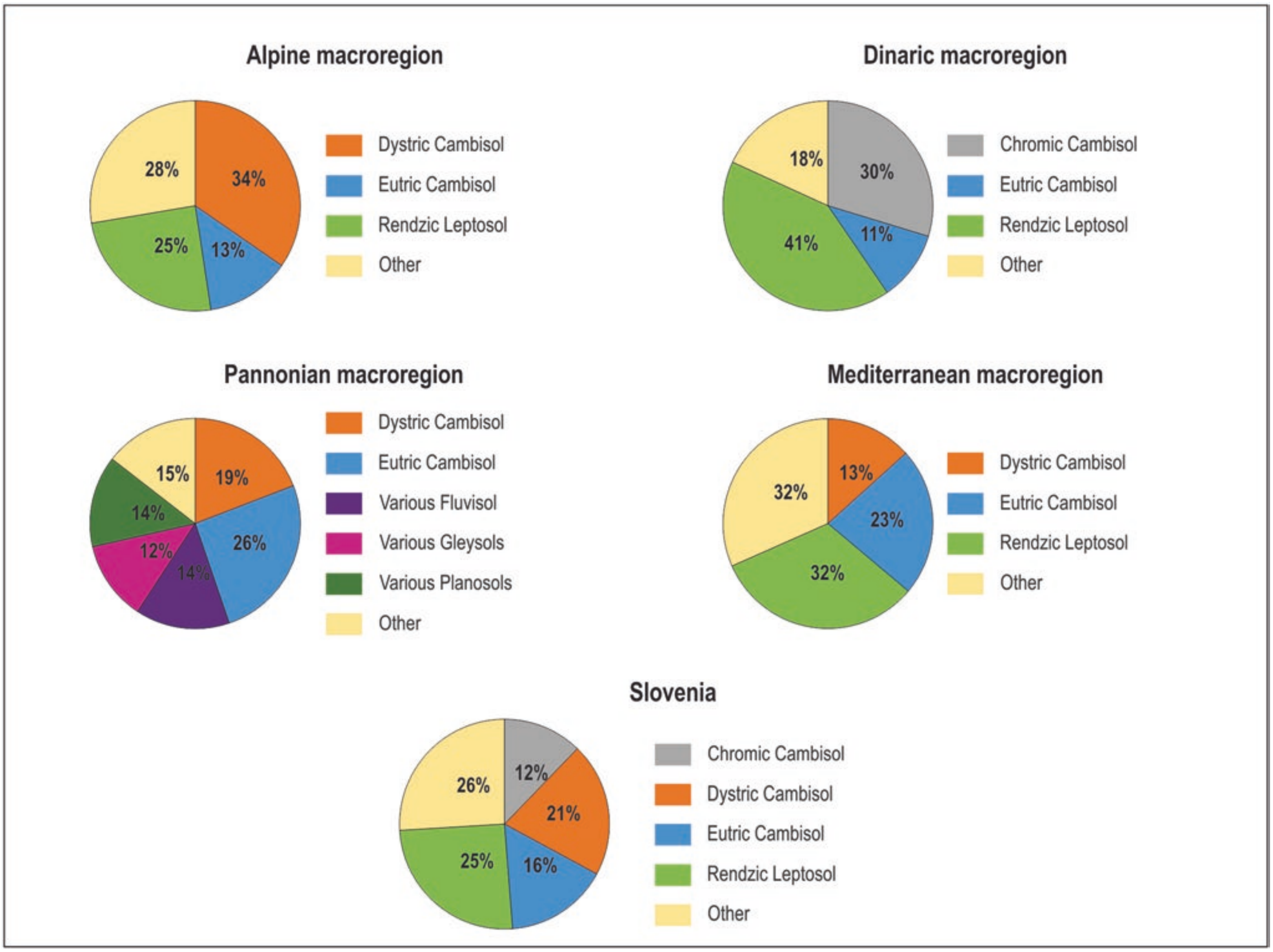

Fig. 6.4 Soils in Slovenia according to the FAO soil classification covering more than 10% of the macroregion or entire country

tant. These include terra rossa (Sln. *jerina*, also termed *jerovica* or *skeletni kromični kambisol* [skeletal Chromic Cambisol]; Fig. 6.5). Its formation is restricted to the Karst Plateau (in southwestern Slovenia), characterized by limestone with chert inclusions. The climatic conditions favor the wine industry (e.g., Karst Terrano, a geographically protected red wine). Chert weathering is slower than limestone, and so its distribution is present in all the soil profile. In addition, soils in the bottom of karst dolines are also important on karst terrain. Because of their complicated structure, they represent pedosedimentary complexes (Durn 2003). Through sedimentation, these were successively transformed by other natural and anthropogenic pedogenetic processes. The source of these soils is flysch, mostly as cave sediment that reached its present position due to dissolution of limestone on the surface that exposed underlying caves (i.e., unroofed caves; Mihevc 2001) or by eolian processes. Eolian material has various sources, and part can also be contributed by bedrock (limestone) residue (Verbič 2010; Fabec 2012; Zupančič et al. 2018).

Soils on karst landscapes are precious because they are scant and shallow (Ciglič et al. 2012). Where soil does occur, the farmers removed the rocks (Figs. 6.6 and 6.7) and then built dry stone walls. Alternatively, the farmers gathered the soil in karst depressions such as dolines and then flattened the bottom of the depressions. On the Karst Plateau around Divača (in southwestern Slovenia), there is in average 100 m per hectare of dry stone walls, and close to the village of Lokev, one dry-walled enclosure indicates that a former cultivated area contained as much as 378 kg of rock per square meter (Gams 2003).

6.4 Soil Degradation

Soil sealing, soil contamination, and soil erosion are the main forms of soil degradation in Slovenia (Vrščaj et al. 2017). The main soil protection legislature can be found in the Environmental Protection Act (Zakon o varstvu okolja 2006) and the Agricultural Land Act (Zakon o kmetijskih zemljiščih 2011). The Forests Act (Zakon o gozdovih 1993)

Fig. 6.5 Reddish soil on the Karst Plateau, known as terra rossa in Mediterranean karst landscapes. Note the dry stone wall on the right as a remnant of ancient rock clearing of farmland. (Photo by Igor Maher, GIAM ZRC SAZU Archive)

Fig. 6.6 In the past, rocks were manually removed from farmland, for example, from a site close to the village of Suhor in White Carniola. (Photo by Ivan Gams, GIAM ZRC SAZU Archive)

covers aspects of soil protection connected with forest infrastructure construction. Many soil protection aspects are included in the European soil protection strategy Thematic Strategy for Soil Protection (2006). Slovenia also has soil protection obligations in some international conventions, the Alpine Convention/Soil Protection Protocol (Protocol … 2005) and the United Nations Convention to Combat Desertification (Zakon o ratifikaciji … 2001), which are also related to land degradation (Zorn and Komac 2013; Grčman et al. 2015).

Fig. 6.7 Modern rock clearing from farmlands on karst terrain. (Photo by Petra Gostinčar, GIAM ZRC SAZU Archive)

Soil sealing is the most destructive form of soil degradation in Slovenia. Since Slovenia's independence in 1991, 70,000 hectares of farmland (or 3.45% of the country's territory) has been built up, and the current municipal planning documents envisage another 57,000 hectares to be earmarked for the construction of housing, business and commercial districts, and transport infrastructure (Razpotnik Visković and Komac 2018). Between 2002 and 2007 alone, the total increase in urbanized areas (i.e., intensive housing, construction of infrastructure, and expansion of new commercial centers) was 19,790 hectares, or 22.5% of the previous urbanized area. The extent of urbanization in this period was more than 17 times greater than in Germany (Vrščaj et al. 2017).

With regard to *contamination* of Slovenia's soils, the country can be divided into two distinct parts. The greater part includes areas with small settlements and the absence of large heavy industry. This results in a smaller concentration of contaminants that changes gradually and mostly depends on the geological conditions of the bedrock. The smaller part includes urban and industrial areas with a high density of population, industry, and traffic (Repe 2002). The soils are mostly contaminated in industrial areas (e.g., ironworks, smelters, and coal-fired power plants). Heavy metals are the main soil contaminants, and the predominant contaminants are cadmium, lead, nickel, and zinc (Grčman et al. 2004; Vrščaj et al. 2017). The most contaminated mining areas are the Upper Meža Valley (containing lead and zinc contaminants due to the former mine in Mežica) and the town and surroundings of Idrija (containing mercury contaminants; Gosar et al. 2016), and the most contaminated metal industry and transport areas are the Celje Basin (zinc, cadmium, and lead as the result of the zinc industry in Celje and iron industry in Štore), the Velenje Basin (cadmium and the coal mine and power plant in Šoštanj), the Sava hills (cadmium and nickel; a number of former mines), the Ljubljana Basin (lead, zinc, copper, and mercury), the Upper Sava Valley (lead, astatine, zinc, and cadmium due to the iron industry), and Maribor and its surroundings (copper, nickel, and chrome) (Grčman et al. 2004; Ogrin and Plut 2009; Žibert et al. 2018).

The soils are rarely contaminated with organic compounds (Vrščaj et al. 2017). Contamination due to farming is restricted to intensive farmlands in flat areas in the Pannonian region (the Drava Plain and the Ptuj Plain), the Alpine region (the Celje Basin and the Ljubljana Basin), and the Mediterranean region (the Vipava Valley), where artificial fertilizers are used. Soils in vineyards have higher values of copper, whereas in fields there are higher values of organic compounds due to pesticides (Ogrin and Plut 2009).

Soil erosion in Slovenia has often been overlooked. This is related to low awareness of this process. In the second half of the twentieth century, until 1989, only one station (Smast near Kobarid) for measuring soil erosion was operational in Slovenia. Low awareness was related to the small size of the parcels, where greater surface runoff is absent and along with hedges prevents the material from being transported to lower positions. In addition, the abandonment of land use and subse-

Fig. 6.8 Rill (water) erosion is frequent on agricultural soils. An example from an olive grove on bare flysch soil in the Mediterranean part of Slovenia. Interrill erosion in this olive grove was measured at up to 90 tons per hectare per year (Zorn 2009), which is estimated to be just 10–25% of total (rill and interrill) erosion. (Photo by Matija Zorn, GIAM ZRC SAZU Archive)

quent afforestation as well as certain measures (e.g., an effort to reduce erosion in orchards and vineyards carried out between 2004 and 2009), as well as certain demands as part of existing agricultural and environmental payments, also contributed to this (Hrvatin et al. 2006; Zorn 2015). There is no station for measuring soil erosion in Slovenia today, nor there is any evaluation of potential soil erosion threat. The actions taken are a result of individual awareness, such as growing grass in vineyards or olive groves (Grčman et al. 2004).

We assume that erosion was greater in the past than it is today because the proportion of cultivated fields was substantially higher and the proportion of forests lower. In 1896, cultivated fields occupied 18.1% of all land but only 10.3% in 2000. Forest occupied 41.6% of all land in 1896 and 60.3% in 2000 (Komac and Zorn 2005).

In the Slovenian literature, there are varying data regarding the total area of erosion areas. The most frequently given figures are 42–44% of Slovenia's territory (880,000–900,000 ha), which is the approximate size of non-karst landscapes. According to some sources, erosion occurs on up to 95% of Slovenia's territory, which is related to its dominant mountainous and hilly landscape (Komac and Zorn 2005).

Foreign literature for Slovenia mentions average annual water erosion of around 1.2 tons per hectare, thus altogether 2.3 million tons, which is 0.4% for all of Europe (Cerdan et al. 2010), and 7.43 tons per hectare, or 1.49% all of soil erosion in the European Union (Panagos et al. 2015), whereby Slovenian territory represents 0.64% of the European Union. Slovenian calculations show that annual erosion is 3–4 tons per hectare (Fig. 6.8) and can exceed 100 tons per hectare on unprotected land (Komac and Zorn 2005; Zorn 2009, 2015).

Wind erosion is currently restricted to southwestern Slovenia as a result of the bora wind. In the 1980s, extensive melioration was used to remove sections of shrubs, bushes, and hedges between various plots of land, and this accelerated wind erosion. Only scant quantitative data are available on wind erosion in Slovenia. In February 1954, wind erosion was studied near Koper. The bora with a maximum speed of 23.7 m/s managed to erode up to 10 cm of soil in places. The bora was again studied close to Koper in 2005, and at a maximum speed of 24 m/s (and weekly average max. speed of 13.5 m/s), there was around 64.28 g/m^2 of soil erosion in 1 week (Zorn 2009, 2015). In February 2012, wind erosion caused by the bora damaged around 1200 hectares of agricultural land in the Vipava Valley. Approximately 530 tons of soil was eroded per hectare, which is altogether around 600,000 tons (Fig. 6.9). Around 3–10 cm of soil was blown away, which caused damage of between €300 and €3000 per hectare in terms of missing soil alone.

Fig. 6.9 Wind erosion from bare fields in the Vipava Valley in February 2012 during a strong bora wind was up to 530 tons per hectare. As a consequence, irrigation ditches next to the fields were totally filled with the eroded soil. (Photo by Andreja Škvarč, GIAM ZRC SAZU Archive)

It is estimated that annual wind erosion of soil in the Vipava Valley is around 0.83 tons per hectare (Zorn 2015), which is approximately two to three times less than the damage from the average water erosion in the country. Slovenia is among the countries with the lowest threat of wind erosion in Europe, with only 0.1% of its territory exposed to significant wind erosion hazard (Borrelli et al. 2016). In addition, the share of wind erodible topsoil is supposed to be among the lowest in Europe.

Although the estimates of erosion, especially wind erosion are relatively low (probably also due to the lack of long-term measurements), on some farmland erosion is an important factor. There farmers invest substantial effort (e.g., money and time) to maintain eroded land due to strong rainfall but, because the damage is not officially noted, it is unknown.

Similar can be said for the soil itself. Although it is one of the most important geographical elements, it is too often overlooked, and consequently people are unaware of its importance for ecosystems. It is only sensed when soil is missing or starts becoming scarce, such as in Mediterranean karst landscapes and Dinaric regions. Slovenia is facing a lack of fertile soil for the food industry and consequently the food economy in general, which is due to the degradation facts mentioned above as well as landscape overgrowth.

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Biodiversity of Slovenia

7

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Abstract

Slovenia is a biodiversity hotspot due to its location at the junction of four biogeographical regions with different ecological conditions. Because of this, 37.87% of Slovenia's area is currently classified as Natura 2000 sites, the highest share among the 28 EU countries. Slovenian flora comprises 3472 vascular taxa and is rich in endemic species, but unfortunately also rare and threatened species. Especially distinctive is the Illyrian floral element—that is, plants with limited distributions along the Dinaric Alps from Slovenia to Albania, mainly thermophilic and heliophilic endemic species. The vegetation of Slovenia differs from that of neighboring regions because of its rich flora as well as its different vegetation history and development after the last ice age. Slovenia is known for its extensive forest cover (58.9%), mostly dominated by beech. Slovenian fauna comprises more than 21,500 continental taxa and at least 1600 marine taxa. Slovenia is known for its Karst region, with a rich subterranean fauna, of which many species were first discovered and described in Slovenia. Three out of five species of large carnivores found in Europe are present in Slovenia: the brown bear, gray wolf, and Eurasian lynx. The extensive forest cover also makes possible a great diversity of mesofaunal carnivores and other mammals.

Keywords

Flora · Vegetation · Fauna · Large carnivores · Subterranean · Iconic species

7.1 Slovenia: A Biodiversity Hotspot

Slovenia is one of the smallest European countries; it is surpassed in area by more than 80% of Europe's other countries, but it has the greatest biotic diversity per unit area (Mršić 1997) and has the second highest biodiversity index in Europe (Berginc et al. 2007). Slovenia is located at the junction of four biogeographical units—the Mediterranean, Pannonian, Alpine, and Dinaric areas—and its biota reflects diverse orographic, tectonic, geologic, edaphic, climatic, and thermal conditions and water regimes. Its diverse ecological characteristics are a consequence of recent conditions as well as their changes (particularly climate) in the (geological) past. Slovenia encompasses less than 0.004% of the Earth's total area and 0.014% of the Earth's total land area, but it is home to more than 1% of all known organisms and more than 2% of all continental (land and freshwater) organisms. In other words, 1 out of every hundred organisms and 1 out of every 50 continental organisms can be found in Slovenia (Mršić 1997).

Slovenian fauna comprises more than 21,500 continental species and at least 1600 marine species and subspecies (Sket et al. 2003). Slovenian vascular flora comprises 3472 taxa (species and subspecies), which constitute and combine into 620 plant communities classified into 51 different classes (Šilc and Čarni 2012; Vreš et al. 2014). Forests cover 1,182,278 hectares of Slovenia or more than half of its area. In Europe, only Sweden and Finland have more forest cover. Ninety-five percent of Slovenia's biota occurs in its southeastern part, especially the Dinaric karst, with an area of around 10,000 km^2: the biodiversity in this small area is comparable to the greatest biodiversity areas in a global sense (Mršić 1997).

The degree of endemism in general reflects biodiversity hotspots, but such areas are rare in temperate regions (Myers et al. 2000). According to Mršić (1997), 3.45% of registered taxa in Slovenia are endemic, with the highest number in the Dinaric region. The high value of Slovenia's biodiversity

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D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_7

was recognized by its government and the European Union, and 37.87% of its area today is classified as Natura 2000 sites, the highest share among the 28 EU countries (Natura 2000 Barometer 2017). The aim of the Natura 2000 network is to ensure the long-term survival of Europe's most valuable and threatened species and habitats. Around 13.3% of Slovenia's area is protected (as of June 2017). These areas consist of 1 national park (IUCN: II/V), 3 regional parks (IUCN: V/II), 44 nature parks (IUCN: V), 57 nature reserves (IUCN: IV and I), and 1164 natural monuments (IUCN: III). Slovenia has four UNESCO World Heritage sites, two of which are natural—Škocjan Caves (listed in 1986), with one of the largest known underground chambers, and the Krokar and Snežnik–Ždroclje primeval beech forests (listed in 2017)—and three Ramsar sites (the Sečovlje Salt Pans, 1992; Škocjan Caves, 1999; and Lake Cerknica, 2006), which are classified as wetlands of international importance, creating the world's largest network of protected areas, covering more than 2.1 million square kilometers (The Ramsar … 2017). Three Slovenian regions—the Julian Alps (2003), the Karst Plateau (2004), and the Kozje region together with the Sotla Valley (2010)—are included in the World Network of Biosphere Reserves (UNESCO … 2017).

The main threats to biodiversity are intensification of agricultural production, urbanization, industry and infrastructure (the traffic network), increased pollution, invasion of nonindigenous species, and abandonment of some seminatural grasslands (Fig. 7.1).

7.2 Flora

Currently, 2092 species and subspecies of freshwater and terrestrial algal taxa are known in Slovenia (Vrhovšek et al. 2006), which corresponds to about 8% of the estimated 26,000 world taxa (Stevenson 1996). Twenty-one species of algae have their type localities in various parts of Slovenia, for example, in the Julian Alps (*Cosmarium triglavense*, *Holopedia dednensis*, and *Staurastrum julicum*), in Lake Cerknica (*Homoeothrix cerknicensis*), along the Mura River at Križevci (*Oedogonium murense*), and so on. The type locality is the geographical location where a specimen of a species was first identified.

Currently, 813 species and subspecies of mosses are known in Slovenia: 638 mosses, 173 liverworts, and 2 hornworts (Martinčič 2016). Among them, 164 species (20%) are listed in threatened categories, of which 121 are mosses and 43 are liverworts; 7 of them (1%) are critically endangered (CR), 83 (10%) are endangered (EN), and 74 (9%) are listed in the vulnerable category (VU). One of the most attractive liverworts and Natura 2000 species is *Mannia triandra*, originally described from the surroundings of Idrija (its type locality) by the Italian naturalist and doctor at the Idrija mine, Giovanni Antonio Scopoli (1723–1788). Scopoli was a contemporary of Carl Linnaeus, with whom he was in constant correspondence in all fields of natural history in the 1760s and 1770s (Soban 1995). *Mannia triandra* (Fig. 7.2), although it is listed under the data-deficient category (DD), is

Fig. 7.1 Early phases of secondary succession of abandoned dry grasslands (to forest) in the Dinaric karst still contribute to biodiversity and landscape diversity. (Photo by Tatjana Čelik, BIJH ZRC SAZU Archive)

Fig. 7.2 One of the most attractive liverworts, *Mannia triandra.* (Photo by Simona Strgulc Krajšek)

a critically endangered liverwort in Slovenia and some other European countries, which was recently confirmed in the Julian Alps when it was encountered after more than 100 years (Strgulc Krajšek and Martinčič 2017).

Slovenia has one of the richest vascular plant floras in Europe, with more than 3500 species and subspecies (including some allochthonous newcomers in recent years), among which a high number are threatened (Vreš et al. 2014). Twenty-seven of them are classified as Natura 2000 species, 778 (22%) are threatened and have been included on the Slovenian Red List since 2002, and 240 (7%) have been protected since 2004. The most attractive and notable vascular plants in Slovenia are either endemic, extremely rare (one or few localities in Slovenia), threatened, or protected taxa with their type locality in Slovenia and/or in Slovenian ethnic territory and are taxa that were described by prominent botanists, providing an important contribution to Slovenian botanical history (Wraber 1990). Some of the most attractive and notable Slovenian vascular plants are presented here (Fig. 7.3).

The hladnikia (*Hladnikia pastinacifolia*), a member of the Apiaceae (the carrot family), is Slovenia's most distinguished plant and the only Slovenian stenoendemic plant at the genus level. It occurs in a very small area of the Dinaric Alps (Čušin et al. 2004) and is named after the Slovenian botanist Franc Hladnik (1773–1844), who founded the Ljubljana Botanical Garden in 1805 (Bavcon 2011).

The Carniolan primrose (*Primula carniolica*) and Idrija primrose (*P.* × *venusta*), its hybrid with the auricula (*P. auricula*), are highly attractive and colorful as well as prominent narrow endemic plants in Slovenia, growing in shady places on carbonate (dolomitic and limestone) rocks in the Dinaric Alps. The French naturalist Belsazar Hacquet first collected the Carniolan primrose in the surroundings of Idrija, where he worked as a doctor at the Idrija mine after Scopoli. He sent some specimens to the Austrian botanist Nikolaus Joseph von Jacquin, who formally described it in 1778 and named it *P. carniolica* after its type location of Carniola. In 1922, it became protected by law, and today it is classified as a Natura 2000 species (Čušin et al. 2004).

Zois' bellflower (*Campanula zoysii*) is a relict endemic species of the southeastern Alps (the Karawanks, the Kamnik–Savinja Alps, the Julian Alps, and the Carnic Alps), named after the Carniolan botanist Baron Karl von Zois (1756–1799), whose beds of Alpine flowers at Brdo Castle in fact constitute the first botanical garden in Slovenia. He found this species of bellflower himself at Mount Storžič and the mountains above Big Field Pasture (*Velo polje*) in the Julian Alps, and he sent it for description to his botanical mentor, the Jesuit Friar Franz Xaver von Wulfen, who was the founder of Carinthian botanical, zoological, and mineralogical research (Praprotnik 2015). Zois' bellflower is widely distributed in Slovenia and occurs in rock crevices, on screes, and on cushion-like carpets on ridges, mostly in

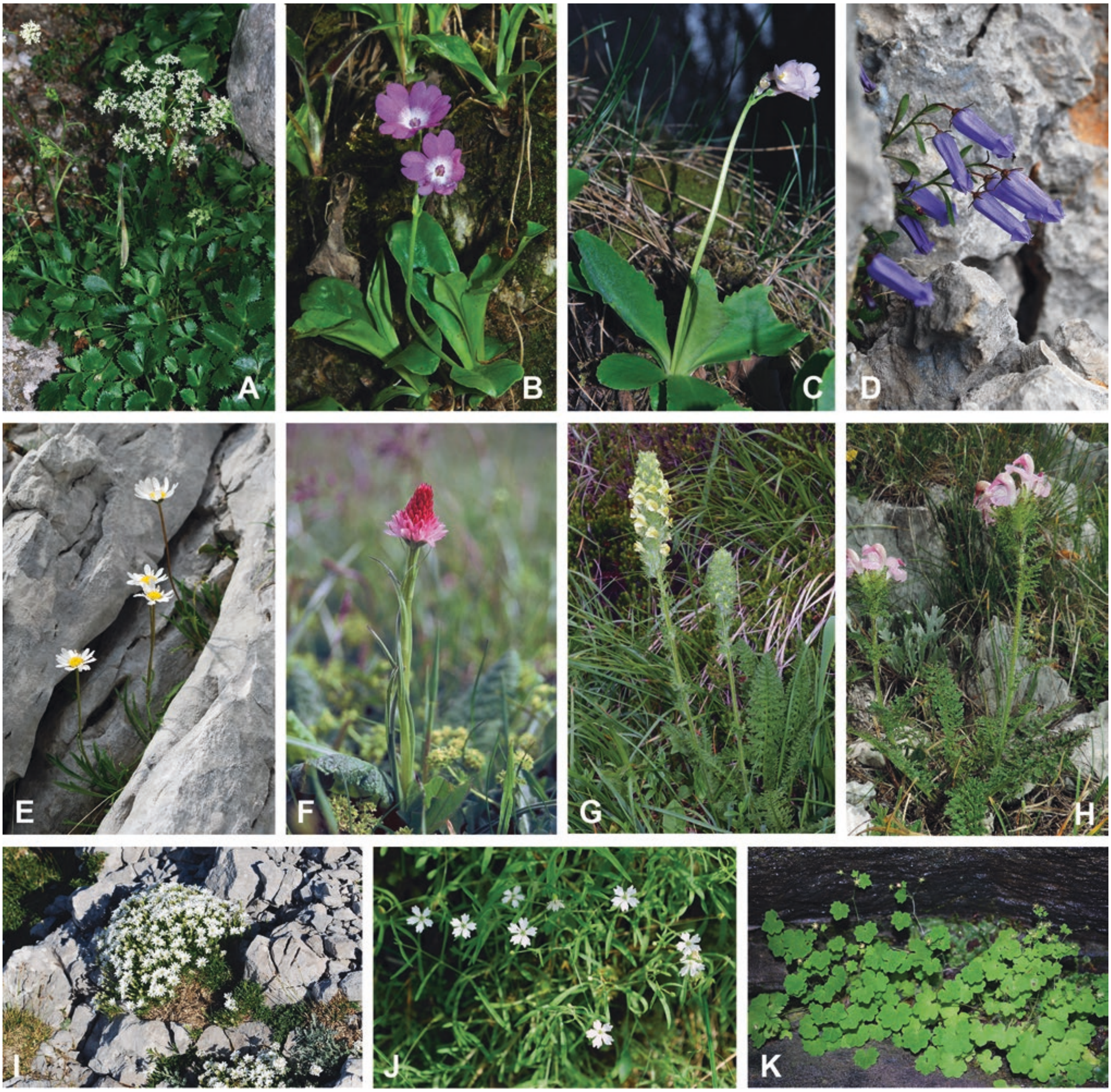

Fig. 7.3 (**a**) Hladnikia (*Hladnikia pastinacifolia*), (**b**) Carniolan primrose (*Primula carniolica*), (**c**) Idrija primrose (*Primula × venusta*), (**d**) Zois' bellflower (*Campanula zoysii*), (**e**) Kamnik daisy (*Leucanthemum lithopolitanicum*), (**f**) Kamnik orchid (*Nigritella lithopolitanica*), (**g**) Julian lousewort (*Pedicularis julica*), (**h**) Mayer's lousewort (*Pedicularis × mayeri*), (**i**) rock mouse-ear (*Cerastium julicum*), (**j**) Widder's campion (*Heliosperma veselskyi* subsp. *widderi*), (**k**) fragile saxifrage (*Saxifraga paradoxa*). (Photos by Branko Vreš, BIJH ZRC SAZU Archive)

the upper montane, subalpine, Alpine, and subnival belts (Čušin et al. 2004).

The Kamnik orchid (*Nigritella lithopolitanica*) and the Kamnik daisy (*Leucanthemum lithopolitanicum*) are narrow endemics named after their type locality, the Kamnik–Savinja Alps. The rocky parts of the Kamnik–Savinja Alps are home to another stenoendemic, the rock mouse-ear (*Cerastium julicum*), which, contrary to its name, does not occur in the Julian Alps, but only on a few mountain tops in the Kamnik–Savinja Alps and Karawanks (Wraber 1990).

The endemic hybrid Mayer's lousewort (*Pedicularis × mayeri*), named after the Slovenian botanist Ernest Mayer (1920–2009), and one of its parental species, the Julian lousewort (*P. julica*), were described from Mount Črna Prst (Dakskobler and Vreš 2016) on the southern edge of the Julian Alps. Both species grow in the subalpine grassland classified in the association *Ranunculo hybridi–Caricetum sempervirentis*. Mount Črna Prst was named a "flower sanctuary" by the botanist Tone Wraber (2006) because it is known for its extremely rich vascular flora of more than 800 taxa of flowering plants with several rare, endangered, and endemic species (Dakskobler et al. 2008; Dakskobler and Strgar 2017).

Fragile saxifrage (*Saxifraga paradoxa*) is a paleoendemic plant that grows in an extraordinary microecological habitat, always in shady and wet places, mostly on silicate rocks in valleys of old mountain ridges in northern Slovenia, in the Pohorje Hills, and in the Kozjak Mountains north of the Drava River. At the three microlocalities along the Mučka Bistrica River in the Kozjak Mountains, it is accompanied by Widder's campion (a.k.a. Widder's catchfly, *Heliosperma veselskyi* subsp. *widderi*), another stenoendemic plant, but at the subspecies level. Widder's campion was also found at two localities just across the Austrian border in the Krumbach Gorge and along the Feistritz River, but the latter locality was flooded between 1988 and 1993 by the Soboth Reservoir as part of the project for the Kor Alps hydroelectric power plant (Wraber 1990).

7.3 Vegetation

The vegetation of Slovenia is diverse and special compared especially to central and northern Europe, and there are several reasons for this. First, Slovenia has a rich flora, as well as rich geographical, ecological, and floristic biogeographical conditions. Other important factors in Slovenia's vegetation diversity and special character are the vegetation history and development after the end of the last glaciation period. The European beech (*Fagus sylvatica*) survived the Pleistocene glacial period in local microrefugia, that is, warmer and wetter regions in central and southern Europe. One of the most important regions for the survival of beech through the ice age was in locations of what is now Slovenia. From here, beech then spread into northern Europe and reached its present distribution areal (Brus 2010).

The main milestones of forest development after the ice age in Slovenia occurred around 15,000 years BP, 10,000 years BP, and 7000 years BP. At the end of the last glacial (15,000 BP), the land was covered mostly with tundra, taiga, and individual trees. With gradual warming in the Holocene (i.e., since 11,700 years BP), a period with pine, birch, and spruce (*Pinus–Betula–Picea*) took over and was replaced in even warmer periods by mixed oak forest (*Quercetum mixtum*), by a phase of hazel (*Corylus*), a phase of beech (*Fagus*), and finally beech-fir forest (*Abies–Fagus*). The successional development of forest communities in Slovenia ended 7000 years BP (although *Fagus* and *Abies* already appear around 9500 BP; Andrič and Willis 2003) with later reoccurrence of previous stages due to natural (climate) and mainly zoo-anthropogenic factors. Since then, *Fagus* has been dominant, but human activity appears to have been predominantly responsible for the intensive forest clearance and opening up of the landscape (Andrič and Willis 2003). The settlement of forests south of the Alps was faster than in the northern parts of Europe, where the development of primary forests lasted until 2000 years BP (Šercelj 1996).

Three floristic regions meet in Slovenia, with the Illyrian floral province being the most characteristic and distinctive compared to neighboring countries. The Illyrian floral element is a terminus that indicates plants with limited distributions along the Dinaric Alps from Slovenia to Albania, in a so-called Illyrian floral province. Ecologically they are mainly thermophilic and heliophilic. In this floral element are included endemic plants of rocks and screes from the Adriatic region, species of heliophilic Austrian pine forest of the Dinaric Alps, and the heliophilic elements of mountain rocks, screes, and meadows. These taxa are Illyrian species in the narrower sense. A special group of species is the so-called Illyricoid elements, that is, the endemic species of mesophilic forest habitats (oak, hornbeam, and beech). They are Tertiary relict species that survived the climatic changes of the Pleistocene ice age in microrefugia with mesophilic vegetation and give a special character to Slovenia's vegetation types. Some of these species are bastard-agrimony (*Aremonia agrimonoides*), barrenwort (*Epimedium alpinum*), dog's-tooth-violet (*Erythronium dens-canis*), *Hacquetia epipactis*, Hungarian widow flower (*Knautia drymeia*), balm-leaved archangel (*Lamium orvala*), creeping navelwort (*Omphalodes verna*), and European scopolia (*Scopolia carniolica*; Trinajstić 1992).

A notable vegetation characteristic of Slovenia is that it ranks third in Europe in terms of forest cover (after Sweden and Finland). Forests cover 58.9% of the land compared to the EU-28 average of 37.1% (Eurostat 2017). Forest cover has almost doubled in Slovenia from 36.4% in 1875. This increase is a consequence of rapid land abandonment after the Second World War, particularly at higher elevations. Sustainable forest management (i.e., selection forestry and close-to-nature management) is characteristic for Slovenian forestry and is the main reason for the good condition of forests in Slovenia (Diaci 2008) as well as their high coverage. Another reason for the increased forest cover is the recent change of forest ownership, and with it less cutting, due to denationalization with the change of the political system in the 1990s. Slovenia is also known for several forest reserves and virgin forests where management is excluded and the forests are left to develop naturally.

The pronounced transitional character of Slovenia is also expressed in various biogeographical regions. Based on vegetation, Wraber (1969) divided Slovenia into six phytogeographical regions (not entirely correct according to phytogeographical terminology): Alpine, Dinaric, sub-Mediterranean, sub-Pannonian, pre-Dinaric, and pre-Alpine (Fig. 7.4).

The sub-Mediterranean region is the most autonomous. It is clearly delimited by the Karst Plateau to the north and west and the coast to the east, and it extends into the Soča Valley. The Mediterranean character of vascular flora and vegetation is weak, and true Mediterranean plant communities are restricted to isolated patches. Because of the colder flysch bedrock, whereas warmer limestone sites are at higher elevations or are cooled by bora winds, plant communities in this region are mostly composed of sub-Mediterranean and central European plants (Wraber 1996).

The Alpine phytogeographical region comprises Slovenian parts of the Southern Limestone Alps and Central Eastern Alps. A central European vascular flora with a large share of Alpine-Nordic species prevails, but plant communities here are also rich in Illyrian species.

The Dinaric region is located on high Dinaric karst plateaus, with a large amount of precipitation and high relative air humidity. The main plant communities are therefore Illyrian beech, altimontane, beech-fir, and maple-beech forests. The vascular flora of this region consists of many Illyric-Balkan elements that connect this region southward to the vegetation of Croatia and Bosnia.

The sub-Pannonian region is located in the northeast, which is influenced by a continental climate and is an extension of the Panonnian lowland from Hungary and Croatia. Illyrian flora elements are rare in the east of the region compared to the rest of the country, the vegetation is degraded, and a cultural landscape prevails.

The pre-Dinaric and pre-Alpine phytogeographical regions are the least delimited, with a very transitional character. They are located in the central part of the country, delimited by both sides of the Sava Valley.

The vegetation map (Fig. 7.5) presents the geographical distribution of the main forest vegetation types. These forest types are generalized and simplified for the purpose of map presentation, whereas the "real" diversity of forest plant communities is very high (i.e., more than 170 plant communities). Beech forests predominate in Slovenia, either as pure beech communities or as mixed stands with other codominating tree species, such as fir, oak, and spruce.

Hornbeam (*Carpinus betulus*) forests are frequent in lowlands on mesophilic sites but also on acid and dry areas. These forests are under strong human influence and have mostly been converted to arable or urban land.

There are several oak plant communities depending on the dominant oak species. Pubescent oak forests (*Quercus pubescens*) are thermophilic, distributed in the sun-exposed sub-Mediterranean and continental part of the country. The sessile oak (*Quercus petraea*) builds forests on dry acid soils, and it also constitutes a part of several beech plant communities. Common oak (*Quercus robur*) forests are found on flooded sites in lowlands and are threatened by urbanization.

The basic zonal forest plant communities in Slovenia are beech forests (Figs. 7.5 and 7.6), which thrive from lowlands to 1600 m in elevation. Beech communities differ according to the climate, bedrock, and phytogeographical region. For each altitudinal belt (on carbonate bedrock), a particular beech forest is characteristic. In the colline belt, the association *Hacquetio–Fagetum* prevails, whereas in the montane belt, the association *Lamio orvalae–Fagetum* is dominant. Both communities are rich in Illyricoid plant species. The typical forest in the upper montane belt in Alps is the *Anemono trifoliae–Fagetum*, and the second most widespread is mixed beech-fir forest (*Omphalodo–Fagetum*), which occurs on large areas of the Karst Plateau and is an important habitat for large carnivores and birds. The *Ranunculo plantanifolii–Fagetum* follows in the upper montane belt and the *Polystichum lonchitis–Fagetum* at the upper forest limit. Ecologically and phytogeographically specific are the *Vicio oroboidi–Fagetum* forests in the sub-Pannonian region and the *Sesleria autumnalis–Fagetum* forests in the sub-Mediterranean region. On south-facing dolomite slopes, one finds the thermophilic association *Ostryo–Fagetum*.

Beech forests also thrive on non-carbonate bedrock; however, they are species-poor compared to beech forests on limestone, with acidophilic elements because of non-carbonate bedrock and intensive use (e.g., litter raking). The most widespread forest type in Slovenia is the *Castaneo–Fagetum*, an azonal community mainly occurring in the submontane belt (Čarni and Jarnjak 2002).

Natural forests dominated by spruce (*Picea abies*) are primarily found in the Alps and in dolines (sinkholes) of the Dinarides. This species has been extensively planted mainly in lowlands (but also in the montane belt) for timber production. Fir (*Abies alba*) is usually mixed in stands with beech, although pure communities also exist. Scots pine (*Pinus sylvestris*) thrives on more extreme sites on carbonate bedrock, and acidophilic pine forests on acid soils or alluvium are also common. Austrian pine (*Pinus nigra*) is natural only in extremely warm and steep sites, but is very common in the Karst area, where it was used for reforestation.

Azonal forests in floodplains occur along rivers. Riparian willow, poplar, and gray alder forests are mostly restricted to narrow belts along flowing water. Black alder carrs are distributed scattered on sites with a high water table across the entire country, with larger areas only in the northeast. Hardwood forests (common oak, *Quercus robur*; white elm, *Ulmus laevis*; and narrow-leafed ash, *Fraxinus angustifolia*) along large rivers are rare and endangered and occur mostly along the Mura River.

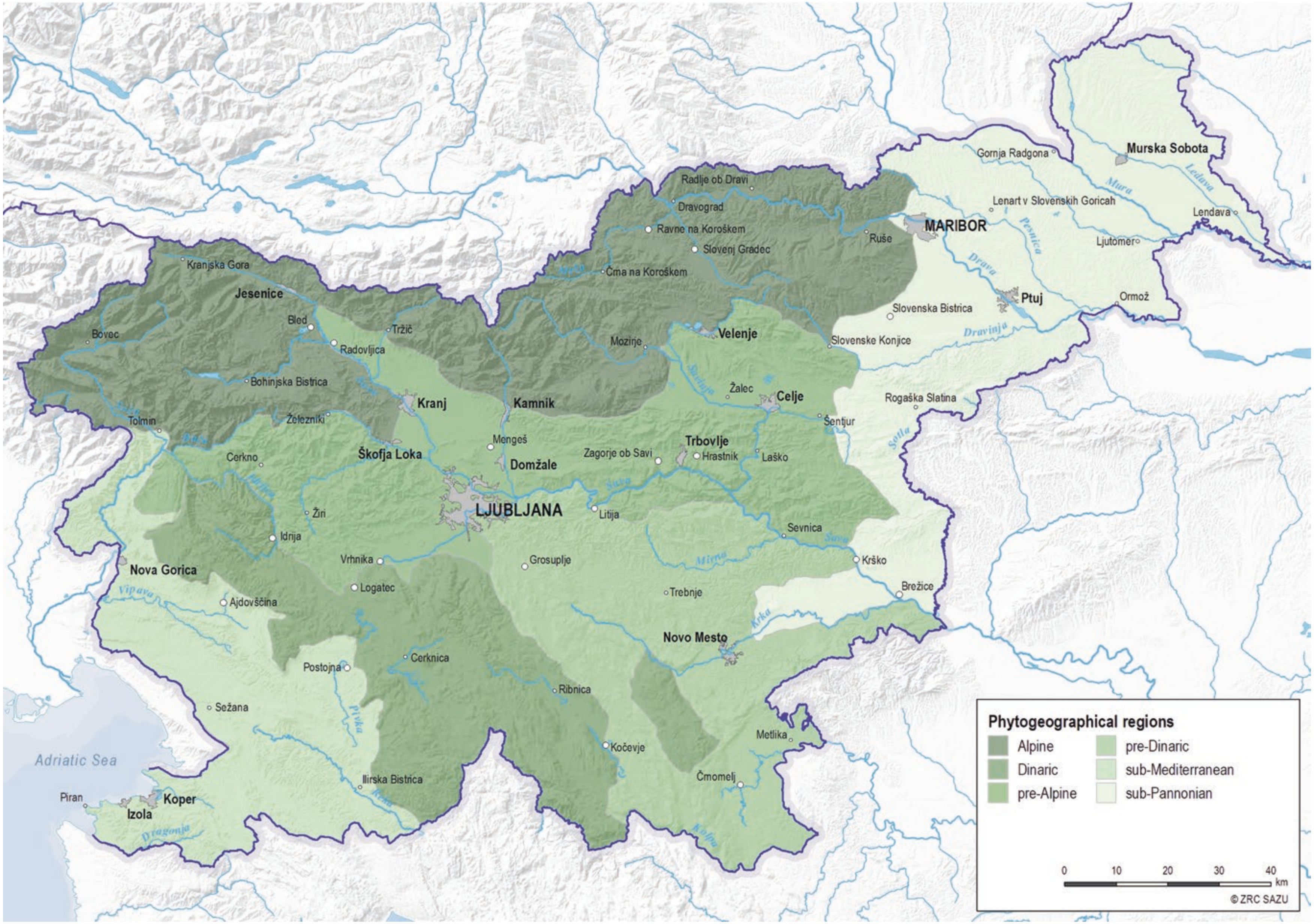

Fig. 7.4 Phytogeographical regions of Slovenia according to Wraber (1969)

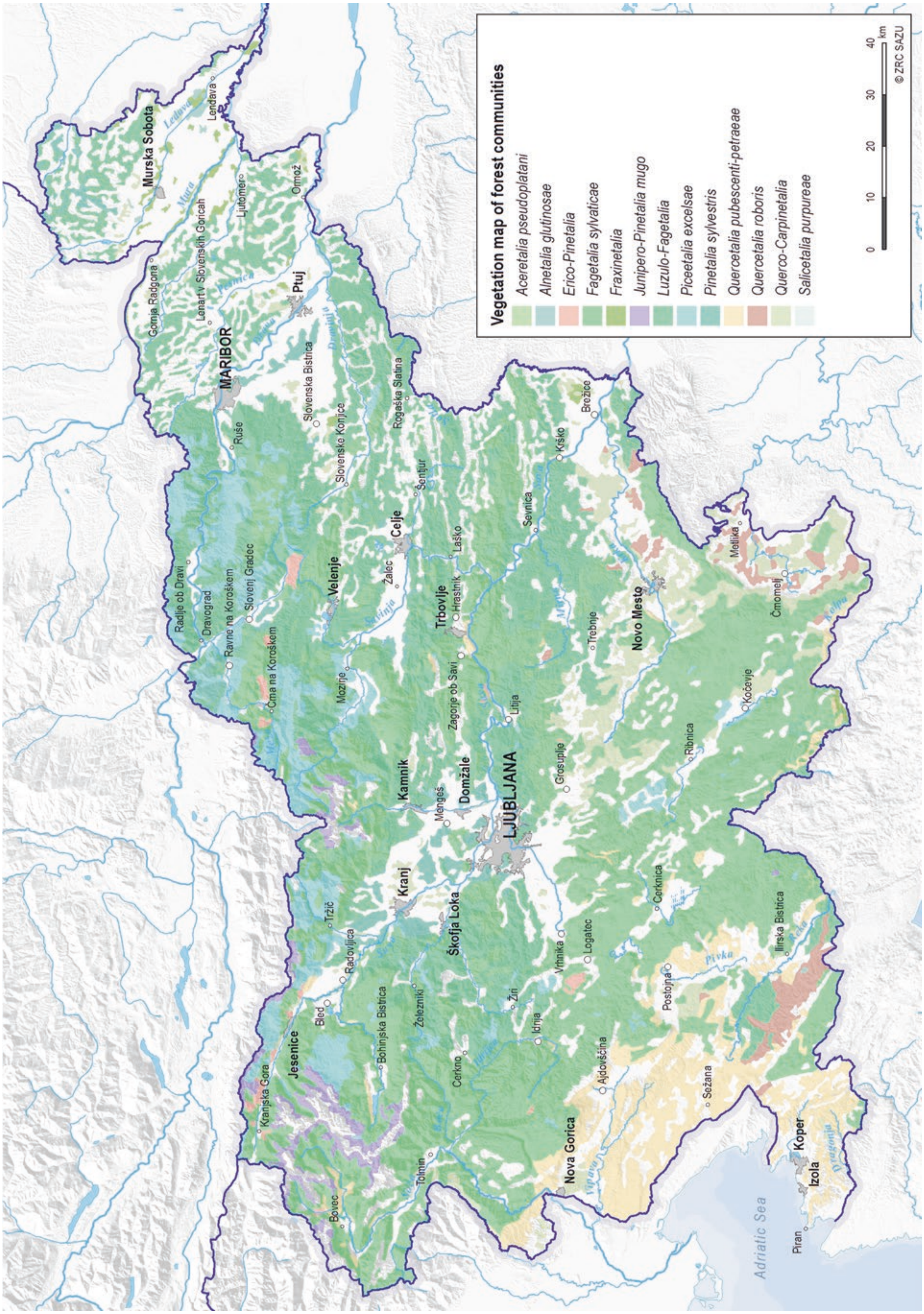

Fig. 7.5 Vegetation map of forest communities. (Adapted from Čarni et al. 2002)

Fig. 7.6 A typical beech forest stand on the Trnovo Forest Plateau. (Photo by Aleksander Marinšek)

Fig. 7.7 Very diverse and picturesque dry grassland in sub-Mediterranean Slovenia. (Photo by Branko Vreš, BIJH ZRC SAZU Archive)

The following paragraphs present non-forest vegetation types. Grasslands are the primary vegetation type in temperate regions only in the Alpine belt above the timberline or on sites too wet or too dry for forests to grow. All other grassland communities are secondary and are the result of long-term human management (mown meadows and pastures). In the continental part, ecologically different grassland types occur: mesic, manured grasslands for haymaking (order *Arrhenatheretalia elatioris*), wet grasslands on nutrient-poor soils (order *Molinietalia caeruleae*), and dry grasslands (order *Brachypodietalia pinnati*). Floristically distinct are dry grasslands in the sub-Mediterranean region (order *Scorzoneretalia villosae*; Fig. 7.7). In the Alps, above the forest line in the Alpine and subalpine belts, there are floristically rich grasslands occurring on carbonate bedrock (*Seslerietalia caeruleae*), whereas grasslands on non-carbonate are rare (*Festucetalia spadiceae*).

The high diversity of grasslands, present in Slovenia until the mid-twentieth century, is declining due to changes and intensification of management and due to the abandonment of remote and less productive grasslands. Mesic grasslands are becoming species-poor, whereas wet and dry grasslands have intensified and changed to more productive types or are undergoing afforestation.

Special plant communities are raised bogs, which occur mostly on high plateaus and are at the southern border of their areal in Europe. Another ecologically specialized vegetation type is halophytic stands along the seacoast. They have developed in abandoned salt pans and most of the sites suitable for them are parts of protected areas (the Sečovlje and Strunjan Salt Pans).

7.4 Fauna

The complex and heterogeneous ecological conditions due to diverse climatic, orographic, tectonic, edaphic, and biotic factors at the junction of four biogeographical units are reflected in a diverse fauna. It comprises about 21,500 continental species and at least 1600 marine species, nearly 80% of which are insects (Sket et al. 2003). According to the characteristic structure of animals, Slovenia is divided into five zoogeographical regions, the sub-Mediterranean, Dinaric, Alpine, pre-Alpine, and sub-Pannonian (Mršić 1997). The zoogeographical division almost completely coincides with the phytogeographical one (Fig. 7.4), with the exception of the pre-Dinaric region, which is merged with the Dinaric region in the zoogeographical division. Among the animal species so far recorded for Slovenia, about 1% are threatened and listed on the national Red List, approximately 10% are protected, and almost 1% are classified as Natura 2000 species (Natura … 2017). Slovenia is rich in endemic taxa, which correspond to at least 2% of the continental Slovenian fauna (Sket et al. 2003). The majority of them live in karst subterranean habitats. The greatest number of endemics is among insects (over 200), millipedes (89), crustaceans (70), and mollusks (55; Sket et al. 2003). Due to comprehensive forest cover and good conservation practices, Slovenia is home to three of the largest European carnivore species: the brown bear, gray wolf, and Eurasian lynx.

Slovenia's subterranean fauna is one of the richest in the world. Among the world's 20 cave systems with the largest number of animal troglobiotic taxa, 5 are located in Slovenia (Culver and Sket 2000). The Postojna–Planina Cave system (PPCS), with 99 species, is the most biologically diverse cave system in the world (Sket 2010). The PPCS is the type locality for many cave-dwelling species (Pretner 1968; Polak 2005); for example, the first cave animal discovered and recognized the beetle *Leptodirus hochenwartii*. It also includes the first described cave representatives of the cave land snail *Zospeum spelaeum*, the cave springtail *Onychiurus stillicidii*, the cave amphipod *Niphargus stygius*, the cave isopod *Titanethes albus*, the cave pseudoscorpion *Neobisium spelaeum*, the cave spider *Stalita taenaria*, the cave millipede *Brachydesmus subterraneus*, the only true cave hydrozoan *Velkovrhia enigmatica*, and others. Most of these species are endemic to the Dinaric karst.

The cave-dwelling bivalve *Congeria kusceri*, described by the Slovenian malacologist Jože Bole in 1962 from specimens from Žira Cave in Popovo Polje (Bosnia and Herzegovina), was known as the only troglobiotic bivalve in the world until 2013, when molecular phylogenetic analyses of *Congeria* from the Dinaric karst revealed three distinct species: *C. kusceri*, *C. jalzici*, and *C. mulaomerovici* (Bilandžija et al. 2013). These species are considered "living fossils" and are the only representatives of a genus that contained numerous species during the Tertiary period. The Slovenian populations belong to *C. jalzici*, which only inhabits subterranean waters in White Carniola (at Cave Mussel Spring, *Izvir Jamske školjke*, in southeast Slovenia) and in northern Croatia. The other two species occur in northwestern Bosnia and southern Croatia and Herzegovina.

The cave-dwelling tube worm *Marifugia cavatica* is unique among around 350 described species of serpulid polychaetes because it is the only representative that inhabits fresh water; all others are marine organisms (Kupriyanova et al. 2009). It is distributed in the subterranean waters of the Dinaric karst (Italy, Slovenia, Croatia, and Hercegovina), in Slovenia only in its southern part in caves near the Kolpa and Krupa rivers, and in Istrian caves below the Karst Rim.

Slovenia is a cradle of speleobiology, a scientific discipline with its beginning in 1831, when the first cave animal was discovered and recognized as a cave dweller. It was the small slender-necked beetle *Leptodirus hochenwartii* (Fig. 7.8). The animal was found by Luka Čeč, an assistant to the cave's lamplighter, when exploring the newly discovered inner portions of the Postojna Cave system. He gave the specimen to Count Franz von Hohenwart (1771–1844), who was the founder and curator of the Natural History Collection at the Carniolan Regional Museum in Ljubljana (Aljančič 1986). He was unable to determine the species, and he gave the specimen to the Carniolan entomologist Ferdinand J. Schmidt (1791–1878). Schmidt recognized it as a new species, named it after the donor, and formally described it in 1832. This discovery later triggered great interest among European naturalists to search for fauna in caves. Today, this beetle is the foundation for the emblem of the Slovenian entomological society, as well as for the journal *Acta Entomologica Slovenica*.

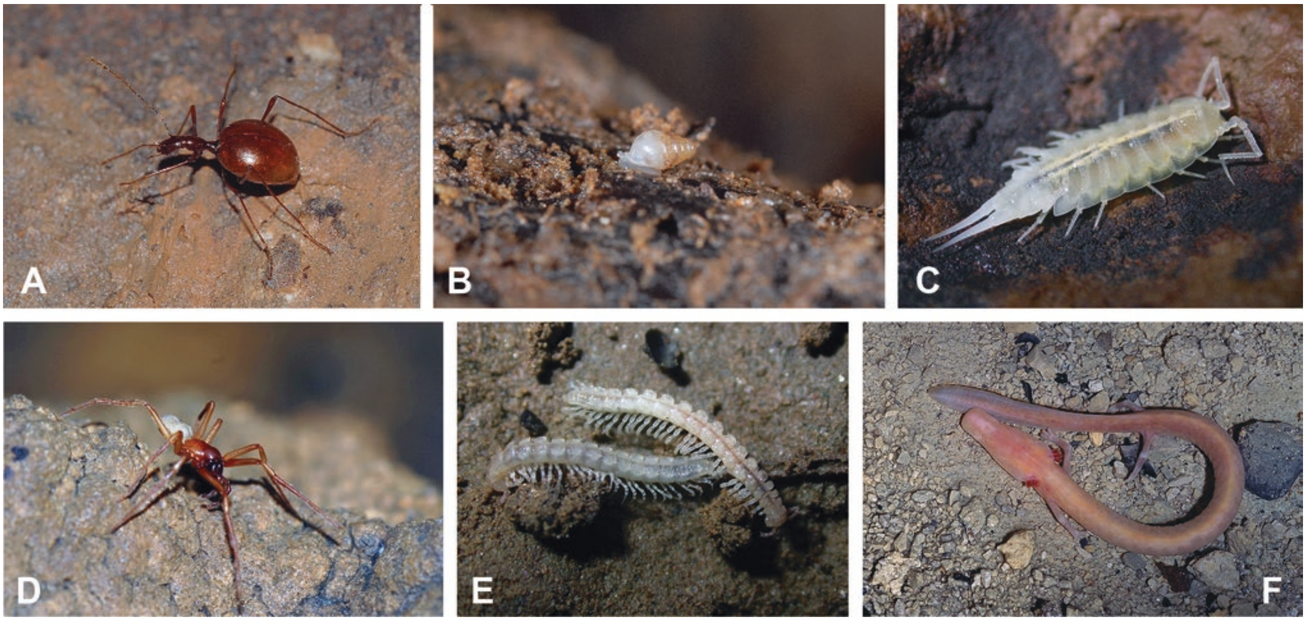

Fig. 7.8 (**a**) the beetle *Leptodirus hochenwartii*, (**b**) the snail *Zospeum spelaeum*, (**c**) the isopod *Titanethes albus*, (**d**) the spider *Stalita taenaria*, (**e**) the millipede *Brachydesmus subterraneus*, (**f**) olm (*Proteus anguinus*). (Photos by Slavko Polak)

Slovenia is globally renowned for the cave-dwelling salamander or olm (*Proteus anguinus*, Fig. 7.8), which was first mentioned in Johann Weikhard von Valvasor's *The Glory of the Duchy of Carniola* (1689) as a lizard-like animal. Almost a century later, at the time of its scientific description by Joseph Nicolaus Laurenti (1768) under the name *Proteus anguinus*, the olm was not recognized as a cave-dwelling animal. Its cave-dwelling habits were discovered a century later, when robust populations were found in the Black Cave (*Črna jama*) near Postojna. Nevertheless, today the olm is recognized as the world's first cave vertebrate described, and it remained the only known European cave vertebrate until 2017, when a cave fish was discovered in Germany (Behrmann-Godel et al. 2017). In January 2016 olms in the tourist-oriented Postojna Cave aquariums reproduced, and the news spread worldwide. However, captive breeding and the study of *Proteus* has a long history in Slovenia and France (Aljančič and Aljančič 1998). *Proteus anguinus* is endemic to the waters that flow through the extensive limestone system of the Dinaric karst, from Italy in the northwest to Montenegro in the south. In contrast to most amphibians, the olm is aquatic its entire life and completely adapted to cave habitats. Due to its pale skin color, one of its Slovenian names is *človeška ribica* ("human fish"). Another local name is *močeril*, which could be translated as "one that burrows into wetness." Despite current genetic research suggesting that the olm is actually a complex of several distinct species (Gorički 2006; Trontelj et al. 2007), at present the only recognized subspecies is the black olm (*Proteus anguinus parkelj*). This subspecies is exclusively endemic to the underground waters of southeast Slovenia, with a distribution estimated to be not more than 30 km^2 (Sket et al. 2003), and the confirmed localities extend over an area smaller than 5 km^2 (Gorički et al. 2017). The black morph was first discovered in 1986 by members of the Slovenian ZRC SAZU Karst Research Institute. Today the olm is a symbol of Slovenian natural heritage. It was depicted on a Slovenian coin before the euro was adopted, and it also gave the name to the oldest Slovenian popular science magazine (*Proteus*), first published in 1933.

There are five species of large carnivores in Europe: the brown bear, the gray wolf, two lynx species, and the wolverine. Due to deeply rooted aversion to large carnivores in human culture, they are the most controversial and challenging animals to conserve (Chapron et al. 2014). The organized extermination of large carnivores in central Europe dates back to the Middle Ages, and human intolerance persists today (Ripple et al. 2014). Large carnivores as apex predators are necessary for ecosystems to function but remain extinct in large parts of the developed world, including Europe. Slovenia is among the few countries that are home to three large carnivore species, the brown bear, gray wolf, and Eurasian lynx (Fig. 7.9), and only the Scandinavian countries are home to four species (Chapron et al. 2014). In addition, Slovenian forests are home to a large diversity of mesofaunal carnivores and other mammals, for example, the wild cat, the badger, the golden jackal, the red fox, the Eurasian otter, two marten species, the roe deer and red deer, the wild boar, and so on.

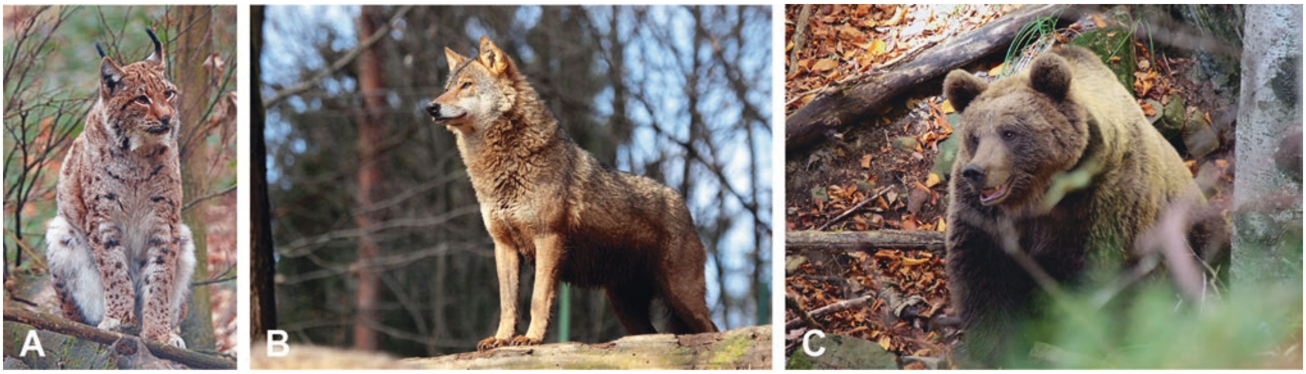

Fig. 7.9 (**a**) Eurasian lynx (*Lynx lynx*), (**b**) gray wolf (*Canis lupus*), (**c**) brown bear (*Ursus arctos*). (Photos by Miha Krofel)

The brown bear (*Ursus arctos*) is Europe's largest carnivore, globally surpassed in size only by its congener the polar bear (*U. maritimus*; Christiansen 1999). The brown bear was widespread throughout Europe in the past and is extinct in most parts today. Nevertheless, it is the most abundant large carnivore, with an estimated total 17,000 individuals that are fragmented into 10 populations (Chapron et al. 2014). Brown bears are the most abundant in the Dinaric Alps and Romania, with 100–200 individuals per 1000 km^2. On the other hand, although they have been permanently found in Scandinavia, their abundance is 0.5 to one individual per 1000 km^2 (Jonozovič 2003). Slovenia constitutes the northwestern edge of the dense Dinaric brown bear population and, according to a current estimate, is home to between 530 and 600 individuals (Skrbinšek et al. 2017). They are most commonly found in beech-fir forests of the Dinaric montane karst, where environmental conditions at elevations between 400 and 1200 m suit them best. Brown bears are found from the Gorjanci Hills and Brkini Hills in the south to the northern part of the karst Trnovo Forest Plateau. Individual bears are sometimes found in the Julian and Kamnik–Savinja Alps. Bears in Slovenia had a wider distribution in the twentieth century. Up to the 1960s, they were common in the Pohorje Hills in the northeast and were found as far east as the Sava River (Švigelj 1961). The brown bear has been protected by law in Slovenia since 1993, but the Ministry of Agriculture, Forestry, and Food can issue a decision to cull a certain number of individuals.

The gray wolf (*Canis lupus*) is the largest living species in the family Canidae (Boitani 1995). The gray wolf has a long history of human association, where most pastoral communities have despised and hunted it due to attacks on livestock. At the end of the eighteenth century, it was widespread throughout Europe with the exception of the British Isles. In the nineteenth and twentieth centuries, especially after the Second World War, the gray wolf was exterminated in central and northern Europe, with remaining populations in Portugal, Spain, Italy, and the western Balkan Peninsula (Hindrikson et al. 2017). In recent decades, both naturally and due to conservation measures, the gray wolf spread back into small parts of Germany, France, Switzerland, and Norway (Mech and Boitani 2003), and today it is Europe's second most abundant large carnivore, with more than 12,000 individuals (Chapron et al. 2014). Because Slovenia is located between the Dinaric Alps (where gray wolves are abundant) and the Alps (where wolves are occasionally found), it is an important bridge between the Dinaric Alps and the rest of Europe. Thus, the conservation of gray wolves in Slovenia is important for a stable wolf population in central Europe in general. Today, the Slovenian gray wolf population is stable and comprises 40–50 individuals, of which more than a third live in cross-border packs (Potočnik et al. 2014). The gray wolf in general is a habitat generalist and is found in forests, arctic tundra, grasslands, and even deserts. In Slovenia, it is most common in beech-fir forests of the Dinaric Alps. The gray wolf has been protected by law in Slovenia since 1993.

The Eurasian lynx (*Lynx lynx*) is Europe's largest cat. In the past, the Eurasian lynx was widespread throughout Europe, with the exception of the Iberian Peninsula, where it is replaced by the Iberian lynx (Kratochvil 1968). The local extinction of the Eurasian lynx started in western Europe and progressed toward the east, peaking in the middle of the nineteenth century. Today, native populations of the Eurasian lynx can be found in the Balkan Peninsula, the Carpathians, Scandinavia, the Baltic region, parts of Poland, and parts of European Russia (von Arx et al. 2004), but it has been reintroduced into several central and southern European countries, for example, the Czech Republic, Switzerland, Germany, France, and Slovenia. Today, the total number of Eurasian lynx is around 9000, but the many reintroduced small populations are stagnating or have even declined in the recent past (Chapron et al. 2014). In the Dinaric Alps, the lynx became extinct in the early twentieth century, but it was reintroduced in 1973 in the Kočevje Rog forest in Slovenia's Kočevje uplands with the release of three males and three females from Slovakia's Beskid Mountains (Čop 1994). The reintroduction was successful, and the population grew until

Fig. 7.10 A marble trout (*Salmo marmoratus*) from the Zadlaščica River. (Photo by Janez Gregori)

the 1990s, when it spread throughout Kočevje Rog and all of Inner Carniola and also deep into Slovenia's southern neighbor, Croatia. However, the lynx population today is in steep decline, likely due to inbreeding and illegal hunting. The Eurasian lynx generally occurs in extensive lowland and mountain forests with an abundance of fallen trees. In Slovenia, it is mostly limited to Dinaric beech-fir forests. In Slovenia, the Eurasian lynx has been protected by law since 1993, and a new reintroduction is in progress.

In addition to these animals, some other notable examples of Slovenian fauna are presented here. The marble trout (*Salmo marmoratus*) is an endemic fish species that lives in freshwater streams of the Adriatic Basin (Fig. 7.10). It is present only in northeast Italy (the Po River) and northwest Slovenia (the Soča River; Crivelli 2006). The species is threatened by hybridization with the foreign brown trout (*Salmo trutta*) stocked for angling, and only five genetically intact populations of the marble trout remain today. Slovenia's Tolmin Angler's Society, in cooperation with its counterparts in nearby towns, has launched a reintroduction program in order to prevent the marble trout from going extinct using intact populations in a breeding program (Povž et al. 1996).

The protected area of the Ljubljana Marsh on the outskirts of Ljubljana, the capital of Slovenia, is a habitat of the largest and one of the world's last populations of the Adriatic marbled bush-cricket (*Zeuneriana marmorata*, Fig. 7.11). This globally endangered species had been considered an Italian endemic until 2004, when it was discovered in wet sedge meadows of the Ljubljana Marsh Nature Park (Gomboc and Šegula 2005). The distribution area of the species in both Italy and Slovenia is estimated at only 30 km^2 (Hochkirch et al. 2016). All remaining populations are declining due to land drainage, succession of habitats with trees and reeds, and the transformation of wet meadows into cornfields. The populations are considered severely fragmented because the species is flightless and thus a poor disperser, hindering gene flow among subpopulations.

Veliki Slatnik, a small village in southeast Slovenia, is the source of the spread of the introduced Japanese silk moth (*Antheraea yamamai*, Fig. 7.12) throughout Europe. The species is endemic to eastern Asia, but it was imported into Europe in the second half of the nineteenth century, intended for tussar silk production by Johann Mach, a well-educated philosopher and connoisseur of nature (Carnelutti 1992). In 1862, he purchased a mansion in the village of Veliki Slatnik and moved there with his family. Five years later he started to breed the species on a nearby hill, today named Mach Hill (*Mahov hrib*), with abundant larval feeding plants, mainly oak. The silkworm breeding was not successful enough, and so he released them into the wild and consequently launched the European invasion of the species. His son Ernst Mach was a notable scientist, physicist, and philosopher, after whom the Mach number, usually used to describe the speed of aircraft, was named. It is less well known that Ernst Mach was the teacher of the great physicist Albert Einstein.

The Carniolan honey bee (*Apis mellifera carnica*) is a subspecies of the European honey bee (*Apis mellifera*) and originated in the Balkan Peninsula. Slovenia prides itself on its northwestern region of Upper Carniola being recognized as the origin area of this bee subspecies. The most important role in the recognition of the Carniolan honey bee goes to the

Fig. 7.11 The Adriatic marbled bush-cricket (*Zeuneriana marmorata*). (Photo by Stanislav Gomboc)

Fig. 7.12 The Japanese silk moth (*Antheraea yamamai*). (Photo by Stanislav Gomboc)

Slovenian beekeeper and painter Anton Janša (1734–1773), who was the first imperial teacher of apiculture under the patronage of the ruler of the Habsburg Monarchy, Maria Theresa. In 1771, he published his legendary book *Abhandlung vom Schwärmen der Bienen* (*Treatise on the Swarming of Bees*). His many improved methods, such as introducing bees to foraging on buckwheat fields, are named the Carniolan method, or Janša method, in Vienna, and new discoveries and beekeeping innovations earned him worldwide renown.

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Part II

Human Geography

The History of Slovenia: Archaeological Evidence from Prehistory to the Slavs

8

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Abstract

A brief overview of the history of Slovenia as told by archaeology runs from prehistory to the Slavs, from the earliest human traces some 300,000 years ago, through the momentous discovery of a purported Neanderthal musical instrument in Divje babe I Cave, the Eneolithic pile-dwellers in the Ljubljansko barje that used two-wheeled carts, the hoards and hillforts of the Bronze Age, and the prosperity of the Hallstatt period with a peak in artistic expression in situla art, to the arrival of the Celts, who mark the end of prehistory. In the last decades of the first century BC, the territory of what is now Slovenia was incorporated into the Roman Empire. Newcomers and indigenous inhabitants lived side by side in a number of flourishing towns, used newly constructed roads, and urbanized the countryside. The period of prosperity ended in late Antiquity with the decline of the Roman Empire. In the face of danger, the population either migrated to safer regions outside the borders of what is now Slovenia or retreated to naturally well-protected peaks that were additionally fortified. The early Slavs entered such a world but left little evidence in the archaeological record.

Keywords

Paleolithic · Mesolithic · Neolithic · Metal Ages · Roman period · Early Slavs

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8.1 The Paleolithic and Mesolithic

Matija Turk

The earliest traces of human presence in what is now Slovenia date back to the end of the Lower Paleolithic. The deepest layers investigated in the karst caves around Postojna have revealed stone artifacts and remains of hunted animals believed to be about 300,000 years old. More evidence of human activity comes from the Middle Paleolithic or the Moustérian, when Europe was inhabited by the Neanderthals. Their earliest traces in Slovenia have been unearthed in the Betalov spodmol Cave [28 in Fig. 8.1] near Postojna (Brodar 2009) and have been attributed to the last interglacial period.

Important new discoveries about Neanderthal culture have come to light at Divje babe I Cave [34 in Fig. 8.1] near Cerkno (Turk 2014). The layers investigated, deposited during the last glacial period, have been radiometrically determined to be between 115,000 and 40,000 years old. The cave was mainly used by cave bears as a den and only occasionally visited by Neanderthals and after them also by anatomically modern humans. The Moustérian layers revealed 21 fireplaces, beside or in which archaeologists have found the remains of captured prey: fish, reptiles, red deer, roe deer, chamois, beavers, and wolves. The find that has attracted the most attention, however, is a purported Neanderthal musical instrument made of bone, initially identified as a flute (Fig. 8.2). It is made from the left femur of a young cave bear and was found next to a hearth in a layer that yielded typical Moustérian tools. The age of the layer was dated using the ESR method as between 60,000 and 50,000 years old. The instrument has two completely preserved holes and two partially preserved ones. The mouthpiece was cut straight. Part of the beveled sharp blowing edge is preserved on it. Experimental perforations of fresh bear bones with metal casts of carnivore sets of teeth have refuted the possibility of the holes being made by carnivores. Using copies of stone and bone tools recovered from the cave, archaeologists per-

© Springer Nature Switzerland AG 2020
D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_8

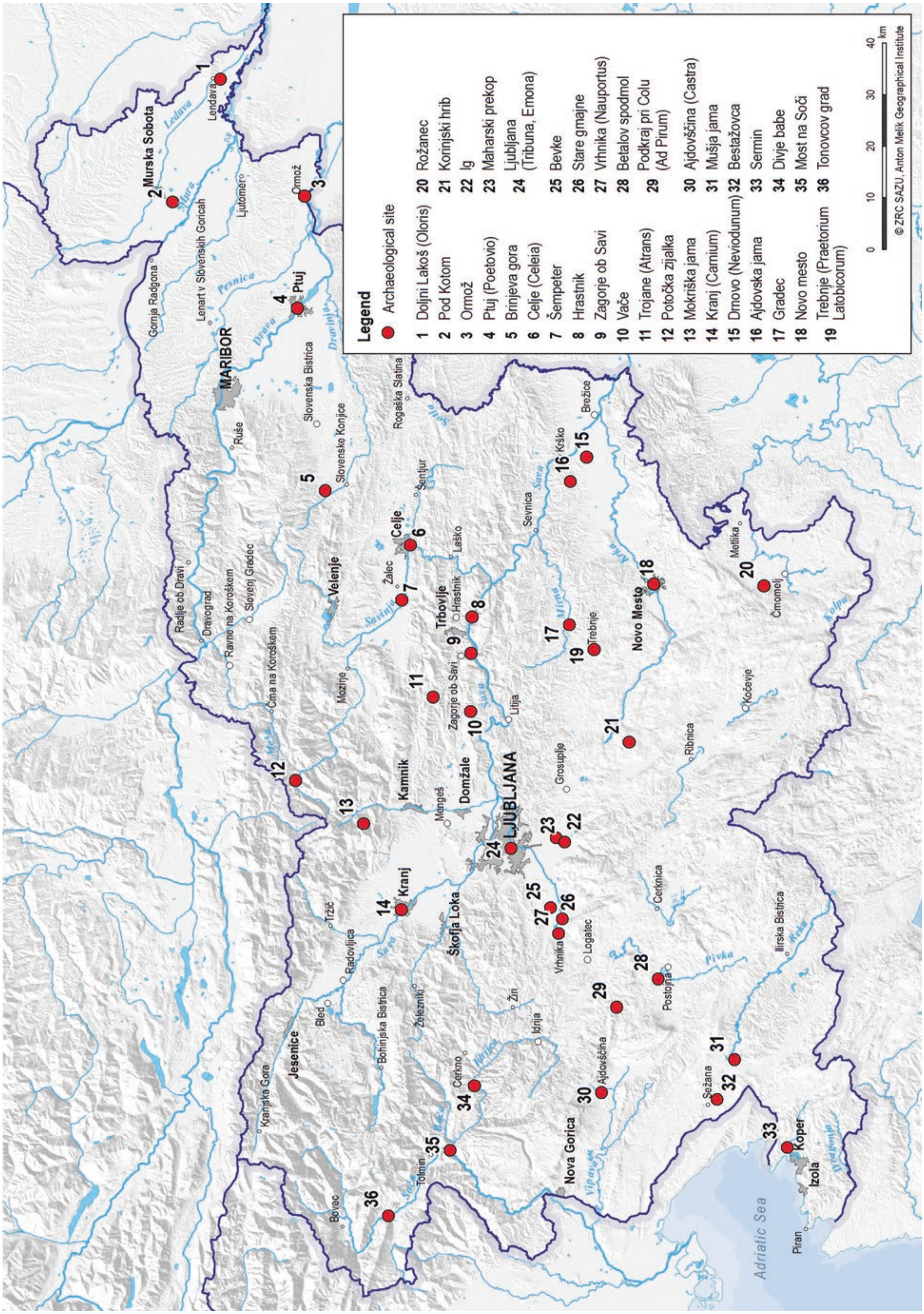

Fig. 8.1 Archaeological sites mentioned in the text. (Prepared by Tamara Korošec)

Fig. 8.2 Neanderthal musical instrument [34 in Fig. 8.1] from Divje babe I (left) and its reconstruction (right). (Kept in the National Museum of Slovenia; photo by Tomaž Lauko)

formed further experiments to establish how a Neanderthal would have made morphologically identical holes. The musical capacity of the reconstructed Neanderthal instrument has a compass of three and a half octaves, which is surprisingly more than other Paleolithic instruments ascribed to anatomically modern humans.

The onset of the Upper Paleolithic period is marked by the Aurignacian technocomplex (dated between 40,000 and 30,000 years ago), which is traditionally associated with the first anatomically modern humans in Europe. The most prominent site of the period is Potočka zijalka Cave [12 in Fig. 8.1], elevation 1675 m, located high in the eastern Karawanks. Its discovery in 1928 profoundly influenced the understanding of the development of the last glacial period. It confirmed the hypothesis of at least one longer warm period, which offered Paleolithic hunters access to Alpine areas. Excavations at the entrance to the cave revealed large fireplaces, stone tools, and bone points, and the cave interior mainly yielded bone points. The Aurignacian bone points—in Slovenia largely made from cave bear bones—were used as either spears or lances. Apart from the over 130 bone points, the site also revealed a bone needle. In 1955, another Alpine post from the Aurignacian period was discovered: Mokriška jama Cave [13 in Fig. 8.1], elevation 1500 m in the Kamnik–Savinja Alps. It, too, contained bone points and is further connected with Potočka zijalka because of perforated cave bear mandibles. It is not clear whether the perforations were made by man or by beasts; some researchers believe them to be flutes, which is supported by acoustic analyses (Brodar 2009).

The Aurignacian is followed by the Gravettian technocomplex (30,000–10,000 years ago). In Slovenia, it is chronologically divided into the Gravettian, Tardigravettian, and Epigravettian. The characteristic Gravettian finds are narrow and long-backed bladelets and Gravettian points, which were fastened to the ends of wooden lances to function as barbs. Bone points become rare. The Tardigravettian coincides with the peak of the last glacial period, when southwestern Slovenia became a refuge for both animals and humans that fled the advancing glaciers to the south side of the Alps. The fauna no longer included cave bears; arctic species appear, such as reindeer and the arctic fox. The main hunted animal was the beaver, and to a smaller extent also reindeer, replaced in the Epigravettian by elk and red deer. The marked microlithization of the backed bladelets in the Epigravettian offers indirect evidence of the increasing use of the bow. This period also left behind some products of artistic expression, such as a horn ring and two engraved stones.

The Mesolithic period spans from the eighth to sixth millennia BC and is divided into the Sauveterrian (early phase) and Castelnovian (late phase). It is characterized by microlithic tools with geometric forms, particularly scalene triangles and trapezes, which were attached to the tips of arrowheads. Trapezes were widely used in the Castelnovian and continued into the Neolithic. Harpoons, unknown in the Paleolithic in what is now Slovenia, were introduced as hunting weapons. Mesolithic hunters mainly hunted red deer and boars. The people inhabiting western Slovenia collected mollusks, specifically land and sea gastropods. Perforated rustic dove shells (*Columbella rustica*) may have been used as jewelry, similar to small perforated stone beads. Bone object are rare, with the exception of those from two open-air sites in the Ljubljansko barje (Ljubljana Marsh). At the end of the ice age, people again exploited the Alpine regions, as evidenced by numerous open-air sites recently discovered in the Upper Soča Valley, which have mainly been attributed to the Early Mesolithic.

8.2 The Neolithic and Eneolithic

Anton Velušček

The first farmers in Slovenia appeared around the middle of the sixth millennium BC in the Karst region and in Istria. Evidence of their activities has been found in caves and rock shelters, and the only known open-air site is at Sermin [33 in Fig. 8.1] near Koper.

Their pottery shows great similarities with the eastern Adriatic Danilo culture. Newcomers settling land unfavorable for cultivation used it to graze small livestock, predominantly sheep and goats. They very likely distinguished between winter and summer pastures. They used caves as occasional shelters. Also from this period are the simple rock drawings in Bestažovca Cave [32 in Fig. 8.1] near Sežana.

The first farmers reached continental Slovenia in the first half of the fifth millennium BC. The colonization of Prekmurje and the eastern Slovenske gorice (Slovenian Hills) probably proceeded from the east, that is, the Pannonian Plain. At the same time, but following yet another route, was the settlement of Štajerska (Styria), central Slovenia, and Bela krajina (White Carniola). Here, people predominantly established their settlements along rivers or at prominent naturally protected locations. The first pile-dwelling settlements appear in the Ljubljansko barje. In Dolenjska (Lower Carniola), the settlement at Gradec [17 in Fig. 8.1] near Mirna was already protected by a stone rampart in the mid-fifth millennium BC.

The Eneolithic followed in the second half of the fifth millennium and roughly lasted until the mid-third millennium. Almost all of continental Slovenia was colonized by the people of the Lasinja culture. They set up their open-air settlements almost at the same locations as their predecessors, but on occasion also chose completely new, naturally protected spots.

Apart from settlements, the people of the Lasinja culture left behind a cemetery located in the Ajdovska jama Cave [16 in Fig. 8.1] near Krško, which is the earliest known cemetery in Slovenia. Around 4300 BC, the remains of roughly 30 individuals were laid into the floor of this cave in the span of a few decades. More than half of the skeletons have been identified as children, who were very vulnerable in prehistory. The burials and later visits to the burial site involved certain rituals, including provisions of food for the afterlife offered in pots, as well as also other utilitarian and decorative goods (Dular and Božič 1999).

In the early fourth millennium BC, continental Slovenia as far west as Postojna was settled by people of the culture producing stab-and-drag style pottery. Contacts with the *Caput Adria* region intensified. Archaeological evidence shows that people engaged in copper metallurgy. Five pile-dwelling sites of this culture have been investigated in the Ljubljansko barje, all discovered after 1998. Two of them were inhabited on several occasions in the span of just under 200 years.

Also from this period is the urn cemetery site at Pod Kotom-jug [2 in Fig. 8.1] near Krog, in northeastern Slovenia, where 179 graves have been excavated. One of them, Grave 136, was the burial of a child less than 1 year old, whose cremated remains were placed in an urn together with grave goods that included a thin copper plate. Analysis of the considerably well-preserved although fire-damaged bone remains of the people buried in this cemetery showed that most died before reaching the age of 35 and only a few lived past the age of 60. The analysis also noted damage to the bones as a consequence of a poor diet and presumably hard labor.

The pile-dwelling site at Maharski prekop [23 in Fig. 8.1] near Ig was inhabited in the decades after 3500 BC. It had a double palisade enclosing a settlement of roughly a dozen houses, largely oriented along the so-called heliothermic axis (*l'axe héliothermique*). The pile-dwellers inhabiting the Ljubljansko barje in the late fourth millennium BC also used carts as a new means of transport (Fig. 8.3; Velušček 2009).

This period was followed by another gap in human habitation that lasted until roughly the twenty-eighth century BC, when pile-dwellers again appeared on the banks of the lake in the Ljubljansko barje, this time with traits of the Vučedol culture. Pottery finds suggest that they arrived in central Slovenia along the Sava and Drava rivers from the southeast, from the core area of the abovementioned culture. They and their descendants maintained contact with the people living on the eastern coast of the Adriatic, in northern Italy, and in the Danube Basin. They were master metallurgists, as revealed by finds of smelting pots, molds, and finished products. In contrast to the fourth millennium, antimony copper was now very popular in the Ljubljansko barje.

Fig. 8.3 Wooden wheel from the pile-dwelling site at Stare gmajne near Vrhnika [26 in Fig. 8.1], around 3150 BC. (Kept in Ljubljana's City Museum; photo by Matija Turk)

There is scant evidence regarding the burial customs of this period. The most reliable information comes from inhumation graves found near Zagorje ob Savi [9 in Fig. 8.1]. The grave goods included a typical shaft-hole axe of the Kozarac type and several stone axes or objects of various shapes; some of them may have been used by copper prospectors.

Prospecting and copper metallurgy were presumably the driving forces of development and were mainly practiced by the people living in continental Slovenia at least from the first half of the fourth millennium BC onward. Apart from these, a pastoral economy remained the mainstay in the Karst region.

Hunting was also important, which supplemented occasional shortages of crops and allowed communities to survive. People hunted large and small mammals, as well as birds and fish.

Along the fringes of the Ljubljansko barje, people in the fourth millennium BC grew einkorn and emmer wheat, barley, and flax. They were also familiar with the poppy. The pollen diagram from the Karst region also reveals wheat pollen, which indicates the beginnings of crop cultivation. Gathering food remained an important activity, however, including raspberries, blackberries, grapes, cornelian cherries, water caltrops, hazelnuts, and so forth. People were also familiar with the medicinal properties of plants.

8.3 The Bronze Age

Primož Pavlin

The Bronze Age began around 2200 BC (Teržan and Črešnar 2014). The Early Bronze Age has not yielded much evidence on the settlement of Slovenia. Pile-dwellings were still inhabited in the Ljubljansko barje, and the plains of Prekmurje were also relatively densely settled. Both areas were part of the Kisapostag and Litzen cultures, which spread across areas up to the north–south stretch of the Danube River. The pottery bears combed or twisted cord decoration impressed into the soft clay.

In the Middle Bronze Age (from the sixteenth to fourteenth centuries BC), the Castellieri culture developed in the Karst region and in Istria and continued uninterrupted into the Early Iron Age. Its name is derived from the Italian word for hillforts (*castellieri*). At the same time, Styria formed part of the central European Tumulus culture, characterized by inhumation burials under tumuli or burial mounds; one such mound was excavated at Brinjeva gora [5 in Fig. 8.1] near Zreče and revealed five individuals. The earliest swords and sickles from the Ljubljansko barje (Sauerbrunn swords and left-handed sickles) show that the territory of Slovenia then acted as an intermediary between Italy and the Danube Basin.

Momentous changes took place across Europe toward the end of the fourteenth century BC, which have been associated with the migrations of peoples and the later decline of some of the mighty kingdoms in the eastern Mediterranean. Due to the common burial practice, the period of the Late Bronze Age is known as the Urnfield period, a cultural phenomenon that spread across all of Europe. The deceased were cremated and buried in flat cemeteries. People inhabited naturally protected elevations additionally fortified by wooden palisades, but not much is known about how they constructed their houses. Apart from hilltops, the Drava Valley, the Mura Valley, and central Slovenia also had lowland settlements.

The clustered settlement at Oloris [1 in Fig. 8.1] near Lendava, in Prekmurje, was enclosed by a moat and a wooden fence. The houses had wattle-and-daub walls supported by wooden posts. They were equipped with a hearth and underfloor storage pits. The settlement at Ormož [3 in Fig. 8.1], in Styria, revealed a different fortification: it was protected by the Drava River to the south and by a moat and rampart on the other three sides. The settlement's interior had a network of cobbled streets up to 4 meters wide lined on both sides by houses of various sizes.

In the Bronze Age, there was a great increase in hoarding. These hoards mainly consist of tools and weapons and to a smaller extent also pieces of jewelry. They were initially interpreted as valuables buried in times of danger, but are now instead seen as offerings to various divinities. Over 60 such hoards are known from Slovenia, including the items deposited at Mušja jama (Jama na Prevali II Cave) [31 in Fig. 8.1] in the Karst region. This is a karst shaft with 50-meter-deep entrance hall into which several hundred objects were thrown during the Urnfield period and later. The closest parallels for some of the objects can be found in the western Balkans, the Danube Basin, central Italy, and the eastern Mediterranean. All of this suggests that the shaft functioned as a supra-regional sanctuary (Dular and Božič 1999).

8.4 Early Iron Age

Sneža Tecco Hvala

The early part of the Iron Age, spanning from the early eighth century to the end of fourth century BC, is also known as the Hallstatt period (Laharnar and Turk 2017). In this period, new territorial entities developed from the common heritage of the Urnfield culture. Their names are not known from ancient literary sources and are therefore based on modern regions' names. They differed in material culture, burial customs, and general development. These differences are rooted in geographical conditions, the distance from the origins of new phenomena, and the openness to novelties. They were influenced by potent cultural and political forces of the Mediterranean. One of the cores of change was also the Carpathian–Danube Basin, where the previous Urnfield culture began disintegrating under pressure from mounted nomads from the east. The appearance of iron had also a significant impact on socioeconomic transformations.

In the eighth century BC, major changes occurred in the settlement pattern of the hilly regions of Dolenjska (Lower Carniola) and Bela krajina (White Carniola). The old settlements along rivers were abandoned, and the inhabitants moved to higher locations with a suitable agrarian hinterland and proximity to iron ore deposits, natural communications, and water sources. The number of settlements decreased to half, but their size doubled. New local centers emerged, which stood out in their economic and social importance. Hillforts that offered good visual control became the typical form of settlements. They were fortified with stone ramparts, which was a novelty in these regions with roots in the Mediterranean. The houses in hillfort interiors were wooden with wattle-and-daub walls, though some were also made in the more advanced, post-pad construction technique. In the sixth century, most settlements were burned, but the inhabitants soon rebuilt them and went on to colonize the hills of the Posavsko hribovje (Sava Hills) to the north. The identity of the Dolenjska community of the Early Iron Age is also perceivable from its specific funerary practice. In contrast to previous periods, the inhabitants now practiced inhumation burial under tumuli that held several generations of deceased belonging to one extended family or clan. The tumuli have a characteristic structure, with burials arranged around a central grave or an empty central space that indicates the veneration of an actual or mythical ancestor. The deceased were buried with objects of status, weapons, banqueting vessels, and even horses. The grave goods reveal the appearance of a warrior class and a military hierarchy with horsemen at the top. The dignitaries of individual families or clans formed the elite and held military, economic, and political power. The basic unit of society was the extended family or a clan, a group of which formed the local community headed by a chieftain. The leader was not chosen on the principle of succession, but had to prove himself worthy through virtues and deeds.

The alpine landscape of the Upper Soča Valley was permanently inhabited for the first time in the Iron Age. Settlements sprang up along rivers at naturally protected locations at confluences, valley entrances, and passages eastward to the Gorenjska region (Upper Carniola) and the Ljubljana Basin. The important centers that emerged in the eighth century were all located along the Soča River, which is a natural communication route connecting the Alps with the Friuli Plain and the Adriatic Sea. The largest settlement core was at Most na Soči [35 in Fig. 8.1]. It had a planned layout of houses with a row of workshops, a system of drainage ditches and canals, and a paved street, which indicates early stages of urban development. Houses were constructed on a sunny slope, they had stone foundations and a wooden superstructure of sleeper beams and posts, and the walls were made of wooden boards. They were equipped with drainage drywalls of stone rubble set up along the walls of the construction pits and intended to protect the houses from moisture. The Iron Age architecture of the Soča Valley shows an advanced level of construction that was similar in its basic principles to that in other Alpine regions. In the early sixth century BC, the inhabitants of the Upper Soča Valley colonized the Bohinj area mainly with purpose of gaining access to its rich deposits of iron ore. They went on to colonize the adjacent valleys and plateaus in the fifth and fourth centuries BC. Throughout the Iron Age, they buried their dead in flat cemeteries located on river terraces. Cremation took place on pyres at the edge of cemeteries, and the cremated remains were usually placed into the grave pit together with grave goods and covered with stones. The grave goods comprise parts of the costume, ceramic, metal, and other vessels, as well as animal bones, predominantly of sheep and cattle.

The onset of the Iron Age in the Karst region caused no major changes in the settlement pattern. Some hillforts dating back to the Bronze Age continued to be populated into the Iron Age, and new ones appeared from the tenth century BC onward. They were located on ridges or the fringes of hills just below the summits and along the communications running along valleys and the outskirts of karst poljes. The region was not colonized all at once, but in waves. In the sixth and fifth centuries BC, all of the major settlements in the Karst region and Notranjska (Inner Carniola) were abandoned. Regarding the burial customs, the people in the Karst region cremated their dead and buried them in flat cemeteries, with the remains placed in stone cists, whereas the population of Notranjska practiced both inhumation and cremation burial in flat cemeteries.

The community centered at Ljubljana spread toward the northwest to Gorenjska all the way to Bled in the eighth century BC but also southward to the Kolpa River. In Dolenjska and Bela krajina, it was soon integrated into the newly formed Dolenjska community, whereas in the center it retained its conservative character, although its power was weakened. In Gorenjska, the settlement centers were abandoned in the second half of the seventh century BC; traces of life again appeared in the fifth century BC. The community retained the old tradition of urn burials in flat cemeteries but also adopted burial under earthen mounds with a stone burial chamber in the center. This practice has also been observed in Carinthia and Styria.

The Bronze Age settlements in Styria were mainly located in the plains of the Drava and Mura rivers and their tributaries, whereas most settlements on hills only appeared in the tenth century BC and continued to be inhabited into the Iron Age, when they were joined by several new ones. These hillforts were enclosed within earthen ramparts and wooden palisades, which is an old tradition in continental Europe. In the mid-sixth century BC, the region witnessed turbulent times that resulted in most settlements across the wide area of Pannonia being deserted. This has been seen as the result of the incursion of mounted nomads from northern Black Sea areas.

The subsistence of the Iron Age communities in Slovenia was based on growing crops and rearing livestock. They grew all of the main cereals, mainly wheat, but also barley, oats, and rye, as well as vegetables such as cabbage, turnips, rutabagas, peas, and broad beans. They reached the level of plowing agriculture. Livestock breeding was widespread, but conservative. The communities in Dolenjska and the Soča Valley mainly reared cattle, predominantly small breeds. The karst areas were better suited to breeding sheep and goats. Transhumance was also practiced. The diet included a fair amount of pork from a rudimentary breed of pigs. Two types of horses were known in Dolenjska: working animals of smaller size and local origin as well as large horses of eastern origin, which were symbols of prestige and status. Dogs were used as livestock guardians and as help in hunting. Hunting was popular, but game did not play a major role in the diet of the day, nor did fish.

Knowledge of iron production spread from Asia Minor and the Near East, and it reached the Alps in the early eighth century BC. Here, the presence of rich deposits of limonite caused a veritable boom in ironworking. The process of smelting iron ore was primitive and the yield poor. Extracting and working metals required special knowledge and skills of metalworkers, smiths, and toreutic masters, who produced objects of the highest quality: helmets, cuirasses, and bronze vessels or situlae decorated with figural scenes (Fig. 8.4).

Other crafts were mainly practiced within households and did not require professional craftsmen. Pottery was predominantly shaped by hand and fired in bonfires. In the early sixth century BC, two innovations were introduced in Dolenjska and the Soča Valley: the hand-operated wheel,

Fig. 8.4 The bronze Vače [10 in Fig. 8.1] situla is the most beautiful, most characteristic, and best preserved product of toreutics and situla art in Slovenia. It represents the pinnacle of figural expression in the region. The narratives of situla art disappeared in the fourth century together with the Hallstatt culture. (Kept in the National Museum of Slovenia; photo by Tomaž Lauko)

which made possible larger-scale production of uniformly shaped vessels, and the pottery kiln, which allowed the potters to control the firing process. This technology arrived from Italy and reached its peak in the fifth century BC. The production of glass items was also an important activity in Dolenjska, with necklaces of colored glass beads as real masterpieces. The partially specialized production of certain goods served not only to meet the local demand but also to make items for barter and trade.

The transitional southeastern Alpine areas played an important role in exchange and trade flows. Precious imports indicate contacts with the Veneti, Etruscans, and Picentes. Particularly important goods exchanged between Pannonia and Italy were iron, livestock, and horses; there was also salt from the Salzburg area and amber from the Baltic. Trade was conducted in two ways: through chain trading or directly between distant places using caravan transport on land or waterways. The trade network was in the hands of the ruling classes, who strengthened their ties through prestige gifts and diplomatic marriages. Grave goods also tell of the cult of heroes such as it was known in the Greek world of Homer and can also be identified in the narratives of situla art. Its iconography echoes the imagery of the Mediterranean world, but in a local interpretation and using a traditional technique dating back to the Urnfield period. Objects from the end of the Hallstatt period also bear the first inscriptions, in either Etruscan or Venetic scripts. Despite the considerable economic and social advances, the nature of these communities remained prehistoric.

8.5 The Late Iron Age

Lucija Grahek

The first contacts with the Celts were already established at the end of the fifth century and in the fourth century BC, and their arrival in Slovenia is first noted in the early third century. The Celtic settlements and cemeteries in eastern Slovenia suggest that they mainly entered from the northeast.

Several different groups of Celts have been documented in Slovenia, in places probably ethnically mixed with the indigenous Hallstatt population and constituting a culturally diverse territory. The community living in Prekmurje and Styria is associated with the Taurisci, possibly even the Boii, and in the first century BC most likely with the Sereti. In Dolenjska, the arrival of the Celts caused extensive changes in the settlement pattern and material culture; the Mokronog group formed here, which was also present in northern Bela krajina, Posavje, the Celje and Ljubljana Basin, and Gorenjska. This group is also associated with the Taurisci and, in the first century BC, with the Latobici, who are only known in Dolenjska. Most of Bela krajina was inhabited by people of the Vinica group, associated with the Colapiani. Its development was influenced by the Iapodes inhabiting Lika in Croatia, who also influenced the transformation of the Notranjska–Karst community to the west. The Idrija group formed in northwestern Slovenia with its center in the Upper Soča Valley, which some authors associate with the tribe of the Ambisonti and others with the Carni.

The Notranjska–Karst and Idrija groups have few Celtic elements of a central European character. The scant archaeological evidence on the early part of the Late Iron Age indicates a decrease in population and a shift in settlement. Later, in the late second century BC, the regions came under increasing pressure from the Roman state following the founding of the colony of Aquileia in 181 BC, which led the people to reinhabit the Hallstatt settlements (Dular and Božič 1999).

Numerous small hamlets sprang up in Prekmurje, on the plains of the Mura River, where people lived in semi-sunken huts and also constructed small aboveground granaries, work and refuse pits, and pottery kilns. These settlements were unfortified (Kerman 2016).

Many of the hillforts in Dolenjska were abandoned after the arrival of the Celts, and new settlements were established in the lowlands. In central Slovenia, a settlement was set up at Tribuna [24 in Fig. 8.1] in Ljubljana along the marshy banks of a stream reinforced with a stone wall, stone-paved surfaces, and fences of intertwined branches. The streets and squares of the settlement were also paved. They separated wooden houses constructed with the post-pad or earthfast post construction methods resting on stone foundations. They had one or two rooms, as well as hearths with built-in vessels.

The arrival of the Celts in Dolenjska also caused an almost complete loss of identity on the part of the indigenous population. The new masters introduced new burial customs: cremation burial in flat cemeteries. Armament also changed, as did dress, religious beliefs, and artistic expression.

The main weapon of the Celts was a long two-edged sword. Inserted into a scabbard, it was worn suspended on a military belt on the right hip. The Celts introduced the western breed of horses and also two-wheeled war chariots with iron-clad wheels.

Another element that the Celts introduced was the foot-powered potter's wheel. However, the pottery from the over 100 graves unearthed at Novo Mesto [18 in Fig. 8.1] still predominantly consists of hand-built vessels decorated in the Late Hallstatt tradition, which suggests that the old inhabitants of Dolenjska only partially mixed with the Celtic newcomers.

The people continued to rear livestock, with an increased role of pigs, but also practiced poultry breeding. Land was worked using an ard plow with a plowshare and coulter. In addition to the usual tools, such as hoes, spades, and axes, people also began using large scythes. They practiced hunting, fishing, and, as suggested by the finds from Tribuna, even fish-farming. Extraction of iron ore and ironworking remained important economic activities.

Some of the old hillforts were reinhabited and refortified toward the end of the second century BC. This may be connected with the early Roman interventions in these areas, such as the punitive expedition by the Roman consul Gaius Sempronius Tuditanus against the Carni, Histri, and Iapodes in 129 BC, which also affected the Taurisci. The move to the hillforts probably occurred in haste because most of the renovated ramparts are poorly constructed. The steep slopes beyond the ramparts were paved at this time, hindering access to the ramparts from the outside.

When the Celtic expansion ended, the crafts again flourished and trade was renewed. Trade probably also led to the development of Celtic coinage. The Taurisci minted their own coins from the mid-second century BC onward, which were similar to the Norican silver coins. Numerous finds of Tauriscan coins have come to light at Celje [6 in Fig. 8.1], where the mint was presumably located. The Tauriscan small silver coins have Apollo's head on the obverse and a stylized horse on the reverse, which are figural artistic achievements in their own right (Guštin 2001).

The development of the Celtic artistic style can best be observed on the scabbards of swords and on some of the decorative items of dress. Contrary to Mediterranean models and the Hallstatt situla art, the Celtic style is not based on realistic depictions, but instead shows two basic, increasingly stylized fantastic styles using plant and animal motifs; also popular was the face mask motif. The plastic depictions of human figures have mainly been associated with the spiritual world.

8.6 The Roman Period

Jana Horvat, Marjeta Šašel Kos, Zvezdana Modrijan

With its foundation in 181 BC, the colony of Aquileia became the military base for Roman eastward conquests and at the same time an important starting point of numerous roads and the seat of many entrepreneurial and merchant families that maintained close ties with the indigenous peoples living in the eastern Alps, the Middle Danube Basin, and the western Balkans. There were two main lines of communication of crucial importance in these areas: the Amber Route, which led north–south and connected the northern Adriatic with the Baltic, and the navigable route that led east–west along the Ljubljanica, Sava, and Danube rivers (Dular and Božič 1999).

When Dacian King Burebista defeated the alliance of the Boii and the Taurisci around 60 BC, the only state that remained to contend with on northeastern Alpine and western Pannonian territory was the Norican Kingdom, although its relationship with the Taurisci is not clear. During his proconsulship of Cisalpine Gaul, Caesar probably annexed the areas of the Illyrian–Italian gates at Postojna and the Emona Basin to the province under his command. The main Roman base was at Nauportus (modern Vrhnika) [27 in Fig. 8.1].

Roman expansion gained new impetus with Octavian's Illyrian War (35–33 BC), although the indigenous communities living in the Julian Alps had been subdued even before that. In the fourth or third decade BC, merchants from Aquileia built a large complex of storehouses next to the harbor at Nauportus, as well as a central square with a portico and a sanctuary. This settlement was enclosed within fortification walls with towers and must have played an important role in transit trade, but was even more important as a supply base for the Roman army engaged in military campaigns in southern Pannonia. The existence of a supply line leading along the Ljubljanica and Sava rivers is corroborated by the army camps documented at Emona (modern Ljubljana) [24 in Fig. 8.1] and the Brežice Gate. Pannonia was conquered between 14 and 9 BC. At roughly the same time, the Norican Kingdom was annexed to the Roman state, and thereby the entire territory of what is now Slovenia was under Roman rule. This territory would only come under threat during the Pannonian–Dalmatian rebellion in AD 6–9.

The long decades of peace that ensued encouraged people to establish settlements along roads and in lowland areas suitable for agriculture. In the early first century AD, a road was constructed across the uninhabited high Hrušica Pass, which shortened the route from Aquileia to Emona by an entire day. From Emona, two important roads led toward the northeast, across Celeia (modern Celje) and Poetovio (modern Ptuj) [4 in Fig. 8.1], and toward the east, across Neviodunum (modern Drnovo near Krško) [15 in Fig. 8.1]. The navigable routes along the Sava and Drava rivers remained important.

Western and central Slovenia in the first century AD administratively belonged to Italy, forming part of the territories of Emona, Aquileia, Tergeste (modern Trieste), and Forum Iulii (modern Cividale del Friuli). The territory of Aquileia extended to the Ljubljana Basin and included the *vicus* of Nauportus (Fig. 8.5), which lost its original importance after the rise of Emona.

In Ljubljana, the *colonia Iulia Emona* may have been founded even before Octavian became Augustus (27 BC). What is certain is that, in the second decade AD, a new town was constructed on the left bank of the Ljubljanica River with the help of the Roman army. The town had a rectilinear layout with a forum and was enclosed within a fortification wall with towers and moats. It contained 48 rectangular building plots or *insulae* of various sizes that welcomed numerous civilians from Italy and in part also Roman army veterans.

The Celje Basin and Carinthia formed part of the Roman province of Noricum. The prosperous Celtic settlement at Celje became *municipium Claudia Celeia* under Emperor Claudius (AD 41–54) and continued its economic prosperity. The local Norican aristocrats that were granted Roman citizenship were members of the municipal upper class. The wealth of the town is reflected in the unearthed remains of lavish townhouses and public architecture, as well as workshops. The town suffered a natural disaster in the third century, possibly a flood that led to a decrease in size and a change in form.

Some of the prominent families of Celeia also lived at what is now Šempeter v Savinjski dolini [7 in Fig. 8.1], which is known for its cemetery and its excellently preserved funerary monuments with reliefs with mythological scenes and portraits of members of the Celeia elite. Another important site is at the Trojane Pass, which was the border between Italy and Noricum and was the location of an important customs post and roadside station of Atrans [11 in Fig. 8.1].

Fig. 8.5 Boundary stone between the territories of Aquileia and Emona, dating to the time of the Emperor Augustus and found in the River Ljubljanica at Bevke [25 in Fig. 8.1]. (Kept in the National Museum of Slovenia; photo by Tomaž Lauko)

Further toward the northeast, an army camp stood at Poetovio almost throughout the first century AD, a site carefully selected because it afforded easy passage across the Drava River. After the last legion left the area under the Emperor Trajan (probably between AD 98 and 102), the settlement that grew next to the camp became *colonia Ulpia Traiana Poetovio*. The colony was mainly settled by veterans from northern Italy. It had a center with administrative buildings, as well as a new or repaired stone bridge, and it stretched 3.5 km along the main road and both banks of the Drava. It became one of the most prominent towns in the province of Upper Pannonia and in the second century was also the seat of the Illyrian customs and tax administration, which covered a large area from Bavaria in the west to the Black Sea in the east. The nearby Pohorje Hills had marble quarries, and Poetovio handled part of the marble production. The town also regulated trade and transport along the Drava River. The large pottery workshops used the navigable Drava to transport their products. Glassmaking and ironworking took place at Poetovio, and literary sources even mention textile manufacturing.

Dolenjska also formed part of the province of Upper Pannonia. The central town in the region was Neviodunum, which was conferred the status of a municipium under Emperor Vespasian (AD 69–79). It was located at the busy road leading from Italy toward Siscia (modern Sisak) and onward but also stood on the Sava River and was therefore associated with a harbor. As in Celeia, Neviodunum had a privileged class of active Celtic dignitaries.

The indigenous peoples that inhabited the territory of Slovenia in the first century AD were listed by Pliny the Elder in his *Naturalis historia* (Natural History). The part of the book dealing with this territory is the first official record of the area in Antiquity. It mentions the Carni, Taurisci, and Iapodes, and it also alphabetically lists tribes never before mentioned in literary sources; for example, the Catali in the karst hinterland of Tergeste, the Latobici in the areas of Neviodunum and Praetorium Latobicorum (modern Trebnje) [19 in Fig. 8.1], unlocalized Catari, Colapiani along the Kolpa River, Varciani and Iasi in western Croatia, and Serretes and Serapilli along the Drava, presumably living in the Poetovio area. Their status was legally and administratively determined. The Iapodes and the Colapiani are explicitly stated to have been governed by prefects; the Carni and the Catali were integrated into the territory of Tergeste and the Latobici probably into that of Neviodunum. Living in the area of Emona was an indigenous population related to the Veneti; based on the evidence of personal names that appear on numerous tombstones in the Ig area, the inhabitants were defined as having belonged to the Ig onomastic group. These names are less common in the colony of Emona itself, ousted by the Roman colonists. The personal names from the territories of Celeia, Poetovio, and Neviodunum are predominantly of Celtic origin, suggesting that the descendants of the indigenous population living here were largely Celtic.

The countryside was quite densely populated and well exploited in the Roman period. Rural estates or *villae rusticae* with residential buildings and associated production facilities were quite common. Mediterranean agriculture was practiced in the littoral area; the estates near the sea included large villas with harbors and fish-farming facilities, where olive oil and wine were produced and exported to the provinces of Noricum and Pannonia. The karst areas in the hinterland of the littoral were mainly used for animal husbandry. In central and eastern Slovenia, the lowland areas suitable for agriculture were densely settled. The small posts in the high mountains of the Julian and Kamnik–Savinja Alps probably served as summer pastures above the tree line.

In construction, the Romans introduced mortar-bound stone and brick as building material, replacing the simple wooden construction of the indigenous population. They developed a wide network of quarries, stonemason's workshops, limekilns, and brickworks. Quarrying and working with local stone was probably the economic base of the Roman settlement at Ig [22 in Fig. 8.1]. Ironworking was important in the Julian Alps.

The indigenous population and the Romans worshipped a variety of gods and goddesses, as well as numerous lesser divinities; their religious beliefs were polytheistic. Their names are known almost exclusively from Roman inscriptions, which show that even the pre-Roman divinities were Romanized to a degree because the act of setting up stone altars to gods was a typically Roman custom. Only three such votive altars have been found at the indigenous settlement at Ig, two dedicated to Jupiter and one to Acinoris, a divinity only documented at Ig and a clear indication of the inhabitants worshipping their gods in the old, "prehistoric" manner from before the introduction of Roman practices. The Greek historian and geographer Strabo reports on an ancient sanctuary of Diomedes at the springs of the Timavo River and on two sacred groves, one dedicated to Argive Hera and the other to Aetolian Artemis—in fact, two Venetic goddesses with similar attributes that were protectresses of weapons, marriage rites, shepherds, hunters, and animals.

As was the case across the empire, most altars were dedicated to Jupiter, the chief god of the Roman pantheon. Temples to Jupiter and other Roman divinities were erected in the fora of most Roman cities. Also important was the cult of the emperor, who was officially venerated in every city, and his worship was attested by numerous inscriptions erected by priests in charge of the imperial cult (Augustales and *seviri*). Gods identified with Jupiter were also worshipped by the indigenous inhabitants; particularly popular in southern Noricum and southwestern Pannonia were Jupiter Depulsor (averter of evil) and Jupiter Culminalis (master of heights). Their epithets are Latin, but they were gods of local significance. The Nutrices—protectresses of babies and small children—were also worshipped under a Latin name, but their local importance and probable Celtic origin are indicated by the fact that their cult is limited to Poetovio and its territory.

The local and indigenous divinities bear witness to the religious beliefs of the pre-Roman population, which differed from place to place, and their cult was unknown even in nearby urban centers. Aecorna is one such example; apart from Jupiter, she was the most popular divinity of the Emona Basin. She was the almighty goddess of the marshes and was one of many female divinities of the Veneti, Liburni, and Histri. Her worship must have been important to the inhabitants of the Emona Basin, as revealed by the sanctuary erected for her at Nauportus by both local magistrates (*vici magistri*) at the decision of the entire settlement; no other divinity has been documented at Nauportus. At Emona, a number of monuments were dedicated to her by less prominent people but also by Publius Cassius Secundus, a prominent member of the Roman equestrian order that served as the prefect of the *ala Britannica*. In Savaria (modern Szombathely), she was worshipped by the community from Emona living there. Apart from the two Jupiters mentioned above, the inhabitants of Celeia also venerated the eponymous goddess Celeia, as well as Noreia, Genius Anigemius, and the Celtic Epona.

The sanctuary discovered at the hamlet of Sava, on the bank of the Sava River opposite Hrastnik [8 in Fig. 8.1], was located at a section of the river with treacherous rapids and two dangerous waterfalls; it was presumably dedicated to Adsalluta, goddess of the rapids and the dangerous section of the Sava. She appears on several altars from this sanctuary either alone or together with Savus, the god of the Sava River. Altogether ten altars were found here and in the vicinity, one of them also dedicated to Magna Mater (Cybele), who took on the role of many a goddess in the late Roman period, including Adsalluta.

Before the ascendancy of Christianity in the fourth century, a number of eastern cults were practiced by the local population, partly transmitted to Noricum and Pannonia via Italy. The cult of Magna Mater, depicted on a throne between two lions, was a popular one. Even more popular, particularly among the military and administrative personnel, was the cult of the sun god Mithras, worshipped in sanctuaries arranged in caves or cave-like buildings. An interesting sanctuary or mithraeum was found at Rožanec [20 in Fig. 8.1] near Črnomelj, where the inscription and the cult image (ritual killing of a bull) were carved into the rock face of an abandoned quarry. Another mithraeum has been documented in the settlement of Praetorium Latobicorum, and as many as five have been found in Poetovio, the seat of the army and the provincial tax offices. Other eastern cults were less popular (Šašel Kos and Kos 2013).

The roads leading to Roman urban centers were lined with family burial plots within walled enclosures, where many would have erected tombstones even prior to their death. Italian immigrants typically had lavish funerary monuments, whereas the goods in the graves were symbolic and relatively few in number. Indigenous and local customs survived in the countryside. The indigenous population on the border between Pannonia and Noricum buried the cremated remains of their deceased under earthen mounds. In Dolenjska and Bela krajina, the grave goods include typical round house-shaped urns. Until the third century, the dead were usually cremated on a pyre; after this time inhumation was increasingly the norm.

The first century and most of the second century were a time of peace and economic prosperity. The calm was interrupted by the incursion of the Quadi and Marcomanni, who entered northern Italy across the southeastern Alpine areas (in 166 or 167). In the ensuing Marcomannic Wars, a military zone (*praetentura Italiae et Alpium*) was established that encompassed a large part of what is now Slovenia. The legion II Italica was stationed at Ločica ob Savinji [7 in Fig. 8.1] near Celeia, in a camp occupied less than 10 years. The war was accompanied by a plague of catastrophic proportions. The war and the plague had devastating consequences on the population and marked a turning point in the development of the region. Life did continue, but differently than before. The devastated areas were settled by poorer classes from the eastern provinces that sought their fortunes in the west.

The crisis of the middle and second half of the third century is mirrored in numerous hoards of coins buried in the face of danger. Examples of such times of danger were the usurper Aemilian marching into Italy in 253 or barbarian incursions in 259/260 and 270. In response, Roman garrisons were stationed at strategic points, Celeia and Castra (modern Ajdovščina) [30 in Fig. 8.1] were given new fortification walls, and the local population occasionally sought refuge in elevated positions. Toward the end of the third century and in the fourth century, a system of barrier walls with watchtowers was constructed across poorly accessible areas, which later literary sources name the *Claustra Alpium Iuliarum*. The walls protected vital lines of communication and passages to Italy. The main road from Aquileia to Emona was protected with as many as three lines of barrier walls; the most extensive fortification complex was constructed across the road and the minor passages on the Hrušica Pass (858 m asl) and included the fort of Ad Pirum [29 in Fig. 8.1]. The barrier system played the most prominent role in the second half of the fourth century, when many civil wars took place in the conflict zone stretching from northeastern Italy to the Middle Danube Basin, and large imperial armies fought against each other on the territory of what is now Slovenia or its immediate vicinity. In fact, the *Claustra Alpium Iuliarum* hindered the power struggle during civil wars much more than the system blocked the progress of barbarian incursions. In 401, the Ostrogoths had no difficulty in passing through the territory, and they fought their way into Italy at the Timavo River. The large-scale constructions of barrier walls manned by large garrisons could not solve the military crisis and even less the political crisis that hit the Late Roman Empire.

The reforms of Diocletian and Constantine the Great brought some economic stability. There were renewed building activities in Roman towns, and crafts and commerce flourished. After religious freedom had been proclaimed in 313, the persecution of Christians came to an end, and foundations were laid for the development of Christian organizations and architecture. An early Christian center was constructed at Emona, on the site of former baths, in the second half of the fourth century, and in the second decade of the fifth century, a baptistery was added. Celeia witnessed large-scale renovations of its houses, streets, and fortification walls. In the early fifth century, a Christian basilica and a baptistery were constructed. Poetovio was the seat of a diocese already from the late third century onward. Clear signs of prosperity can even be felt in the countryside, with some of the countryside villas furnished with mosaics and frescoes.

Drastic changes and a general impoverishment came toward the end of the fourth century. Towns decreased in size. Life in Poetovio concentrated at the foot and on the slopes of Grajski grič and Panorama [4 in Fig. 8.1], while the more exposed parts of the town already lay in ruins. In Celeia, pieces of funerary and other stone monuments from the Roman town were reused in the construction of the Late Antique fortification walls. A thick layer of burnt debris covering the last of the buildings has been documented in Emona, which may be connected with the incursion of the Huns into Italy in 452.

From the mid-fifth century onward, there are no clear signs of life in towns and lowland settlements along the major roads. Part of the population probably migrated to better-protected areas of the empire (i.e., Istria and Italy), and others sought refuge on naturally protected elevations that received additional fortifications. The buildings in their interiors were largely built of stone, but were sometimes wooden with stone foundations.

Some settlements protected the major lines of communication and were inhabited by the local population and small garrisons. The post on the hill of Korinjski hrib [21 in Fig. 8.1] south of Grosuplje was defended by five towers, while its interior held a small early Christian church. Some of these hilltop settlements had a pronounced ecclesiastical function, with double churches. These were more modest in comparison with the churches known from cities, adapted to the terrain and less lavishly furnished. The floors are not covered in mosaics and stone furnishings are rare. Some churches have painted walls and glass window panes, which were an important element in experiencing the church interior. The settlements thus served ecclesiastical, military, and administrative functions and thereby assumed the role previously performed by towns.

Carnium (modern Kranj) [14 in Fig. 8.1] developed into the most important settlement in what is now Slovenia in the sixth century because of its naturally defended position overlooking the confluence of the Sava and Kokra rivers; this allowed it to exercise good control over the crossing of the Sava and access to the Upper Sava Valley. It was enclosed by a fortification wall, parts of which still survive on the western side of the fortress. Discovered at a building next the wall were two Byzantine lamellar armors and a Frankish lance (*ango*) dating to the second half of the sixth century. The armor is a rare find in Europe and bears witness to the great importance of Carnium in this period. Remains of an early Christian church with an octagonal baptistery added on the north side have survived under the current parish church. The cemetery associated with the fortress has been investigated on the slopes below, so far revealing around 700 burials of the indigenous population, the Ostrogoths and the Langobards.

The settlement on the hill of Tonovcov grad [36 in Fig. 8.1] near Kobarid represented the center of a wider area along the Soča and Nadiža rivers. It exerted control over a major communication from Italy to the region of Koroška and was manned by a garrison stationed there in the late fourth century and first half of the fifth century. In the sixth century, the settlement developed into an important ecclesiastical and administrative center. It was protected by steep slopes and a fortification wall where access was easier. Its interior had around 30 different buildings, including an early Christian complex comprising a double church and an added third church (Fig. 8.6). All three had a stone bench for the clergy at the east end. The presbyteries were raised above the naves via a stone step. The altar survived in the north and the central churches and in the north church also the pulpit (*ambo*). The churches had mortar floors and windows closed with glass panes.

Archaeologists also investigated a large residential building, which yielded rich finds and offered good insight into everyday life. The finds include many tools and pottery for daily use. The settlement was almost self-sufficient, but the recovered amphorae show that it had contacts all the way to the Mediterranean that supplied it with oil, wine, and other goods at least to the late sixth century.

Life in these fortified hilltop settlements ended roughly in the sixth century, but not everywhere at the same time. Some met a violent end even before the turn of the century, whereas others survived into the first few decades of the seventh century, after which they were gradually abandoned.

8.7 The Arrival of the Slavs

Andrej Pleterski

The Slavs first arrived in areas once forming part of the Roman Empire as early as the first third of the sixth century; these areas are now part of northeastern Slovenia in southwestern Pannonia (Pavlovič 2017). They were not numerous and did not leave behind much in the way of the archaeological record. They did not have an efficient military organization such as the Vandals, Huns, Langobards, and many others, although they were persevering and eager collaborators. Their society was not stratified according to wealth, but instead differentiated by individuals' personal skills and capabilities. Ancient authors from the sixth century perceived them from the point of view of the Mediterranean

Fig. 8.6 Presbyterial part of the double church constructed in the sixth century at Tonovcov grad [36 in Fig. 8.1], a hill overlooking the Soča Valley. (Photo by Slavko Ciglenečki, IA ZRC SAZU Archive)

civilization and its economic, social, ideological, and political differentiations. They were unable to understand who and what the Slavs were; for them, they were vermin threatening and attempting to devour them, God's punishment.

This civilizational discrepancy and incompatibility worked in the Slavs' favor. Whereas the various Germanic peoples that settled the territory of the Roman Empire largely became Romanized, and changed their way of life and even their languages, this did not befall the Slavs.

Their basic unit of territory, economy, politics, jurisdiction, and identity was called the *župa* (Pleterski 2013). These were social fractals joined together to form an adaptable and efficient network with great power of absorption. A *župa* could accept anyone as its equal member if the individual was willing to submit to its rules and to the law. The impoverished indigenous population, eventually renounced even by the Church as an organization, saw the seemingly egalitarian and autarchic society of the Slavs as at least a lesser evil, if not an option with numerous advantages; this was the beginning of the process of Slavization. It was a long process, with individual groups of Slavs only reaching Friuli and Istria in the early ninth century.

The Slavs called a group of *župas* a *kneževina*, that is, a principality. Some of these in the eastern Alps are known by name: Carantania (now central Carinthia, Austria), Liburnia (now upper Carinthia, Austria), and Carniola (now northwestern Slovenia). Such groupings were determined by the former logistical networks of Roman town territories. Permanent settlement accelerated the privatization of land, which in turn led to a differentiation in economic status. Individuals striving for power, authority, and wealth were no longer an exception. They quickly found the ideological base for realizing their ambitions in Christianity and the models for the way of life and political conduct in the Christian west. Rulers of various origins soon initiated a process of integration that eventually encompassed all of Europe. What remains unknown and hidden is the old life of a *župa*, which adapted to new conditions through mimicry and survived into the modern period.

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9 The History of Slovenia: The Middle Ages to the Present

Miha Kosi, Miha Preinfalk, and Petra Svoljšak

Abstract

The early Middle Ages was a decisive period in the history of Slovenia, defined by the settlement of the Slavs, which shaped the area's ethnic character. From the Middle Ages to the 1918 dissolution of the Habsburg Monarchy, this territory was administratively divided into the historical provinces of Carinthia, Carniola, Styria, and Gorizia, of which only Carniola had a majority Slovenian population. From the Middle Ages onward, Slovenian territory was traversed by important trade routes that ran between the Pannonian Basin and northern Italy and between Vienna via Graz and Maribor toward Trieste. In the sixteenth century, the Reformation laid the foundations for the development of the standard Slovenian language and Slovenian literature, and in the late sixteenth century, the Slovenian lands were marked by Ottoman incursions and the triumph of the Counter-Reformation. Under absolutism, the Theresian and Josephinian reforms aimed to unify the Habsburg lands, which led to the beginnings of the Slovenian national awakening. Around 1800, Slovenian territory was impacted by the Napoleonic Wars, and in 1809, the Illyrian Provinces were established, with Ljubljana as their capital. The pre-March period was when Slovenia's greatest poet, France Prešeren, was active. He wrote the poem "Zdravljica" (The Toast), which later became the Slovenian national anthem. In 1848, the Slovenian political program United Slovenia (*Zedinjena Slovenija*) was drafted, calling for the unification of all Slovenians into one political entity and equal use of Slovenian in public. Around 1900, clashes between Slovenians and ethnic Germans and the political division of Slovenians into clerical and liberal factions grew stronger. During the First World War, the Isonzo Front between Italy and Austria-Hungary cut through Slovenian ethnic territory. The end of the war saw the dissolution of the monarchy; the establishment of the State of the Slovenes, Croats, and Serbs on October 29, 1918; and its merger with the kingdoms of Serbia and Montenegro into the Kingdom of the Serbs, Croats, and Slovenes (Yugoslavia) under the Karadjordjević dynasty on December 1, 1918. After the borders had been set, Slovenians were divided among four countries. During the Second World War, Slovenian territory was divided among four Axis powers, and the Slovenian people were affected by ethnocide, the resistance movement, collaboration, and fratricidal war. The resistance movement became part of the anti-Hitler coalition and came out of the war as the victor in Slovenia. After the Second World War, the border was settled at the Paris Peace Conference. The new authorities led by the Communist Party established a Yugoslav communist regime. In 1990, the first democratic multiparty elections and a referendum were held in Slovenia, leading to Slovenia's independence in June 1991.

Keywords

Middle Ages · Early modern period · Late modern period · Carniola · Styria · Carinthia

9.1 Slovenia During the Middle Ages

The early Middle Ages (from the end of the sixth century onward) was a decisive period in Slovenian history that shaped the area's predominant ethnic character: the settlement of the Slavs. This period coincided with the settlement of nomadic Avars in Pannonia after the Lombards relocated to Italy (in AD 568). The Avars controlled the territory extending to the borders of Italy and Bavaria, politically subjugating the local population. During the seventh century, a border area was thus created, separating the Frankish–

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© Springer Nature Switzerland AG 2020
D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_9

Lombard controlled west from the Slavic–Avar east and southeast. The linguistic and ethnic border established at that time has remained almost the same until today. The original Slavic settlement of the wooded and hilly territory was sparse and uneven, and denser in central Carinthia (now part of Austria) and in Carniola. The Slavs settled the territory where Roman rule and culture had already died out, but they were able to adopt elements of Classical Antiquity (toponyms and hydronyms, and means of livelihood) from the remnants of the Romanized population (the Vlachs). However, the territorial structure typical of Antiquity changed significantly: the towns—the previous political, cultural, church, and economic centers of regions—disappeared and with them the ecclesiastical organization (except in the Roman towns in Istria). Christianization and the rudiments of a new ecclesiastical structure can only be observed as late as the eighth century and especially in the ninth century (Štih et al. 2008; Štih 2010).

A Slavic principality called Carantania took shape in Carinthia, independent of the Bavarians, Franks, and Lombards to the west and the Avars to the east. This was the oldest early medieval political entity in the Eastern Alps (Fig. 9.1). Even though it was multiethnic, it was predominantly Slavic in terms of the language used by the authorities (the elite), the judiciary, and other distinctive elements. The Carantanians were a Slavic people (*gens Sclavorum*) and were also regarded as Slavs (*Sclavi*) by contemporary writers. Around 740, the threat of Avar incursions made them politically unite with and subjugate themselves to the Bavarians, and thus indirectly to the Frankish king. With the arrival of Irish monks to the area in the mid-eighth century, Christianization began, especially at the initiative of the Diocese of Salzburg (which soon afterward became an archdiocese) and to a lesser extent the Patriarchate of Aquileia, which resulted in three unsuccessful uprisings by the pagan opposition (the last one taking place

Fig. 9.1 Political situation in the seventh and eighth centuries (Bajt, Vidic (eds) 2011)

in 722). Up until 828, the administration of the dependent principality under Frankish rule consisted mainly of local princes, after which they were replaced by Frankish counts. The introduction of an administration run by counts brought an end to the independent Carantanian principality and led to its final integration into the Frankish state. Carantanian tribal law was replaced by Bavarian–Frankish law, but the unique Slavic ritual of enthroning princes (later Carinthian dukes) remained in place well into the fifteenth century. The Bavarians that settled in Carantania (missionaries and landowners) also assumed power (Kahl 2002; Štih et al. 2008; Štih 2010).

Carantania did not include the Slavic-inhabited territory south of the Karawank Mountains, where the hegemony of the Pannonian Avars prevailed in the seventh and eighth centuries and extended all the way to the frontier of Lombard Italy. This part of what is now Slovenia was referred to as *Carniola* in the early Middle Ages (Fig. 9.1). The Lombard writer Paul the Deacon treated it as a Slavic land (*Carniola Sclavorum patria*) at the end of the eighth century, and he referred to its inhabitants, who were once again subjugated by the Frankish forces in 820, as "Carniolans, who live along the Sava River" (*Carniolenses, qui circa Savum fluvium habitant*). They formed an independent Slavic principality with Kranj (*Carnium*, *Chreina*, *Krainburg*) as its administrative center, which bordered Lombard/Frankish Friuli to the west (the eastern border was unclear). During the wars that Charlemagne waged against the Avars in 795 and 796, Carniola came under Frankish rule, and with the introduction of counts in 828, the tribal principality was dissolved once and for all. Through this, Carniolan political and ethnic identity disappeared, but the name *Carniola* remained. Through a reform in 828, all of the territory conquered in the Avar wars (including Carantania and Carniola) was incorporated into the Frankish Empire (after 843 the Kingdom of the East Franks). Thus, the majority of Slovenian territory became politically and administratively permanently tied to the north (until 1918), but the border with Italy continued to run across the Karst Plateau passes. After the Hungarian incursions, Carniola was attested as a border march of the Holy Roman Empire for the first time in a 976 charter of Emperor Otto II. This was also the period of the first intense process of feudalization and formation of feudal estates (Štih et al. 2008; Štih 2010).

Up until its conquest by the Franks in 788, Istria was a Byzantine province, where the Roman population and the traditions and institutions of Classical Antiquity (towns with dioceses) had been preserved, which was in significant contrast with inland Slovenian territory. Frankish rule introduced major changes, including the settlement of pagan Slavs. Following Charlemagne's decree of 804, the region retained its traditional autonomy and the political power of its towns and fortified settlements (*castella*), which remained in place throughout the Frankish period and even later on. In terms of ecclesiastical organization, from 827 onward, the Istrian dioceses and the majority of what is now Slovenia belonged to the Patriarchate of Aquileia (until 1751). During the Frankish period, the first economic contacts were established with Venice, which started to gain influence in Istria. Koper (Lat. *Caput Histriae*) had already become the most important Istrian town during this time. The region belonged to Italy throughout the Early Middle Ages, and it was only in the eleventh century that it began to be counted under the German part of the empire as a border march (Štih et al. 2008; Štih 2010).

After the Frankish wars against the Avars, the eastern territory of what is now Slovenia belonged to Lower Pannonia during the ninth century. From approximately 840 to 874, the region was ruled by Frankish vassals, Prince Pribina and his son Koceľ. Its center was in *Mosapurc* (now Zalavár, Hungary) near Lake Balaton and the ethnic mix of Slavic colonists from Pannonia and Carantania, Bavarians, and other peoples had a predominantly Slavic character (Koceľ held the title of *comes de Sclauis* "count of the Slavs"). In the west, the region also included the town of Ptuj (*Pettovio*), which was located next to a bridge across the Drava River and was considered the most important Slovenian early urban settlement of that time. Between 867 and 874, the Byzantine missionaries Constantine and Methodius were active in Lower Pannonia together with their pupils, introducing Slavic liturgy (they also devised the Glagolitic alphabet). However, after the fall of Koceľ in 874, the Frankish Church (the Archdiocese of Salzburg) soon prevailed. The economic and cultural achievements in Pannonia were soon destroyed by the Frankish–Moravian War and, after 894, also by Hungarian raids. After the devastating defeat of the Bavarian forces at Bratislava in 907, the Frankish rule in the southeast finally collapsed. For the next half century, the territory of what is now Slovenia turned into a transit zone for Hungarian invasions of Italy. Their incursions only ended with a defeat in the Battle of Lechfeld in 955 against king Otto I, which allowed Slovenian territory to be gradually incorporated into the new Holy Roman Empire (Štih et al. 2008).

The peaceful period that followed the Hungarian incursions also made it possible for the southeastern part of the emerging empire that developed from the Kingdom of the East Franks to develop further and adopt new organizational forms. The large, strategically important territory with communications toward Italy and across Alpine passes toward Germany came under the rule of the Bavarian duke in 952, and then in 976, it was divided: Emperor Otto II formed a new duchy of Carinthia separate from Bavaria, surrounded by a series of marches, extending from the Semmering Pass to Verona in the west. Marches are mentioned in the sources for the first time during the tenth century: the Eastern March (i.e., Austria, which was part of Bavaria), the Carantanian

March (the core of later Styria), *Saunia* in the Savinja Valley (with its center in Celje), Carniola in what is now central Slovenia, Istria, Friuli, and the March of Verona.

The establishment of a firm political organization made possible the introduction of a feudal economic and social system following the western European model. Granting royal land to wealthy church and secular individuals led to the formation of feudal estates in the tenth and eleventh centuries as the basic economic–organizational and judicial–administrative units. Intensive colonization took place in parallel, expanding the borders of settlement and creating a new cultural landscape. The centers of feudal estates (i.e., castles) with their appertaining settlements became the "central places" of administration, the judiciary, ecclesiastical organization, and the economy; many developed into medieval towns. The earliest recipients of large land grants were the dioceses of Salzburg, Freising, Brixen, Bamberg, Aquileia, and Gurk. The development potentials of the empire's periphery also attracted some high-ranking nobility to the southeast, settling down in the area and playing a major role there (e.g., the Weimar–Orlamünde family from Thuringia, Eppenstein, and Spanheim families from Franconia, the Heunburg family from Saxony, and the Andechs, Bogen, and Otakar families, and later counts of Görz (modern Gorizia) from Bavaria (Štih 1996, 2010; Kos 2006; Štih et al. 2008)).

The king's authority was initially represented by dukes and margraves, appointed by the ruler, who governed the Duchy of Carinthia and its accompanying marches. These administrative units formed the basis for the gradual formation of the territories (Germ. *Land*) that politically defined the Slovenian area up until 1918 (i.e., Carinthia, Carniola, Styria, Görz and Istria). From the High Middle Ages onward, these territories assumed increasingly more autonomous role within the empire. By the Peace of Westphalia in 1648, and under the rule of the Habsburg dynasty, they became a virtually independent state (Štih et al. 2008).

The credit for the early formation of Styria goes to the Otakar (or Traungau) dynasty, which was granted the function of margraves along the middle course of the Mura River (*marcha Karentana*) around 1050. Based on their family estates north of the Alps, at Steyr, they referred to themselves as "Styrian" margraves (*marchio Stirensis*). Through rich inheritance, they also obtained large estates south of the Alpine ridges, which finally extended from the Danube in the north down to the Savinja and Sava in what is now Slovenia in the south. They effectively combined the vast territory and a series of rights to secure the position of territorial princes as early as 1160 or thereabout. A new provincial center with a court and a noble judicial body was established in Graz. These developments reached their peak in 1180, when Emperor Frederick I Barbarossa elevated the march to the Duchy of Styria (*ducatus Stirie*). Otakar IV, the last in the line, died childless and in 1192 the territory of Styria was inherited by the Austrian dukes of Babenberg (1192–1246) (Štih et al. 2008).

Carinthia formally became a duchy two centuries before Styria (in 976), but its development into a unified territory was slower. The main reason was the distinct ownership fragmentation of the region: extensive stretches of land belonged to the Church (the dioceses of Salzburg, Bamberg, and Gurk, as well as various monasteries) and the strong regional nobility (the counts of Görz, Ortenburg, and Heunburg). Good bases for later development were only created under the Eppensteins, the first major ducal dynasty on the Carinthian throne (1077–1122), and their successors, the Spanheims (1122–1269). Systematic consolidation of ducal authority can be observed especially under Duke Bernhard of Spanheim (1202–1256), who was the first to refer to himself as a territorial prince (*princeps terre*), but the Spanheims never succeeded in taking control of the entire territory of the old Duchy of Carinthia. After their extinction in 1269, for a short while (until 1276), dukedom was assumed by their cousin Ottokar II of Bohemia (a member of the Přemyslid dynasty), who occupied Carinthia and Carniola in 1270. Ottokar lost his life in the 1278 war against German King Rudolph I of Habsburg, who introduced a new dynasty to the Eastern Alps. The Habsburgs only assumed direct power in Carinthia (and Carniola) in 1335, but for a long time, they were unable to unite the politically fragmented land. With the 1436 elevation of the counts of Cilli (now Celje) to princes, it even appeared that the land would break apart completely. A major turn of development only happened in the second half of the fifteenth century, after the 1456 extinction of the counts of Cilli. In 1460 the Habsburgs came out of the struggle for their inheritance as the victors, and in 1500, after the death of the last count of Görz, they were able to unite most of Carinthia under their rule (Štih et al. 2008).

The development of the central Slovenian territory of Carniola also concluded late. After several powerful eleventh-century margraves, in 1077 this function was assumed by the Patriarchate of Aquileia, which was, however, too weak to establish effective territorial authority. Carniola was fragmented into more than ten large estates owned by the Church (the dioceses of Aquileia, Freising, Brixen, and Gurk) and noble families (the Andechs, Spanheims, Weichselbergs, Ortenburgs, Heunburgs, Bogens, Auerspergs (Fig. 9.6), and Scharfenbergs). By the early thirteenth century, the strongest position was secured by the Bavarian counts of Andechs, one of the most prominent noble families in the empire at that time. After the death of Henry of Andechs, margrave of Istria, in 1230 their possessions in Carniola were assumed by Frederick II, Duke of Austria and Styria from the House of Babenberg, who was the first to call himself the "lord of Carniola" (*dominus Carniolae*). His death in 1246 triggered a years-long struggle for Babenberg

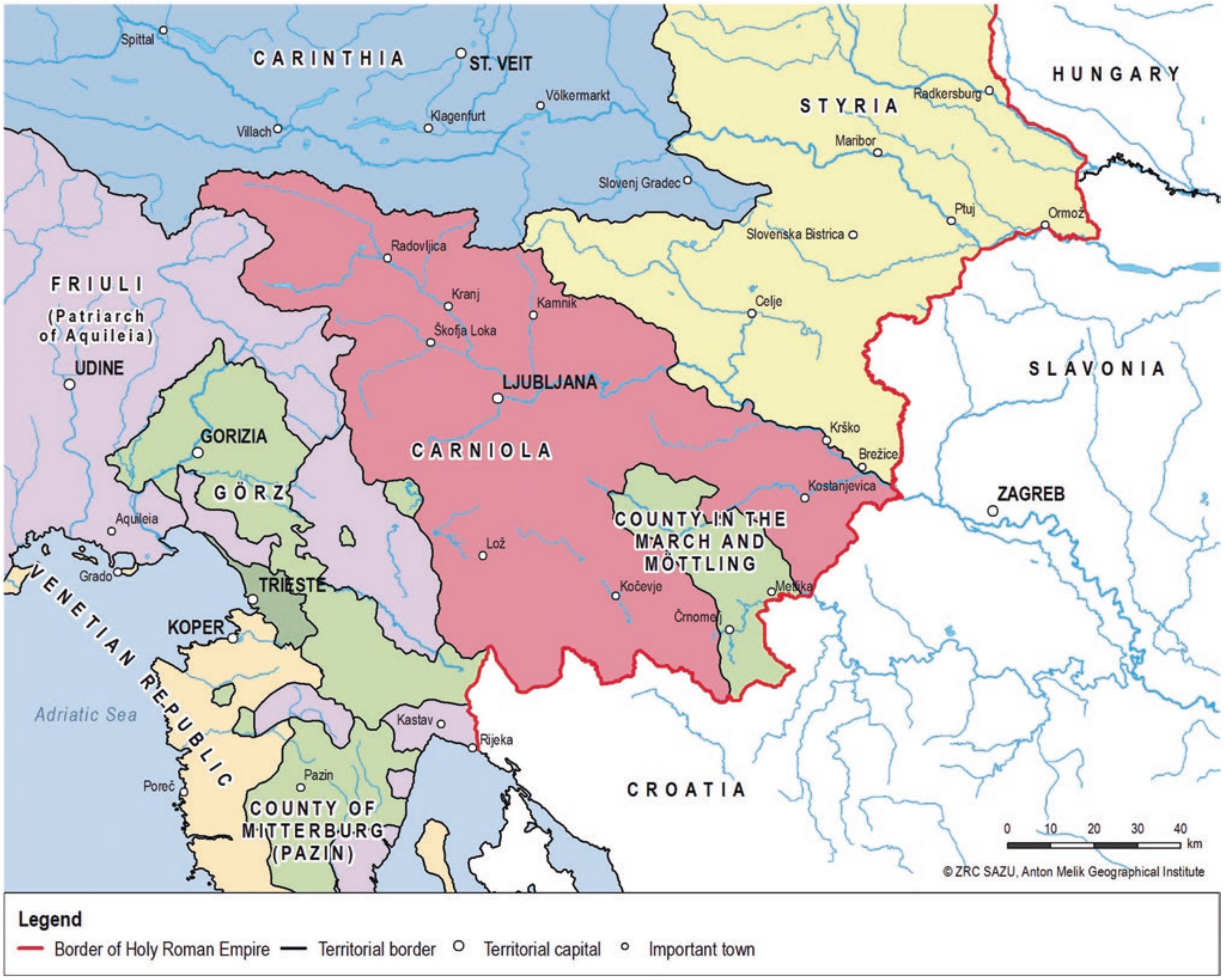

Fig. 9.2 Territories in the southeastern Holy Roman Empire in the mid-fourteenth century (Bajt and Vidic (eds) 2011)

inheritance in the Eastern Alps, in which Ulrich III of Spanheim, Duke of Carinthia (1256–1269), was the most successful in Carniola. He effectively established himself as the territorial prince and succeeded in uniting all of Carniola under his rule. After his death in 1269, his achievements were reaped by his cousin Ottokar II of Bohemia and, after his 1278 defeat, by the Habsburgs. By defeating Ottokar, King Rudolph I of Habsburg opened the path into the Eastern Alps for his dynasty. However, in 1277, he pledged Carniola to his allies, the counts of Görz-Tyrol (and also granted them Carinthia as a fief in 1286), and it was only in 1335 that the Habsburgs assumed direct power over these lands as well. In 1338 they granted a privilege (*Landhandfeste*, the basic "constitutional" document) to the nobility of the territory of Carniola (*lande ze Chrayn*). Ljubljana (Germ. *Laibach*), which had already experienced urban development by the early thirteenth century, became the territorial capital. The area controlled by the counts of Görz in southern Carniola (the "County in the March and Möttling") became an independent territory in the fourteenth century (Fig. 9.2). Although inherited by the Habsburgs in 1374, it retained its independence well into the sixteenth century, when it was formally incorporated into Carniola. In parallel with their successes in Carniola, the Habsburgs also advanced toward the Adriatic, finally gaining Trieste in 1382; in addition to Fiume (modern Rijeka), Trieste was the only port in the northern Adriatic that avoided the expansion of the Republic of Venice. As early as the late thirteenth century, Venice managed to conquer Koper (1279), Izola (1280), and Piran (1283) and to occupy all of western Istria and its coastal towns. After successfully expanding to its mainland domains in the Veneto region (*Terra ferma*), Venice also occupied Friuli in 1420. Through this, in the west, the territory of the Republic of Venice expanded far into what is now Slovenia (Bovec, Tolmin, and Idrija with its mercury mine) (Štih 1996; Štih et al. 2008).

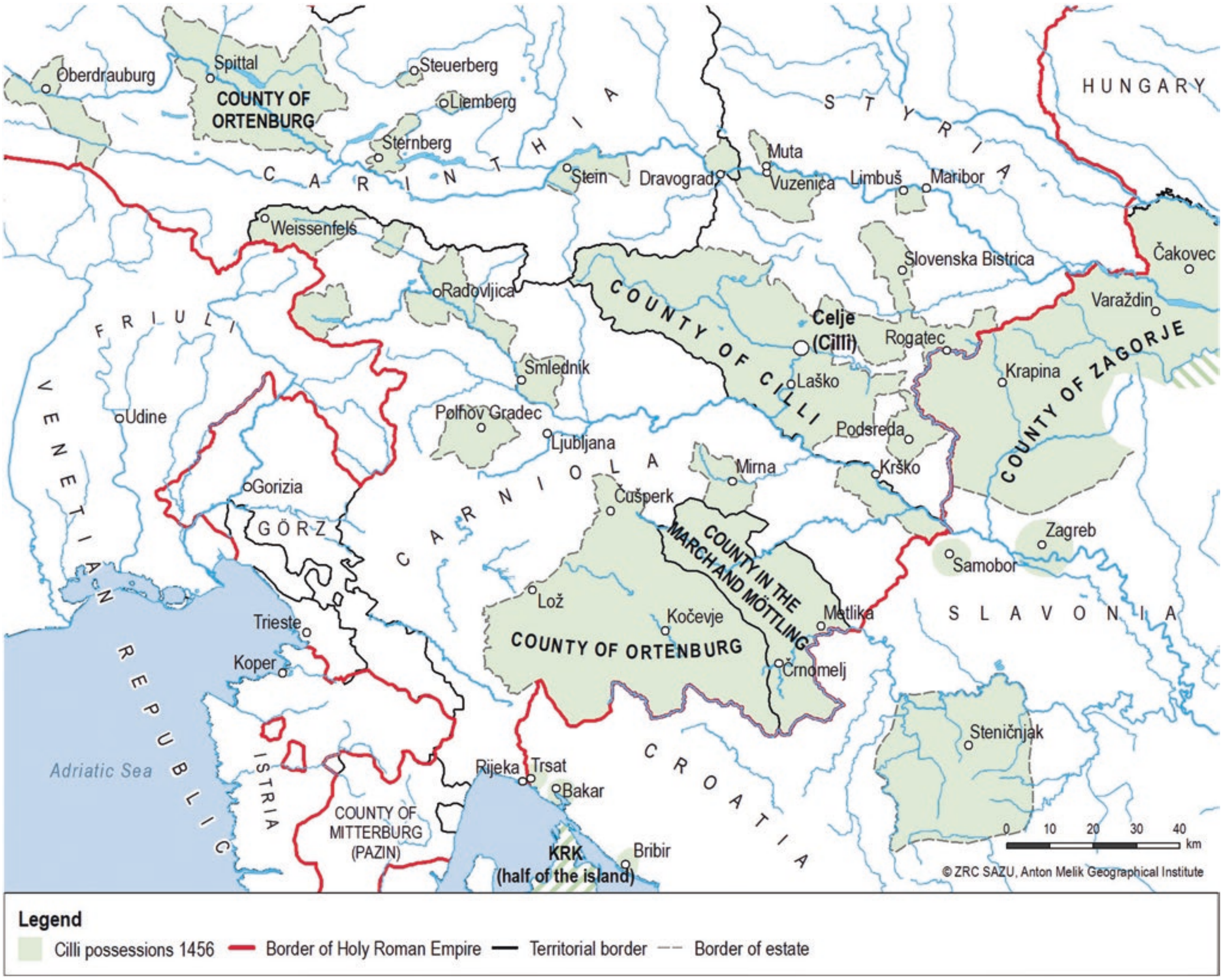

Fig. 9.3 Possessions of the counts of Cilli in 1456 (Bajt and Vidic (eds) 2011)

In the early fifteenth century, the consolidation of Habsburg power in the southeast of the empire was threatened by the counts of Cilli (Fig. 9.3), the most important medieval noble family to originate in the territory of what is now Slovenia. Their meteoric political rise was facilitated by their close family ties with the House of Luxembourg: from 1405 onward, Barbara of Cilli was married to Sigismund of Luxembourg, King of Germany, Bohemia, and Hungary and Holy Roman Emperor from 1433 onward, who in 1436 elevated the counts of Cilli to imperial princes and all of their estates in Styria, Carniola, and Carinthia to a principality. In this way, a new independent territory began to take shape and was well on its way to breaking free of the Habsburg orbit in the Eastern Alps. Between 1437 and 1443, a major conflict ensued with the Habsburgs, which left the counts of Cilli defeated. Their attempt to form their own territory was subdued, and their estates remained part of the Habsburg provinces. After the 1456 extinction of the counts of Cilli and the successful struggle for their inheritance (which lasted until 1460), the Habsburgs consolidated their dominion in Carniola: its unity was achieved, and in 1461 a diocese was also established in Ljubljana. Between 1466 and 1472, these successes were complemented by the acquisition of the vast Walsee estates in the Karst area and in the Kvarner Gulf, including the port of Fiume (now Rijeka), and in 1500 by the inheritance of territories from the extinct counts of Görz, which also gave them the already united county of Görz (the 1500 death of Leonhard, the last count of Görz, also symbolically marks the end of the Middle Ages and the beginning of the modern era on Slovenian territory). The Austrian territories now directly bordered the Republic of Venice to the west, and the struggle to control the hinterland of the northern Adriatic was inevitable. In 1508 the first Habsburg–Venetian war broke out. It ended with a Habsburg victory, and the western border was thus settled for several centuries (until 1797). The only parts of what is now Slovenia that were not part of the Habsburg hereditary territories were Prekmurje in the extreme northeast and the coastal belt in the extreme southwest (Fig. 9.5). Prekmurje was part of the Kingdom of Hungary and did actually come under Habsburg rule in 1526, after the Hungarian and Bohemian crowns passed to the House of Habsburg based on a contract of inheritance following the death of Louis II of Hungary. The Littoral only became part of the Austrian Empire after the 1797 downfall of the Republic of Venice (Štih et al. 2008; Štih 2010).

In many aspects, the Middle Ages shaped the region and its economic and social structure, which lasted for centuries. Agrarian colonization reached its peak between the tenth and thirteenth centuries. All flatland areas were deforested and settled, and between the thirteenth and fifteenth centuries, it also expanded to hills up to 1200 m in elevation. The colonists largely originated from the local native population, and their ethnolinguistic structure did not change significantly (Štih et al. 2008). The main exception was the mid-fourteenth-century colonization of the Kočevje (Germ. *Gottschee*) region, when the largest German language island was created in what is now Slovenia (with more than 170 settlements) and was preserved until the Second World War (with a Gottschee German population). Castle construction intensified in the twelfth century (there are more than 200 medieval ruins). Castles became the centers of the feudal estates, administration, and judiciary. The earliest ones with a central role in the wider region (early urban settlements were tied to them from as early as the twelfth century onward) were found in Ljubljana (*Laibach*), Kranj (*Krainburg*), Kamnik (*Stein*), Škofja Loka (*Bischoflack*), Gorizia (*Görz*), Celje (*Cilli*), Ptuj (*Pettau*), Maribor (*Marburg*), and Slovenj Gradec (*Windischgraz*). In what is now mainland Slovenia, urban settlements were built on different bases than in the Littoral and Istria. Many had predecessors in the "central places" of the early Middle Ages and began to be more intensively developed in the twelfth century during the revival of the monetary economy. During the thirteenth century, all major towns also developed in the legal sense, with autonomy and communal arrangements. By the end of the thirteenth century, the division into cities (*civitas*, *Stadt)* and the usually smaller and generally unfortified market towns (*forum*, *oppidum*, *Markt*) was firmly established. By the fifteenth century, the urban network comprised 26 cities and around 60 market towns. This also included the cities in Istria, which were significantly older and had been settled continuously since Antiquity. There communal forms of urban life developed significantly earlier than in the interior and major cities (*civitates*) also served as the seats of dioceses (e.g., Koper and Trieste).

It was especially merchants that moved into Slovenian cities from other (German and Italian) cities, but a considerable portion of the population also came from the surrounding Slovenian countryside. The Jews also formed an economically important group; they settled down in all major cities and some market towns from the thirteenth century onward (the largest Jewish community lived in Maribor). They were banished from Carinthia and Styria in 1496 and from Carniola in 1515 (Kosi 2009, 2014; Štih et al. 2008).

The rise of cities was closely connected with transit trade and only to a smaller extent also to craft production (for the local market). Slovenian territory was traversed by a major European trade route that connected the Pannonian Basin (Hungary) with northern Italy (Venice). It ran through Ptuj, Celje, Kamnik, Ljubljana, and Gorizia (or Trieste) towards the west. After the fourteenth- and fifteenth-century consolidation of Habsburg rule, this route was joined by another one, running from Vienna via Graz and Maribor toward Trieste. The main goods traded long distance were Hungarian ox-hides and herds of oxen that were sold in Italy and cloth, silk, and other fabrics, herbs and spices, citrus and other fruits, glass, and paper, which were traded in the opposite direction toward the east. Residents of all major cities, especially Ljubljana and Ptuj, participated as middlemen in this trade. Since the end of the fourteenth century, Ljubljana merchants had traded all the way to Vienna, Venice, and even Nuremberg and Frankfurt. In terms of scale and significance, middle-distance trade was more important for the majority of smaller cities and market towns, especially trade between the coast and the interior, in which the local rural population was heavily involved with packhorse transport. The main goods that were traded included sea salt, wine, and olive oil in one direction and wheat (for the towns in the Littoral), Upper Carniolan and Carinthian iron and iron products, timber, linen, hides, fur, wax, honey, and so on in the other. In the eastern part of Slovenian territory, a similar role was played by trade in Lower Styrian wine, which traveled from Ptuj, Maribor, and Radkersburg to Carinthia and Upper Styria. Alpine (rock) salt from Aussee and Hallein, iron, and iron products were the main goods traded in the other direction (Kosi 1998).

By 1500, the Habsburgs had consolidated their dominance over the Slovenian area, but the second half of the fifteenth century was very turbulent for these territories. After the 1463 fall of Bosnia, the Ottoman border was now only about 100 km from Carniola, and the period from 1469 to 1483 was the time of the most devastating Ottoman incursions. This overlapped with the rebellion of Styrian nobility instigated by Andreas Baumkircher (1469–1470), the wars between Emperor Frederick III and Hungarian King Matthias Corvinus (1477–1490), and the first major peasant uprising (taking place in Carinthia in 1478). The largest Ottoman campaigns affected Carniola, Carinthia, and Styria (in 1473, 1476, 1478, 1480, and 1483), and occasionally the Görz region, the Karst area, Friuli, Istria, and even Upper Styria (1480) as well. The 1483 truce between Matthias Corvinus and the Ottomans brought 8 years of peace, which was followed by new but less devastating raids (in 1491–1499, 1511, and 1516). The territorial prince and estates did not react effectively to the Ottoman threat. Defense was limited to fortifying the towns, leaving the countryside to suffer the most; according to the estimates of the Carniolan, Carinthian, and Styrian provincial estates, up to 200,000 people had been taken captive by 1508. The subjects tried to protect themselves by setting up rural fortifications or strongholds, especially around churches (around 350 have been identified in Slovenian ethnic territory). Ottoman incursions caused migrations of people from Croatia and Bosnia (called the Uskoks, Prebegi, Vlachs, and so on), who, especially during the sixteenth century, settled down in the border areas (the Žumberak Hills and White Carniola), the Karst area, and some parts of Styria (the Drava and Mura basins). Their descendants still live in Slovenia today (Štih et al. 2008).

After Suleiman the Magnificent came to power in 1520, the Ottomans intensified their expansionist campaigns, which were accompanied by practically daily incursions of Ottoman light cavalry and smaller troops (Fig. 9.4) into White Carniola, the Karst area, and Istria. In 1529 they even broke through to Vienna via Styria and besieged it for several weeks, albeit unsuccessfully. From the second half of the sixteenth century onward, incursions into Slovenian territory became rarer, with the last incursion into Carniola recorded in 1559. This most likely resulted from better organization of defense, which, among other things, was also evident in the formation of the Military Frontier, a defense system in Croatia that successfully halted the penetration of the Ottoman Empire into the countries to the north and west. The formation of the Military Frontier also stimulated closer connections between Croatian territory and the lands of Inner Austria, which led to the top command positions in the Military Frontier being held by nobleman from Carniola and Styria. One of the most famous battles with the Ottomans took place in June 1593 at Sisak. The Christian army led by commanders from Inner Austria defeated the Ottoman forces led by Telli Hasan Pasha. The victory resonated strongly across Europe, dispelling the myth of the invincibility of the Ottoman army. From the second half of the sixteenth century onward, Prekmurje was the region most exposed to Ottoman incursions. The local population experienced especially great pressure during the second Ottoman siege of Vienna in 1683, when the Ottomans invaded Gornja Lendava (now Grad) and Dolnja Lendava (now Lendava). After 1684, in the Great Turkish War, when the imperial forces achieved great successes in the Balkans under Eugene of Savoy and the Ottoman dominion receded toward the east, Prekmurje too was finally rid of the Ottoman pressure. The 250-year period of Ottoman incursions into Slovenian territory came to an end (Fig. 9.5).

Fig. 9.4 Battle with the Turks (Valvasor 1689)

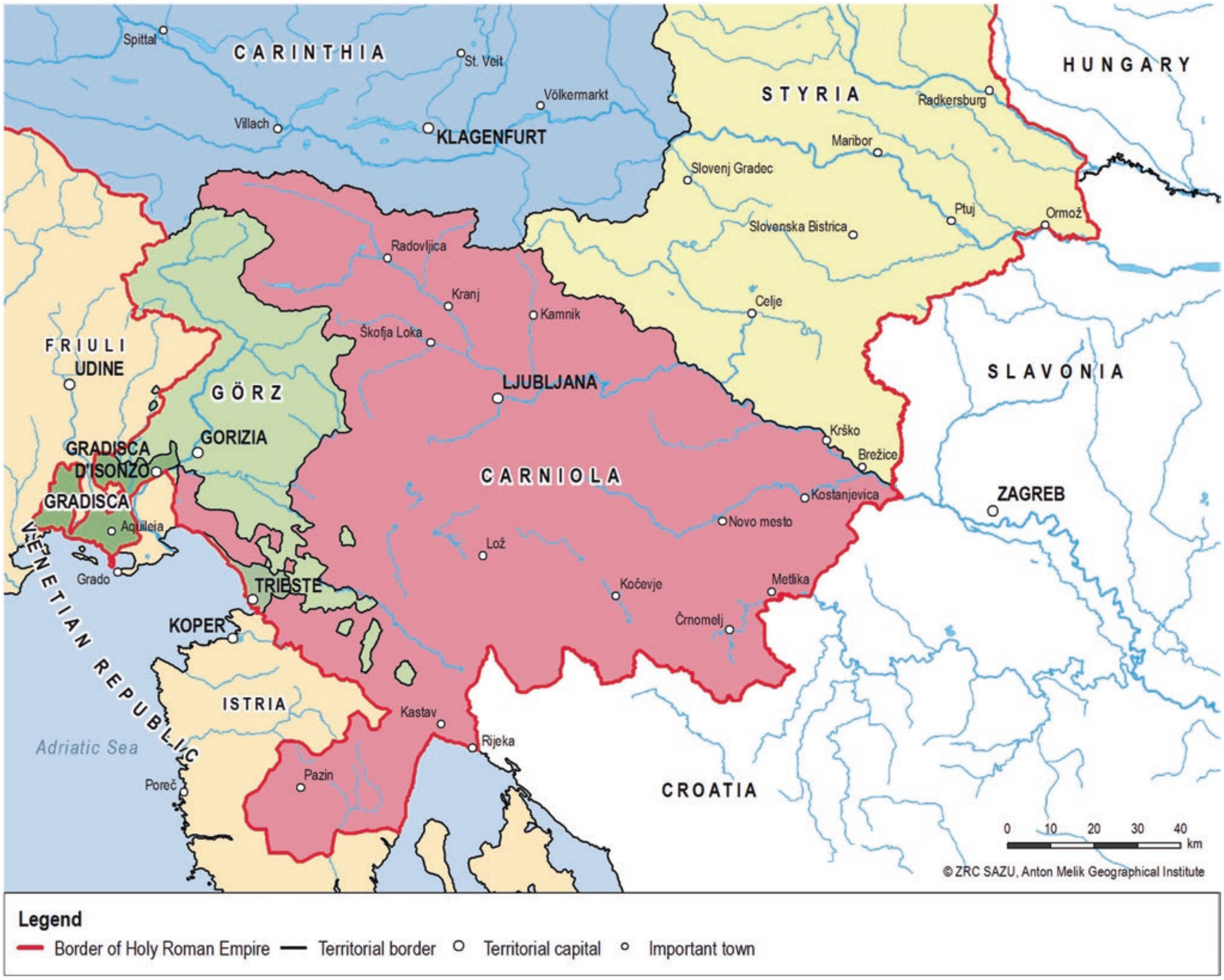

Fig. 9.5 Territories in the southeastern Holy Roman Empire from the sixteenth to eighteenth century (Bajt and Vidic (eds) 2011)

9.2 From the Reformation to the First World War

The Reformation is considered one of the watersheds of Slovenian history because the foundations for the standard Slovenian language and Slovenian literature were laid during that period. The year 1550 saw the publication of the first two Slovenian books, the primer *Abecedarium* and *Catechismus* (Catechism). They were written by the leading Slovenian reformer Primož Trubar (1508–1576). The first Slovenian translation of the Bible was also made during this period (in 1584 by Jurij Dalmatin). Overall, the Reformation was characterized by intense production of primarily religious books, facilitated by Janez Mandelc's press in Ljubljana. The reformers also promoted the development of Slovenian-language education because they believed that primary education in the vernacular was the foundation for direct familiarization with God's word (Štih et al. 2008) (Fig. 9.6).

The Ottoman incursions and changes in the Habsburg court at the end of the sixteenth century led to the weakening of the Reformation and the emergence and final victory of the Counter-Reformation. The sovereign prince and later emperor Ferdinand II enforced the principles of the Peace of Augsburg without reservation, achieving the banishment of wealthy Protestant townspeople and Protestant nobility after that. According to his order of 1628, the Protestant nobility was forced to re-Catholicize or move out of the Habsburg lands. This caused great social changes: new noble families replaced the old ones, originating from either the local urban and even rural environment or abroad (especially northern Italy). At the same time, the Counter-Reformation almost completely halted Slovenian book production; standard Slovenian was pushed into the background and German gained increasing importance.

Slovenia's early modern period was also marked by a series of large-scale peasant uprisings, which spread across

Fig. 9.6 Turjak (Auersperg) Castle (Preinfalk 2006), one of the oldest and best-known castles in Slovenia. (Photo by Barbara Žabota)

parts or all of Slovenian territory. Major uprisings included one in Carinthia in 1478, two pan-Slovenian uprisings in 1515 and 1638, a Croatian–Slovenian one in 1573, and the Tolmin uprising of 1713. The most frequent reasons for the unrest were excessive burdens imposed on peasants, introduction of new taxes, limited rural trade, change in currency, and feudal autocracy. One after the other, the uprisings were suppressed by the troops of the nobility or the army from the Military Frontier. Peasant uprisings caused great upset in Slovenian society until 1848, when feudalism was abolished as a result of the March Revolution and peasants became the owners of the land they cultivated. In later Slovenian history, the uprisings also played a great symbolic role because they represented a foundation on which the awareness of the modern Slovenian nation (the Slovenian peasant versus the German feudal lord) was shaped (Štih et al. 2008).

In the second half of the seventeenth century, Slovenian territory was influenced by Italian art and culture. Italian started being widely used by the upper classes, Italian artists introduced Baroque art (e.g., the sculptor Francesco Robba), and Italian theater and opera performances were very popular. This cultural flourishing (Fig. 9.7) was also followed by provincial historians—for example, Bauzer (a.k.a. Baučer), Schönleben, and Valvasor—who studied the history of individual lands and sought their roots deep in Classical Antiquity. These efforts reached their peak with the establishment of several academies following the Italian

Fig. 9.7 Saint James' Church and the College of the Society of Jesus in Ljubljana. (Valvasor 1689)

model, the most active among which were the Academia Operosorum (1693) and the Academia Philharmonicorum Labacensis (1701). At the same time, superstition spread among all classes, manifesting itself in witch trials, which were especially common in Styria (Štih et al. 2008).

In terms of politics, from the seventeenth century onward, the absolutist tendencies of the Habsburg emperors and territorial princes resulted in a smaller role of the provincial estates, with the absolutist state increasingly interfering in the economy, raising taxes, and imposing new ones. With regard to trade (in mercury, wax, honey, tobacco, and sea salt), it created monopolies and leased them especially to wealthy entrepreneurs from northern Italy. These were primarily involved in wholesale trade, but they also became important in iron production, and later they also expanded their activity to include other manufacturing industries (woolen cloth and silk production). The development of trade in what is now Slovenia was also closely tied to the territories in the Balkans and Hungary that, thanks to Eugene of Savoy, the Habsburg Monarchy won in the war against the Ottoman Empire. In 1717, Emperor Charles VI declared freedom of navigation in the Adriatic, in line with the mercantilist policy, and he declared Trieste and Fiume (now Rijeka) free ports 2 years after that, which had a positive impact on economic development in the interior (Štih et al. 2008).

During the eighteenth century, as part of the Habsburg Monarchy, the Slovenian lands were affected by the Habsburg power struggles caused by the lack of male successors within the Habsburg dynasty. In 1713, Emperor Charles VI issued the Pragmatic Sanction, also allowing his female descendants to assume power over the Habsburg hereditary lands. Hence, after his death in 1740, his eldest daughter Maria Theresa took control of these lands, but she had to secure her power by dint of arms because her rivals started the War of the Austrian Succession, which lasted for 7 years. After winning the war, which ended with minimal territorial changes, Maria Theresa began implementing large-scale structural reforms in her lands to strengthen them inwardly and outwardly. These reforms were financial (reducing the role of the provincial estates, the Theresian cadaster), administrative (establishing provincial governments, introducing provincial administration buildings), military (the draft system, population censuses), judicial (provincial courts, the Theresian code), educational (compulsory primary school), and church-related (dissolving the Patriarchate of Aquileia). The reforms were continued by her son and heir to the throne, Joseph II, who was even more radical (he reorganized the parishes and dissolved monasteries and convents, abolished bond service, and introduced the patent of tolerance), which caused a great deal of general disapproval and resistance. Consequently, a reaction ensued after his death in 1790, especially among the nobility, which is why his successor and brother Leopold II had to reverse many of the reforms.

The Theresian–Josephinian reforms strove for homogenization of the Habsburg lands, including at the level of language. On the one hand, this caused resistance and fear of complete Germanization among the Slovenian population, and on the other, it stimulated the beginnings of the Slovenian national awakening. At first, this awakening was primarily cultural, striving for a better status of Slovenian in society. Hence, in 1768, *Kraynska gramatika* (Slovenian Grammar), written by the Discalced Augustinian Marko Pohlin, was published, and the first Slovenian almanac of poems, titled *Pisanice* (Little Writings), started being issued under the editorship of Feliks Anton Dev (also known in Slovenian as Janez Damascen Dev). However, the strongest traces in this area were left behind by the Zois circle, a group of Slovenian intellectuals gathered around Enlightenment-era Baron Sigismund Zois. It was under his aegis that Valentin Vodnik began to write his poems, Anton Tomaž Linhart wrote the first two Slovenian plays, and Jernej Kopitar started conducting research on Slovenian (Štih and Simoniti 2009).

During the period around 1800, Slovenian territory was strongly impacted by military conflicts with France and Napoleon. French troops occupied the territory twice for a short period of time (in 1797 and 1805), until in 1809, after its defeat at Wagram, Austria was forced to surrender a large portion of land to Napoleon, including the central and western parts of Slovenian-inhabited territory. Napoleon turned the newly acquired estates into the Illyrian Provinces with Ljubljana as the capital. Their main purpose was to impose customs barriers and disrupt trade between Austria and Great Britain. Under French rule, the Slovenian population was introduced to modern bourgeois society for the first time. The French introduced several changes (equality before the law, universal military service, and a modern administration and school system), but because they were unfamiliar with the local conditions, their measures did not have a long-term effect. However, some of their measures, especially a greater role of Slovenian in schools, had an important impact on the development of the Slovenian national movement. After Napoleon's defeat in Russia, the French began leaving the Illyrian Provinces, and in October 1813, the territory was reclaimed by the Austrians, who reinstated the previous order in all areas. At that time, the Habsburg Monarchy acquired some new territory, including the Littoral. Hence, for a while, all Slovenian ethnic territory was united under the same ruler (Vodopivec 2006).

Shortly after that, Ljubljana assumed another important role in shaping Europe's political landscape: this was where the leaders of the Holy Alliance met from January to May 1821 to discuss and agree on the actions to be taken in the conflict points that arose in Europe after the Napoleonic

Wars (at the Congress of Laibach). Thus, for a short while, Ljubljana took center stage in European politics.

During the pre-March period, Slovenian political aspirations did not come to the fore. This period was marked by the greatest Slovenian poet, France Prešeren, who, among other things, in 1844 wrote the poem "Zdravljica" (The Toast), which later became the Slovenian national anthem. A year earlier (in 1843), the newspaper *Kmetijske in rokodelske novice* (Farmer's and Craftsmen's News) began being published under the editorship of Janez Bleiweis. It was initially only intended for farmers and craftsmen, but later it also featured political articles. Its main credit was the consolidation of standard Slovenian and the adoption of the alphabet developed by Ljudevit Gaj, which brought the Slovenians closer to other Slavic nations and continues to be used today. Under the influences of Romanticism, interest in Slovenian and Slavic linguistics also grew. In the early 1830s, Slovenian territory underwent early industrialization and the influx of Viennese and Trieste capital grew increasingly stronger. Trade and transport were greatly boosted by the construction of the Southern Railway, which was extended to Ljubljana in 1849 and to Trieste in 1857. This shortened the journey from Vienna to Trieste from several days to less than a day (Vodopivec 2006).

The year 1848 was a watershed in Slovenian history, not only in economic terms (the abolition of feudalism) but also, or first and foremost, in terms of Slovenia's development as a nation. The demands for the unification of all Slovenians into a single political entity under Habsburg rule and the equality of Slovenian in public, which Matija Majar (pen name Ziljski) composed at the end of March 1848, became the foundation of the Slovenian political program United Slovenia (*Zedinjena Slovenija*). This remained the joint Slovenian political program up until the 1918 dissolution of the monarchy. As early as April 1848, the first two societies called *Slovenija* were founded in Graz and Vienna. With the 1851 establishment of Bach's absolutism, Slovenian political aspirations were suppressed, and cultural activity came to the foreground. The central cultural institution of that time was the Hermagoras Society (established in 1851), which is considered the oldest Slovenian publisher. Cultural societies flourished; at first, they operated as reading rooms, which gradually grew into societies with more complex programs. The societies established at that time included the Theater Society, the Music Society, and the Slovenian Society (*Slovenska matica*). The goal of the Slovenian Society was to publish Slovenian prose, poetry, and research. A special form of cultural and political events was the open-air rallies (*tabori*) that took place in 1868 and 1871, and at which Slovenians publicly demanded the realization of the United Slovenia program. However, these political and cultural activities largely involved only the townsfolk, whereas farmers and the old aristocracy were excluded from these developments (Vodopivec 2006).

During the 1850s and 1860s, Slovenian territory was strongly affected by the formation of two strong nation-states on the Austrian borders: Italy and Germany. Austria was involved in several military conflicts that largely ended in a defeat. This led to the loss of Venetian Slovenia and its annexation to Italy in 1866, and the formation of the dual monarchy of Austria-Hungary.

9.3 Modern Slovenian History

From the 1860s onward, Slovenian political and other demands caused increasing conflicts between the ethnic Germans and the Slovenians, which were also manifested in physical altercations. Exacerbating interethnic relations led to ideas of transforming the dualist monarchy on new foundations following federal principles, in which the Slavic nations would also play a role, which their large numbers entitled them to. Especially after the 1908 annexation of Bosnia-Herzegovina, when the share of the Slavic population in the monarchy increased significantly, ideas of a trialist state grew increasingly stronger, but they were never realized.

Internal conflicts among Slovenians were also coming increasingly to the fore. Even though they politically and culturally already divided themselves into the "Old Slovenians" (i.e., conservatives) and "Young Slovenians" (i.e., liberals) in the 1860s, they held the same stance toward the ethnic Germans and the German politics up until the first half of the 1870s. However, during the 1880s, under the influence of certain Catholic notables, the Slovenian political scene split into a Catholic/clerical and national/liberal faction. This division, which was described as "the separation of spirits," was reflected in the establishment of new parties and attacks against one another in the newspapers—the clerical *Slovenec* (The Slovenian) on the one hand and the liberal *Slovenski narod* (The Slovenian Nation) on the other (Luthar 2008).

During the first decade of the twentieth century, Slovenian territory was marked by exacerbating Slovenian–German relations and the emergence and spread of the Yugoslav movement. Seeking new forms of the monarchy's system of government was the central national–political topic, and the ideas of trialism and federalism predominated among the Slovenian political parties. However, loyalty to the emperor remained unbending, and the dissolution of the monarchy was utterly unimaginable. During the First World War, the inhabitants of the Slovenian lands shared the fate of the monarchy and its military and sociopolitical processes. The outbreak of war paralyzed political life in the monarchy until the end of May 1917. When Italy switched to the Triple Entente through the Treaty of London, according to which

Italy would also gain part of western Slovenian ethnic territory, this opened up a new front between Italy and Austria–Hungary that ran down from the Swiss–Italian–Austrian tripoint, with the Isonzo Front in its southeast. Eleven Italian offensives took place in the Isonzo Front, and in the 12th battle, also known as the Battle of Caporetto, the allied German–Austrian army pushed the Italians all the way to the Piave River (Luthar 2008). The end of the war also resulted in the dissolution of the Habsburg Monarchy and the formation of the State of the Slovenes, Croats, and Serbs on October 29, 1918, which was, however, not internationally recognized. On December 1, 1918, this state merged with the kingdoms of Serbia and Montenegro into the Kingdom of the Serbs, Croats, and Slovenes under the Karadjordjević dynasty.

The Austrian border in Carinthia was defined by a plebiscite on October 10, 1920. The western border was defined by the Treaty of Rapallo, signed on November 12, 1920, according to which Italy acquired the territory defined in the Treaty of London, as well as Tarvisio, Postojna, and Mount Snežnik (the border ran across Mount Mangart, Mount Triglav, Krnice pri Novakih, Mount Špehovše, Hotedršica, Planina, and Mount Snežnik down to Rijeka). Prekmurje belonged to the Kingdom of the Serbs, Croats, and Slovenes. The Slovenians were divided among four countries: 985,155 lived in Yugoslav Slovenia (according to the 1921 census) and 400,000 remained in neighboring countries. Those living outside Yugoslavia were exposed to violent assimilation in fascist Italy (300,000), Austria (90,000), and Hungary.

After the war, Slovenian political life took place within three political blocs, whereby the Slovenian People's Party (SLS) with the most influential Slovenian politician, Anton Korošec, was the leading political party in the country. The first constitution of the Kingdom of the Serbs, Croats, and Slovenes (also known as the Saint Vitus Day Constitution of 1921) laid the foundations for a centralist and unitarian state following the model of France. With the establishment of the university (in 1919) and the Academy of Sciences and Arts (in 1938), Slovenians achieved national emancipation in education and culture, and economically Slovenia was the most developed part of the state (Slovenia accounted for 6.5% of Yugoslavia's territory, 10% of its population, and 29% of its industrial production; Štih et al. 2008). The 1929 royal dictatorship abolished the Saint Vitus Day Constitution, and the state was renamed the Kingdom of Yugoslavia, erasing the names of individual nations. The state was divided into nine provinces named after geographical features; the Drava Province encompassed all of the Slovenian territory in Yugoslavia after 1931. After the 1934 assassination of King Alexander in Marseilles, some political restrictions were relaxed. The SLS assumed power in the Drava Province, which enhanced the political and ideological differences in Slovenian society (Godeša and Perovšek 2016).

After the Yugoslav coup d'état of March 27, 1941, Hitler decided to attack Yugoslavia, which he carried out on April 6, 1941. Slovenian territory was divided by four countries, which then annexed it (i.e., Italy, Germany, Hungary, and Croatia). Under the new regime, the Slovenian nation was subjected to ethnocide and a policy of violent assimilation and expulsion. The leading figures of the prewar political authorities already compromised themselves at the start of the conflict, when they decided to side with the Axis powers and tried to achieve the status of a puppet state, following the model of Slovakia and the Independent State of Croatia. Because Hitler disagreed with them, their attempts were completely unsuccessful. They later used the policy of waiting to stand up to the resistance movement, ending up in armed collaboration with the Axis forces from summer 1942 onward; they collaborated with the Italians through the Anti-Communist Volunteer Militia (MVAC) and with the Germans through the Slovenian Home Guard, which operated under the command of German SS units (Štih et al. 2008). At the initiative of Slovenian communists, the Liberation Front (OF) was established on April 26, 1941. It soon called for armed resistance against the Axis forces, thereby convincing broad segments of the population, regardless of their ideological background, to join its ranks. The Yugoslav resistance movement led by Josip Broz Tito became part of the anti-Hitler coalition and came out of the war as the victor in Slovenia (Godeša and Perovšek 2016).

After the Second World War, the border issue was settled at the Paris Peace Conference. With their agenda of uniting all Slovenian ethnic territory, the resistance movement succeeded in changing the Rapallo border and annexing the majority of the Littoral to Yugoslavia, even though Trieste and Gorizia remained part of Italy. The Yugoslav–Italian border issue was settled with the Memorandum of Understanding signed in London in 1954, and the border became final with the 1975 Treaty of Osimo (Prunk 2008; Godeša and Perovšek 2016).

The new authorities under the leadership of the Communist Party started introducing changes that discontinued the prewar social system and implemented a communist social order. They also took vengeance against the opponents of the communist regime, who were accused of collaboration and whom the British returned from Austrian Carinthia, by killing them without trial. After the war, Slovenia acquired the status of a federative republic, and it politically consolidated its regime by persecuting political opponents and nationalizing businesses and industries.

With the 1948 Tito–Stalin split, Yugoslavia embarked on its independent path into communism with the introduction of workers' self-management and with the Non-Aligned Movement in its international relations, where Tito was one of the leading figures. The key changes in the country occurred when Tito, the pillar of stability for the multiethnic country, died in 1980. A political thaw also brought about extreme interethnic conflicts, which were exacerbated by a deep economic crisis and the increasing influence of the Yugoslav army (Godeša and Perovšek 2016). Among the Yugoslav republics, Slovenia was considered the most open and developed, and its federal status significantly eased its path to independence. In 1990, the first multiparty democratic elections were held in Slovenia, allowing Slovenia to gain independence in June 1991 and successfully defend itself against the Yugoslav People's Army's aggression in the Slovenian Independence War. Milan Kučan became the first democratically elected Slovenian president. Independence was decided in a referendum held on December 23, 1990. The turnout was 93.2%, and 95% of voters (i.e., 88.5% of the electorate) voted for independence. The results were announced on December 26, 1990, which is now a Slovenian national holiday. After independence (Fig. 9.8), Slovenia gradually became member of various EU and world organizations: it joined the UN in 1992, the EU and NATO in 2004, the eurozone and Schengen Area in 2007, and the OECD in 2010.

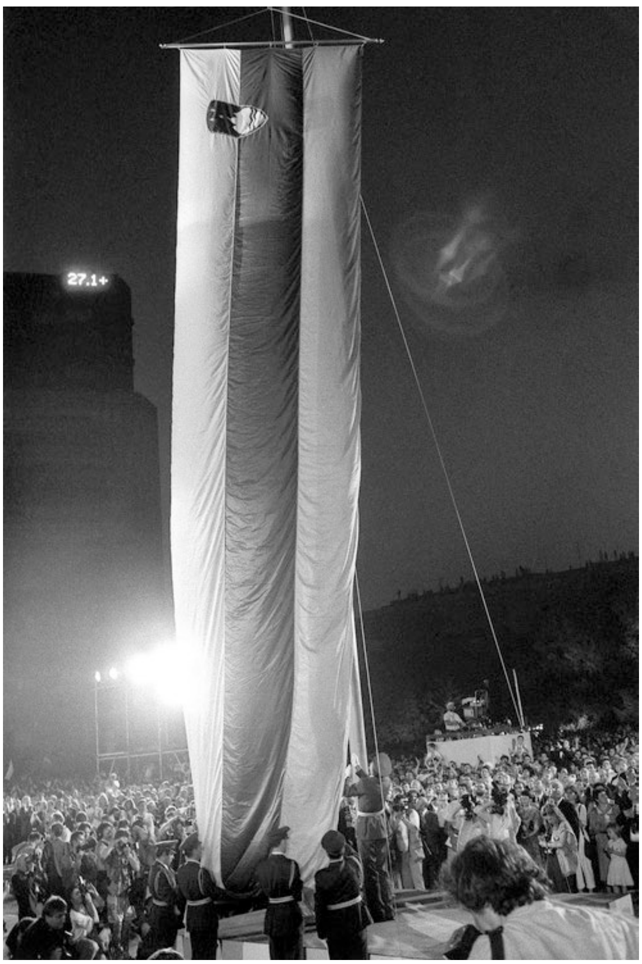

Fig. 9.8 Revolution Square (*Trg revolucije*) on June 26, 1991, the day after the official declaration of independence. (Photo by Nace Bizilj, National Museum of Contemporary History Archive)

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Slovenia's Population

10

Drago Kladnik, Jani Kozina, and Peter Repolusk

Abstract

As of January 1, 2017, Slovenia had a population of 2,066,880. Even though only 5% of the population still makes a living with agriculture, half of the population is rural. Only the capital city of Ljubljana has a population of more than 100,000. During recent decades, suburbanization has been more characteristic than urbanization. The population is aging rapidly, life expectancy is increasing, and demographic trends are worrisome. A negative migration rate was characteristic from the mid-nineteenth century to the 1960s, when rapid industrialization was accompanied by increased migration from other parts of the former Yugoslavia. Immigration again strengthened after 1995. The spatial distribution of Slovenia's population has been affected more by internal migration than cross-border migration. The employment structure is dominated by service professions, although since 2000 there has been a strong increase in creative professions. The country is quite homogenous ethnically and religiously. Ethnic Slovenians account for more than four-fifths of the population, and among those with a religious identity, Catholics strongly predominate at 91%.

Keywords

Demogeography · Natural increase · Migrations · Ethnic structure · Socioeconomic structure · Slovenians

10.1 The Origin of Slovenians

The Slovenians are one of the smallest nations in Europe. They are South Slavs despite various other theories about their ethnogenesis. The ancestors of today's Slovenians were Slavs, but throughout history members of many other ethnic groups have mixed with them (Ivanič 2002).

Slovenian ethnic territory today comprises only a third of the territory that was settled by the Slavs in the Eastern Alps, along their pre-Alpine margin, and in the northern Adriatic hinterland. The first wave of Slavic settlers in the Eastern Alps during the mid-sixth century came from the north—that is, from what is now the West Slavic area—and the main wave at the end of the sixth century came up the Sava and Drava rivers from the east, from what is now the South Slavic area (Ivanič 2002).

The history of the Slovenians does not begin with the settlement of the Slavs in the Eastern Alps. Recent research indicates that the Slovenians formed a separate nation over a long period of development (especially from the sixteenth century onward) as the result of a fusion of Slavic heritage with a rather strong settlement heritage that was indigenous or dated back to Antiquity as well as later mixing with other ethnic groups, especially Germans, Friulians, Croatians, and Uskoks. The most distinct and consistent feature marking their historical development was their linguistic identity, although the adoption of Christianity was also an important element because the formation of their language and culture was closely tied to the Catholic Church. The development of the Slovenians was heavily affected by nearly 1200 years of foreign rule (Vidic et al. 1999; Ivanič 2002).

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© Springer Nature Switzerland AG 2020
D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_10

10.2 The Development and Distribution of the Population and Its Characteristics

As of April 1, 2017, Slovenia had a population of 2,064,836, of whom 1,948,995 were Slovenian citizens and 115,841 or 5.6% were foreign nationals. According to the last census, as of January 1, 2011, Slovenia had a population of 2,050,189 (SURS 2017).

It can only be estimated what population the territory of what is now Slovenia had before the first censuses were carried out: around 700,000 in the mid-eighteenth century and 1,100,000 in the mid-nineteenth century. The population established during the first census, carried out in 1857, was 1,101,854. Until the First World War, the number increased relatively evenly by 0.3–0.4% a year. Due to war and extensive emigration, the population decreased between 1910 and 1921, after which it grew by an average of 0.6% a year until 1931. A similar stagnation in demographic development was caused by the Second World War, after which the population jumped upward again. It increased by an average of just under 1% a year until the 1981 census, by just under 0.5% a year until the 1991 census, by only 0.25% until the 2002 census, and by even less until the last census carried out in 2011 (Figs. 10.1 and 10.2; Perko 1998d, 2007).

In early 2017, the average population density in Slovenia was 101.9 people per km^2 (Fig. 10.3; SURS 2017), compared to only 56 people per km^2 recorded during the first census in 1869. Because Slovenia has very dynamic terrain, its population is distributed unevenly, and this unevenness is increasing further. The most densely populated were the Alpine plains, with 582 people per km^2, and the most thinly populated were the Dinaric plateaus, with only 18 people per km^2. During the twentieth century, population density increased the most in the Alpine plains, where it nearly tripled, and the Pannonian plains, where it doubled; it decreased the most in the Dinaric plateaus (by over a third) and the Mediterranean plateaus (by over a fifth). At the end of the twentieth century, four-fifths of today's Slovenian territory had a below-average population. As much as 25% of the total Slovenian population lives in the Alpine plains, which cover only 4% of Slovenia, and only 3% lives on Dinaric plateaus, which cover one-fifth of its territory (Perko 1998a, 2007).

Nearly half of Slovenian territory—especially the mountains, hills, Alpine and karst plateaus, and majority of border areas—is covered by areas with rapidly decreasing population density. Almost one-fifth of Slovenia is covered by areas with slowly decreasing population density, just over a tenth has areas of slowly increasing population density, and the remaining sixth of Slovenia (nearly without exception consisting of plains only) is characterized by rapidly increasing population density (Perko 1998b).

Because of the expansion and development of nonagricultural activities, the farming population is increasingly falling. Even just over a century ago, three-quarters of the population living in what is now Slovenia were farmers. Immediately after the Second World War, the share of the farming population decreased to less than half. Since then, it has decreased even faster, and the share after 1980 has been under one-tenth (Natek 1998). Even though only 5% of the

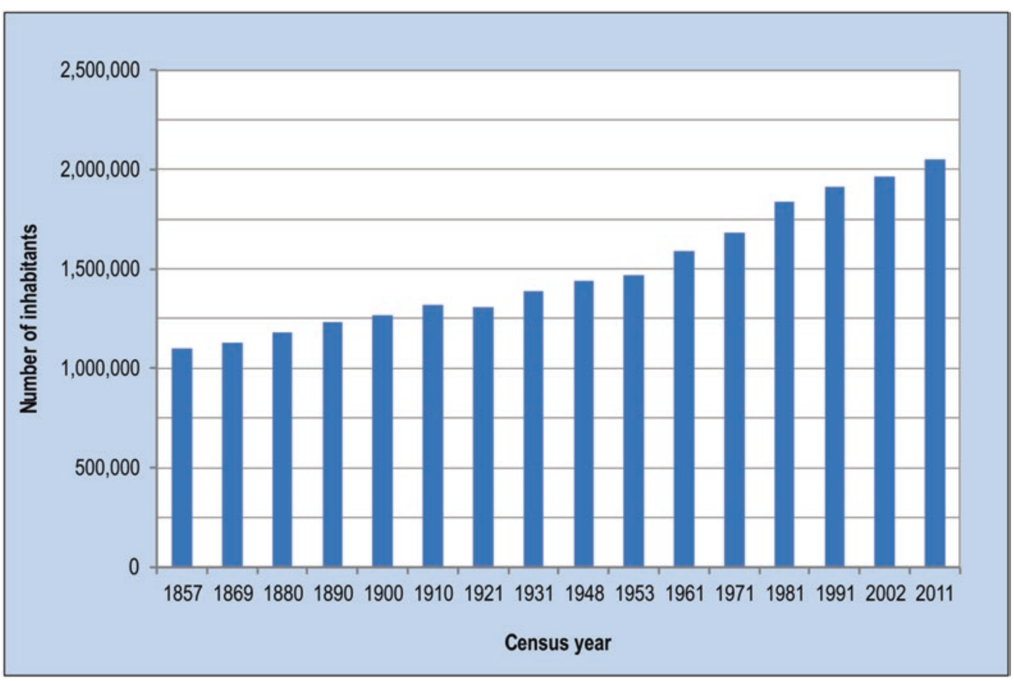

Fig. 10.1 Population changes based on censuses from 1857 to 2011

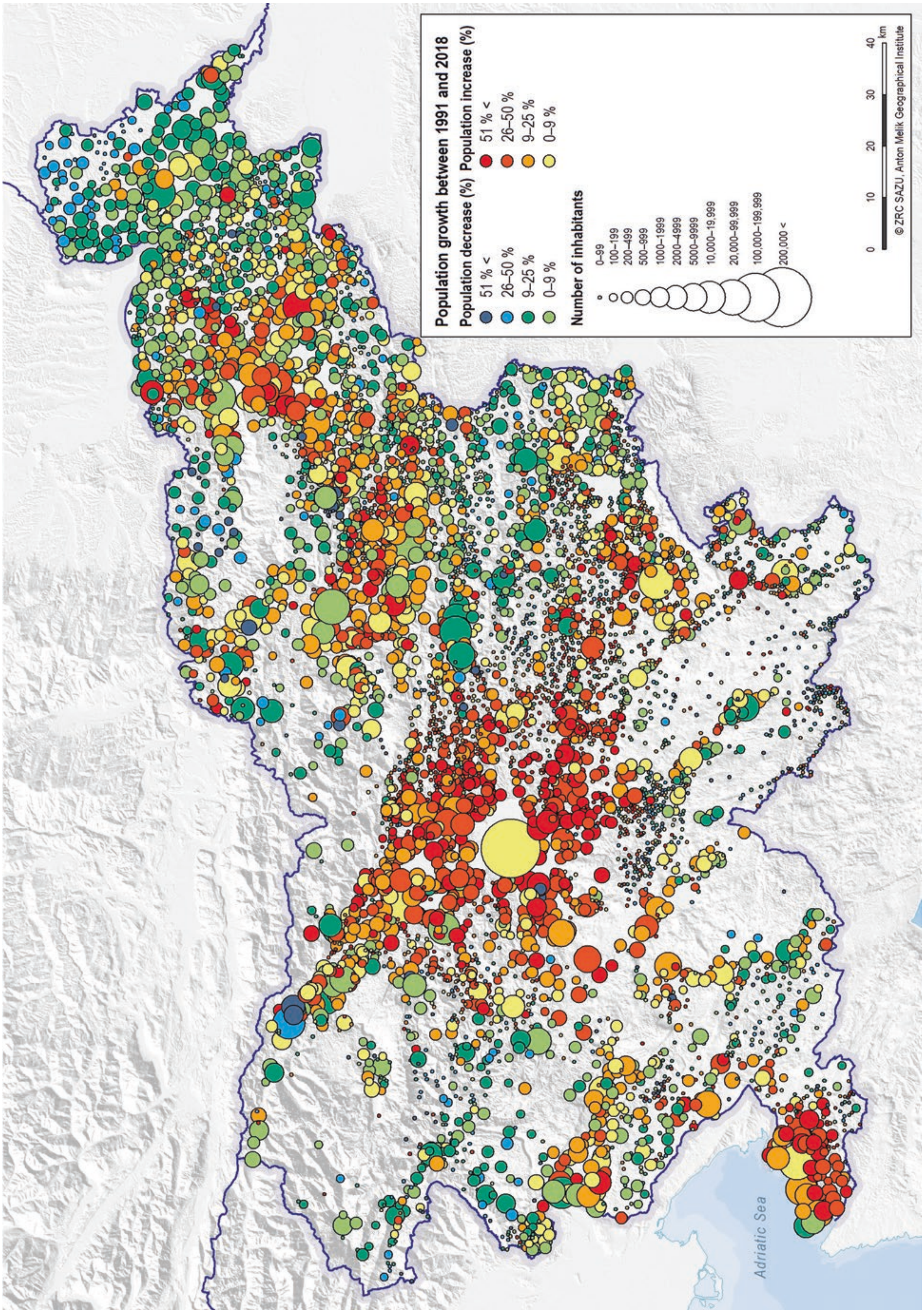

Fig. 10.2 Population growth between the 1991 and 2018

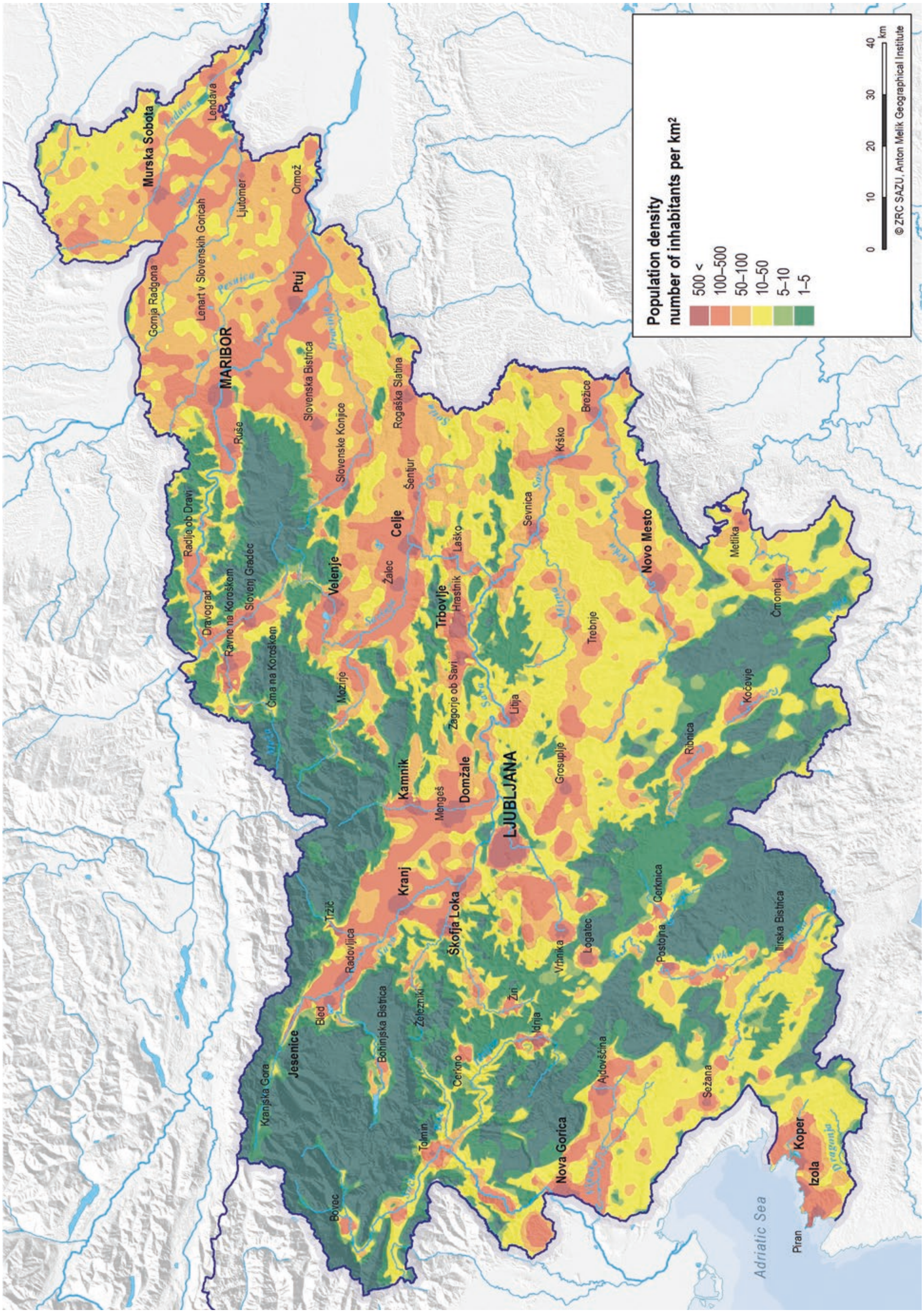

Fig. 10.3 Population density in 2017

population engaged in farming in 2011, exactly one-half of Slovenia's population lived in rural areas. The other half lived in urban areas (SURS 2017).

Slovenia has always had a low urbanization rate (Vrišer 1969; Dijkstra and Poelman 2014). Ljubljana is the only city with a population over 100,000 (i.e., 289,000), and the only other city that comes close to this number is Maribor (94,900). In addition to these two cities, there are a large number of small towns with a population under 20,000, and there is a general lack of medium-sized towns with a population of around 50,000, which is why some authors talk about "under-urbanization" (Kos 2007) or a lack of "urbanism as a lifestyle" (Uršič and Hočevar 2007). From the 1980s onward, this situation has been strongly supported by suburbanization (Ravbar 1992), which can be described as people moving out of towns to fulfil their life's dream of building a detached house in green surroundings (Bole et al. 2007). Analyses of suburbanization in Slovenia carried out to date (Ravbar 1992, 2002, 2005) reveal that by studying geographical manifestations, at least two development stages or types can be identified: housing (or demographic) suburbanization and the suburbanization of production and services. Early suburbanization is characterized by the demographic growth of suburbs and dispersed urbanization along the main roads with favorable access and a lower density of structures on the urban edge, next to older rural settlements. The collapse of communism was soon followed by a nearly identical spatial expansion of building sites for production, commercial, and service activities, or so-called industrial suburbanization. Since 2000, the development of jobs and the spatial transformation of production and services in the suburbs have already been taking place with the same intensity as the demographic development of settlements (Ravbar 2002).

Landscape suburbanization is a response to changes in the growth of production and consumption, as well as the postindustrial element of a different distribution of jobs and housing (Ravbar 1997). In this regard, suburbanization can also be studied in terms of commuting as a cultural, social, and primarily physical spatial change (Gabrovec and Bole 2009), which at the same time is an important building block of the living or residential environment (Kozina 2016; Tiran 2017). Even though, in recent decades, Slovenians have been traveling increasingly longer distances while commuting to work or school, the amount of time spent traveling remains constant; however, this only applies to private transport. Over the past decades, the difference in the speed of public and private transport has continually increased, which is primarily the result of accelerated construction of freeway infrastructure and insufficient attention paid to the railroad. Hence, public transport has become less competitive in terms of time, and the lack of demand for it has resulted in it being cut back. Less competitiveness caused a drastic decline in its use, so that the share of public transport users commuting to work decreased from 58% in 1981 to 10% in 2002, whereas the share of car transport among commuters increased from 27% to 85% (Bole and Gabrovec 2012).

10.3 The Rate of Natural Increase and Its Consequences

The rate of natural increase depends on the birth rate, death rate, and the age and sex structure. In terms of the male-female ratio, Slovenia is a balanced country: in 2015, men accounted for 49.6% and women 50.4% of the total population (SURS 2017). In the past, these ratios were different. For example, there were only 46.9% men in 1948, which was because more men died during the Second World War (Perko 1998c). Later the share of men increased, also because of immigration and the fact that men predominate among immigrants. Even though there are slightly more women, approximately 106 boys are born per every hundred girls every year. Because of a higher mortality rate of men in all age groups, at approximately age 50, the number of women begins to exceed the number of men of the same age (Josipovič and Repolusk 2007b).

The Slovenian population is an old population, like those in most of the developed world. The population type by age is usually defined in terms of the share of individual age groups or the age index, which shows the number of elderly (65 or more) per hundred young people (age 0–14). In a young population, the share of young people is over 25%, and in an old population, the share of the elderly is over 10%. The population type between these two is referred to as the working-age population (Jakoš et al. 1998; Malačič 2006).

In 2015, the share of the young population in Slovenia stood at only around 14.8% (a total of 305,219). It amounted to 20.8% in 1991 and as much as 27.3% in 1961. In contrast, the share of the elderly has been increasing from census to census. Thus, it increased from 7.8% in 1961 to 11.2% in 1991 and 17.9% in 2015 (Fig. 10.4; SURS 2017). Such development causes concern because the trend of population aging will continue. The cohorts that are gradually turning into the elderly population are much larger than the cohorts of newborns. The number of elderly already exceeds the number of newborns; from 1961 to 2015, it increased from 124,218 to 369,368. The aging index is also increasing rapidly: from 29 in 1961 to 54 in 1991 and 121 in 2015 (SURS 2017). The aging of the population has primarily resulted from the declining birth rates in the second half of the twentieth century and rising life expectancy.

The birth rate, or natality, is the total number of live births per thousand in a population in a year, or the average number of live births during a woman's reproductive period in a year (also referred to as the total fertility rate). Rapidly declining birth rates in the developed world were connected with the

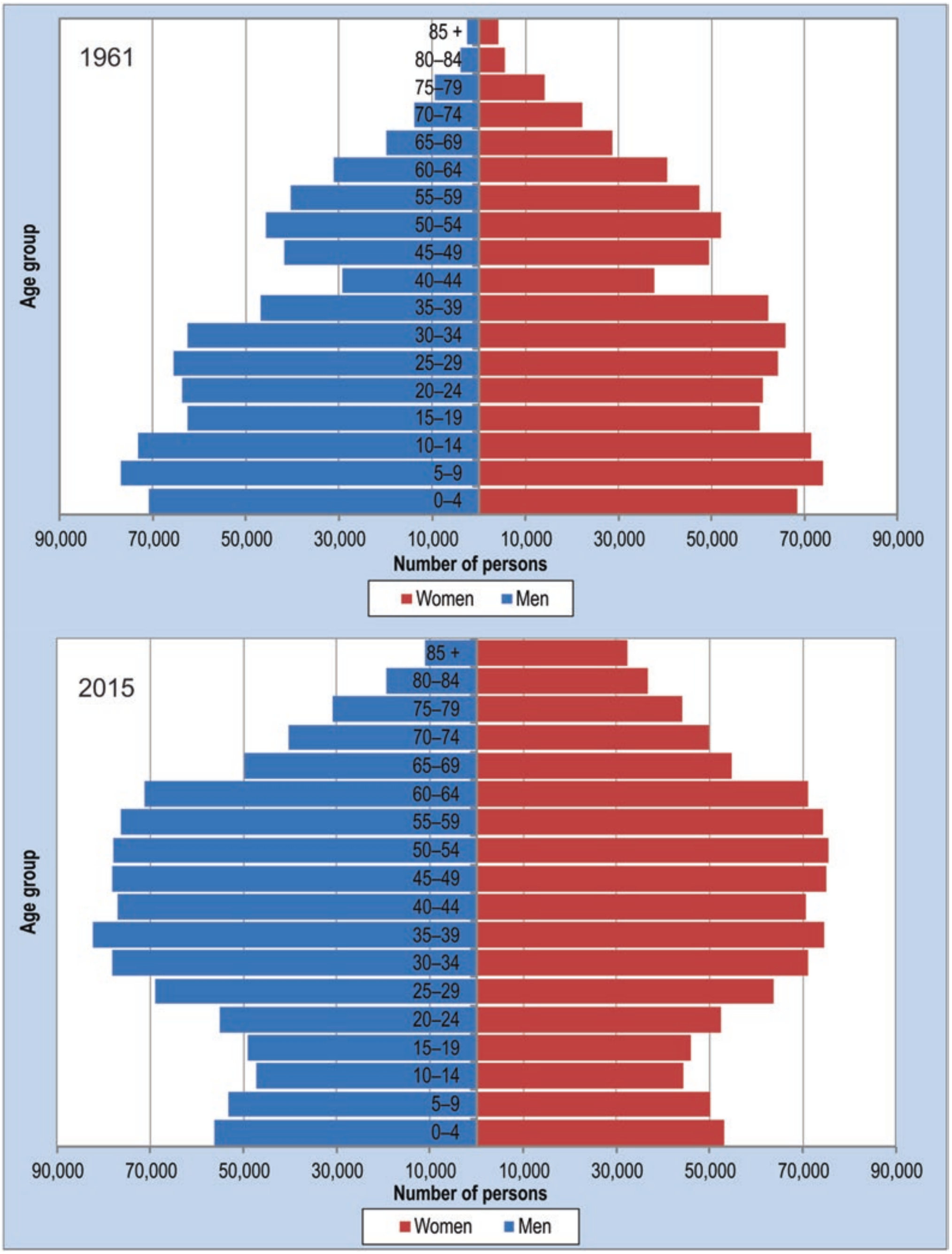

Fig. 10.4 Age pyramids for 1961 and 2015

demographic transition from high to lower birth and death rates. In Slovenia, this occurred during the 1960s (Šircelj 2006). In the second half of the nineteenth century, the birth rate in what is now Slovenia was still high: approximately 35. It declined most rapidly during the interwar period and the decades following 1980, especially after 1989. The birth rate decreased because couples wanted fewer children and because of the longer time spent in school and the increased employment of women. It first declined in urbanized areas and later also in the countryside. After the Second World War, the number of newborns peaked in 1950 (35,992). Even in 1979 there were still more than 30,000 newborns, but since then their number has been rapidly declining, and it has already fallen below the replacement fertility rate (Šircelj and Kladnik 1998a; Šircelj 2006), which is approximately 2.1 newborns per woman over her reproductive period. The fewest children (17,321) were born in 2003, when the total fertility rate was only 1.2 and there were only 8.6 live births per thousand in the population (Josipovič 2004; Josipovič and Repolusk 2007b; Kladnik 2007). After that, the birth rates slightly increased, with an average of 21,500 live births a year recorded between 2008 and 2015. The total fertility rate rose to 1.5, which is still only 75% of the replacement fertility rate.

The death rate, or mortality, refers to the number of deaths per thousand individuals. Due to improved healthcare, the rate in Slovenia already decreased significantly during the interwar period. It was the lowest (8.8) in 1961 (Šircelj and Kladnik 1998b), but it later increased somewhat (to 9.5) due to population aging. At the same time, life expectancy at birth is increasing: on average, men born in 1961 live 66.1 years and women 72.0 years, and men born in 2015 are expected to live 77.6 years and women 83.5 years (SURS 2017). The average age of women at death in 2015 was 81.0 and that of men was 72.8. Deaths before age 65 are much more common among men (27%) than women (11%). Approximately 90% of both men and women die of circulatory diseases, neoplasms, injuries, and respiratory and digestive diseases (SURS 2017).

Longer life expectancy, declining birth rates, and population aging have led to changes in the rate of natural increase. In Slovenia, this has been declining for the past century, even though it only fell below the rate of ten per thousand individuals in the mid-1950s. It began to drastically decline again around 1990, especially due to the rapid decrease in birth rates. It was even negative between 1997 and 2005. It later slightly rose again due to the increasing number of live births, but over the past 10 years, it has only stood at one per thousand individuals. The fact that the population in Slovenia is nonetheless growing results from the positive net migration rate, which has accounted for as much as 81% of the total population growth since 2000 (SURS 2017).

Natural growth components also influence the basic aggregates of the population, households, and families. The number of households in Slovenia continues to grow, whereas their size continues to decrease. There were 630,000 households (composed of 3.0 members on average) in the 1991 census, 685,000 (2.9 members) in the 2002 census, and as many as 821,000 (2.5 members) in 2015 (SURS 2017). Single-person households continue to grow in number. There were 117,000 in 1991, 150,000 in 2002, and 268,000 in 2015; they were mostly composed of individuals under 30 or over 64 (SURS 2017).

The number of families is also increasing, albeit not as quickly. It increased from 556,000 in 2002 to 576,000 in 2015. Declining birth rates and a different perception of the traditional lifestyle and values among young people have caused major structural changes. Over this same period, the share of couples without children increased from 23.0% to 25.5%, and the share of one-child families increased from 48.6% to 54.8%. In addition, the share of single-parent families also increased from 24.4% to 33.3%. More than one-fifth of parents are unmarried (Urbanc and Žnidaršič 2007; SURS 2017).

10.4 Migration

Due to economic reasons, for a long time, more people left Slovenia than entered it. A negative net migration rate was characteristic from the mid-nineteenth century to the 1960s. In the decades preceding the First World War, people tended to emigrate to North America, whereas during the interwar period, they largely emigrated to western Europe. During the first years after the Second World War, strong short-term migration flows to North and South America and Australia occurred because of political reasons. The situation changed in the 1960s, when immigration from other Yugoslav republics grew stronger, first and foremost from Bosnia and Herzegovina. The migration flow was strongest between 1975 and 1982, when approximately 6500 more people a year entered Slovenia than left it (Kuhar de Domizio 1998).

With the exception of certain individual years, Slovenia remains a country of immigration (Fig. 10.5). Immigration from abroad again increased after 1995, and a positive net migration rate of approximately 4100 people a year was typical between 1996 and 2015. The countries of origin remain similar to those in the past: the majority of immigrants (86%) come from the other former Yugoslav republics, especially Bosnia and Herzegovina, Croatia, and Serbia. The number of immigrants from other European countries, such as Germany, Italy, Austria, Russia, and Ukraine, has also slightly increased. There are only a few immigrants from other continents. Immigration is three times greater than emigration. In half of the cases, people emigrate to the other former Yugoslav republics (most of them are returning migrants). Other target countries primarily include west central European countries, especially Germany, Austria, and Switzerland, and Italy in southern Europe. Men predominate among international migrants; until 1990, women accounted for nearly half of all migrants, after which their share decreased to less than one-third (Dolenc and Josipovič 2007; SURS 2017).

The spatial distribution of the Slovenian population was primarily influenced by internal migration rather than international migration; the share of internal migration was over 80% after the Second World War (Kuhar de Domizio 1998). The most important impact on this was exerted by deagrarianization, industrialization, and urbanization, which stimulated strong rural-urban migration flows. During the 1950s and 1960s, major urban centers experienced the most rapid growth. Balanced regional development, which started com-

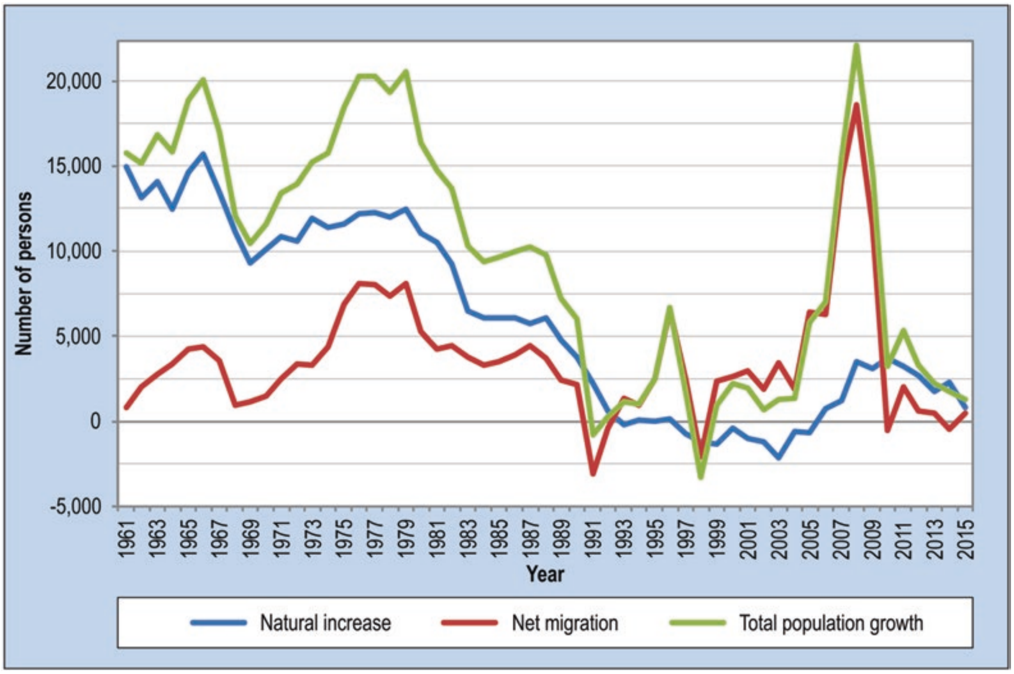

Fig. 10.5 Natural increase, net migration, and total population growth between 1961 and 2011

ing to the fore in the 1970s, reduced the interregional migration flows. The greatest concentrations of population were found in regional centers, as well as the municipal centers of that time (Bevc 2000; Bevc et al. 2004; Bevc and Uršič 2013). The main migration stimulators were jobs, greater income, social security, and more free time (Kuhar de Domizio 1998).

During the stagnation of employment in the industrial sector and the gradual revival of small businesses on the edges of large- and medium-sized towns in the 1980s, the migration flows shifted from urban centers to areas surrounding towns (Kuhar de Domizio 1998) as part of the process known as suburbanization (Ravbar 2005). With Slovenia's independence in 1991, internal migration slowed down somewhat (Bevc et al. 2004).

The internal migration dynamics in Slovenia are significantly lower than in other EU countries (Bevc 2000). Based on this indicator, Slovenians are similar to nations in southern and eastern Europe, which are among the least mobile in Europe (Martin-Brelot et al. 2010). The extremely low migration in Slovenia is most likely the result of strong attachment to the local environment and the extremely immobile real estate and labor market (Kozina 2013).

Emigration is an exceptionally important element for Slovenia and Slovenians in this context, considering that in just over a century, more than half a million people have permanently moved abroad from what is now Slovenia. Slovenians are among the European nations that have suffered the greatest damage due to emigration. Emigration from Slovenian ethnic territory was the most extensive from the mid-nineteenth century to the 1960s (Zupančič 1998a).

The largest Slovenian expatriate communities can be found in North America. According to some data, there are approximately 300,000 ethnic Slovenians living in the United States. The 1910 census recorded 183,431 American residents with Slovenian as their native language. At that time, Cleveland was deemed "the third largest Slovenian city," just behind Ljubljana and Trieste. The majority of emigrants came from southern and southeast Slovenia. People left the homeland for economic motives and partly also for political reasons. Emigration grew even stronger due to the economic crisis after the First World War, when a new wave of emigrants left the country. Because of American restrictions on immigration, they emigrated to developed western European countries, Canada, South America, and Australia instead (Zupančič 1998a).

During the interwar period, tens of thousands of Littoral Slovenians emigrated from areas under the fascist Italian rule due to political pressures. In many aspects, these emigrants resembled refugees (Zupančič 1998a).

Immediately after the Second World War, all ethnic Germans left Slovenian territory, and during the 1950s, after part of Istria was annexed to Slovenia, the majority of ethnic Italians left as well. Several thousand Slovenians, especially those from mixed marriages, also moved to Austria, Germany, and Italy. A special wave of refugees consisted of collaborators with the Axis forces and their family members, who moved overseas from temporary refugee camps, especially to Argentina, the United States, Canada, and Australia, and some of them also to central and western Europe. Approximately 18,000 Slovenians left Slovenia after the Second World War (Zupančič 1998a). Emigration slowed down during the 1960s and the net migration rate became positive.

Since the 1960s, it has been very common for Slovenians to leave home to study or work abroad. Their permanent residence remains in Slovenia, but they temporarily live abroad and plan to return home after a while. According to the 1991 census, 52,631 Slovenians or 2.7% of the total Slovenian population temporarily lived and worked abroad. The majority (84.3%) lived in Europe, especially Germany, Austria, Switzerland, and Italy, and 7.2% lived overseas in North America and Australia (Zupančič 1998c). The main reasons for their temporary relocation included a lack of employment opportunities in Slovenia, higher salaries, and a better professional career.

Recently, this phenomenon has been associated with brain drain because it is usually the most highly educated and qualified young individuals that move abroad. Foreign countries are opening their immigration doors wide to them because the best-developed countries are well aware that specialist training is very expensive and remains the burden of the source country.

In addition to Slovenia itself, Slovenians are also indigenous to the border regions in all the neighboring countries. The largest area outside Slovenia where ethnic Slovenians live is in Austria, followed by Italy, Hungary, and Croatia. The approximately 4300 km^2 of ethnically mixed territory across the Slovenian border has a population of approximately 710,000. According to the official records, there are 79,500 Slovenians among them, but Slovenian experts believe they actually amount to around 140,000: 61,000 in Italy, around 50,000 in Austria, 5000 in Hungary, and more than 22,000 in Croatia. More than half of the area populated by ethnic Slovenians is mountainous, hilly, and difficult to access. The main urban centers of ethnic Slovenians across the border are Trieste (sln. *Trst*) and Gorizia (*Gorica*) in Italy and Klagenfurt (*Celovec*) in Austria (Zupančič 1998b).

10.5 Anticipated Development of the Slovenian Population in the Future

Declining birth rates in particular will most likely lead to sub-replacement fertility, an increasing share of the elderly, and a gradual steady population decline. According to the 2008–2060 demographic projections carried out by Eurostat in 2008 for all EU countries (Vertot 2009; EUROSTAT 2017), Slovenia is among the countries for which the most unfavorable demographic trends are anticipated. The baseline projection variant for Slovenia envisages that its total population will decrease by 12%, the number of young people will fall to 226,000, and the number of the elderly will increase to 590,000. The aging index is anticipated to increase to 261.

10.6 Socioeconomic Structure of the Slovenian Population

In 2011, the majority of employed people in Slovenia worked in the service sector (42%), a slightly smaller percentage worked in the creative industries (38%), and significantly fewer people worked in manufacturing (14%) and agriculture (5%) (Fig. 10.6). The share of the creative labor force in Slovenia is comparable to that in northern and western Europe (see Andersen and Lorenzen 2005; Fritsch and Stützer 2007; Clifton 2008; Boschma and Fritsch 2009). According to Florida (2002), more than a third of people in the economically most developed countries work in the creative industries.

From 2000 to 2011, the working population in Slovenia only slightly increased. Nonetheless, there were significant

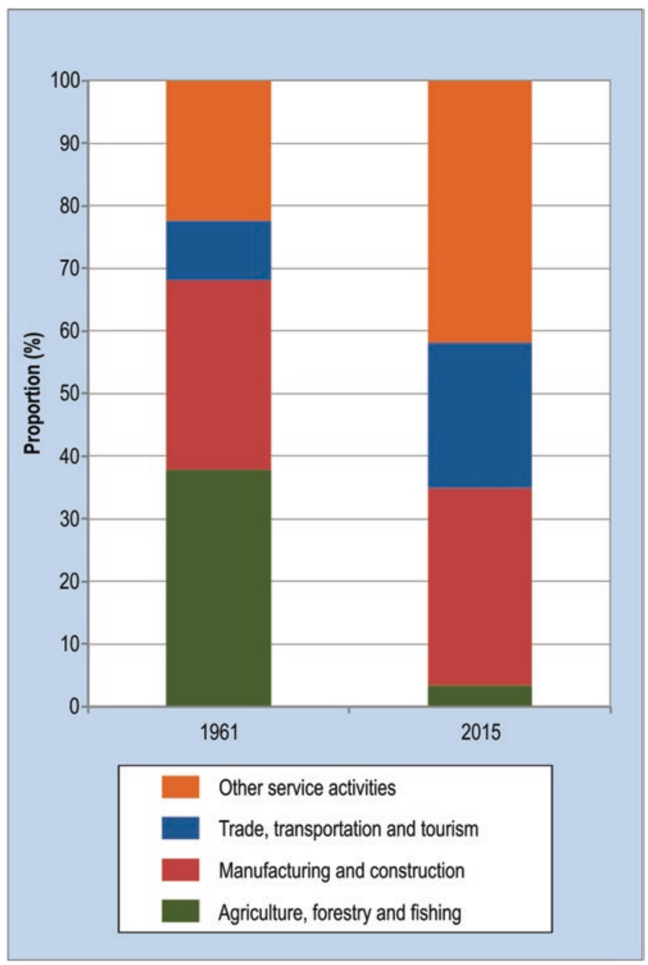

Fig. 10.6 Changes in employment structure between 1961 and 2015

oscillations during this period, which can primarily be linked to the macroeconomic and political situation. Thus, no major changes in the size of the labor force occurred from 2000 to 2003, but after Slovenia entered the European Union in 2004, there was a significant increase, which lasted until the outbreak of the global economic crisis in 2008. The labor force increased by almost one-tenth and unemployment fell by more than one-fourth. The employment rate rapidly increased in the years before the crisis, but it began to decrease even more rapidly after its outbreak. The situation was the worst between 2008 and 2010, when the number of employed persons rapidly fell to the level recorded around 2000 and unemployment was the highest after 1999.

A more detailed examination of changes in the labor force by occupational group shows that the only group that increased in size between 2000 and 2011 was the creative industries. Its share increased by more than one-fourth (27%). On the other hand, the share of people employed in manufacturing decreased the most, by nearly one-third (30%), whereas the share of people working in agriculture and the service sector stagnated. It is interesting to observe the changes in trends that occurred with the outbreak of the economic crisis in 2008. At that point, the share of creative professions increased even more significantly, whereas the share of people working in the manufacturing sector decreased even more strongly than in the preceding years.

Ravbar and Kozina (2012) reached similar conclusions in studying the geographical dimensions of the knowledge society. They report that, despite the decline in its working population and increased unemployment, which nearly doubled from 2008 to 2010, Slovenia is witnessing great structural changes in the labor market. The economic structure of the labor force during the last economic crisis was unable to rise to the global challenges. On the one hand, there is an evident decrease in the number of persons employed in professions that do not demand advanced education or in medium- or low-skilled jobs, and on the other hand there is an increase in the number of persons employed in professions that require the highest levels of education.

These findings reflect new features and tendencies in the socioeconomic system that indicate that Slovenia is slowly but persistently moving toward a stage of creative industries. The new situation is the logical next step in the socioeconomic transition model that Klemenčič (1989) designed in the late 1980s based on changes in the structure of the working population. Klemenčič established that after the Second World War, Slovenian society experienced a fundamental and sudden socioeconomic transformation from the predominantly rural (agricultural) phase into a predominantly industrial (manufacturing or Fordist) phase with pronounced indications of entering a service (postindustrial or post-Fordist) phase. He thus defined three basic development stages: the rural, industrial, and service stages. The first lasted until the 1960s and was characterized by a large share of the agrarian sector (over 40% of employed persons), which was declining rapidly, and a small share of the industrial sector, which was increasing, but did not yet exceed the share of the agrarian sector. The share of the service sector was small (around 20%). The second stage, in which industry predominated, lasted from the 1960s to the 1990s. It was characterized by a predominant share of the industrial sector, which initially increased and then began to decrease. The agrarian sector had a minor role in terms of the share of the working population, whereas the share of the service sector was on the increase. The service stage began when the share of the service sector exceeded that of the industrial sector; in Slovenia, this occurred in the early 1990s (Kladnik and Ravbar 2007). It can be claimed that Slovenia is currently in a mature service stage (Bole 2008). The next development stage, which Slovenia is more than evidently approaching, can be referred to as the creative stage. It is characterized by a decline in the (traditional) industrial production, growth of the creative labor force, and stagnation in the number of service and agricultural employees.

In 2011, Slovenian society consisted of approximately half women and half men but, looking merely at the working population, men predominated by nearly one-tenth (SURS 2016). It is interesting that the situation was nearly identical if only creative workers are taken into account. A brief comparison between the current situation and that of 2000 shows that things are moving toward a slight increase in the share of women in the creative professions and a decrease in their share in other professions.

The analysis of the age structure reveals that on average creative workers are slightly older than the rest of the working population. The reason for this may be their educational structure. Specifically, on average creative professionals are significantly more highly trained, which means that they stay in school longer and therefore enter the labor market later than others (Kozina 2016). Thus in 2011, over 50% of creative professionals had a tertiary degree of education, whereas in the overall working population, this share was approximately only half that. The educational structure (Fig. 10.7) also shows that, despite the evident correlation, a high level of education is not the only condition for engaging in a creative profession. Specifically, only just over half of creative professionals have a tertiary degree of education, whereas nearly four-fifths of employees with a tertiary degree engage in a creative profession. Someone may thus work in a creative profession even though he has a lower level of education and vice versa. This agrees with Florida's (2002) hypothesis that any individual can be creative. The

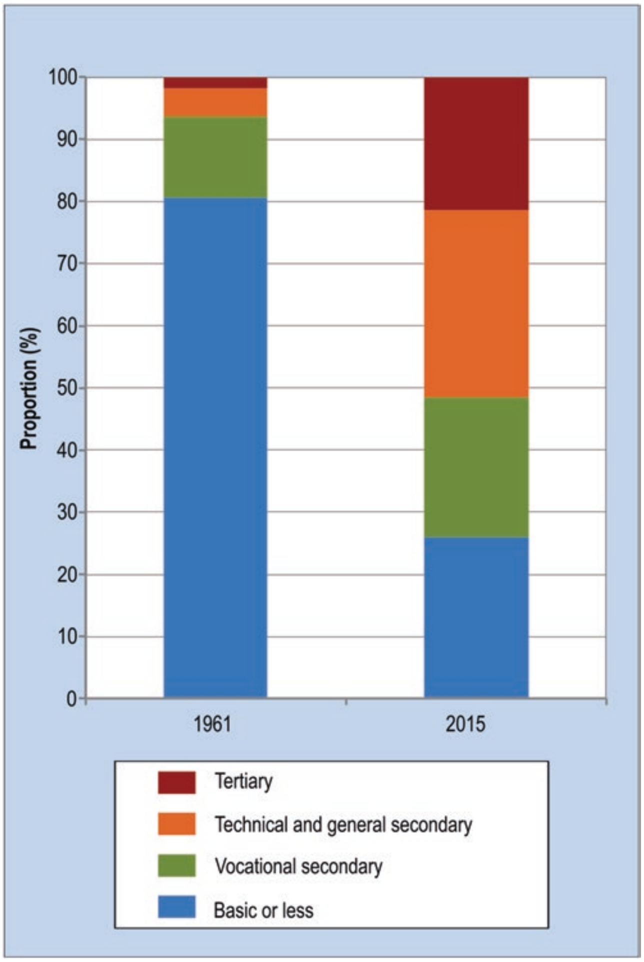

Fig. 10.7 Changes in the educational structure between 1961 and 2015

only thing that matters is whether they develop and capitalize on their potential or not.

10.7 Ethnic, Linguistic, and Religious Structure and Its Changes

The ethnic, linguistic, and religious structure of the Slovenian population was only included in censuses until 2002.

Slovenia is relatively ethnically homogenous. Slovenians are the predominant ethnic group, and they accounted for 83.1% (1,631,363) of the total population in 2002. Two recognized indigenous ethnic minorities live in Slovenia: the Italians (2258) along the Slovenian part of the Adriatic coast and the Hungarians (6243) along the border with Hungary. Since the Second World War, the number of Italians and Hungarians has gradually decreased. Another ethnic group native to Slovenia is the Roma (3246), who predominantly live in southern and eastern Slovenia. According to estimates by social services, their actual number is probably at least twice that in the official records. In all the censuses, all three ethnic groups together accounted for less than 1% of the total Slovenian population (SURS 2016). In the past, tens of thousands of German speakers also lived in Slovenia, but after the First and Second World Wars, they largely relocated to Austria and Germany. Part of them did this voluntarily, and part of them fled the country because they were accused of collaborating with the Axis forces (Repolusk 1998).

During the 1961 census, Slovenians accounted for 95.6% of the total population. The later significant changes in the ethnic structure (Fig. 10.8) were mainly the result of immigration from other Yugoslav republics. In 2002, the prevailing immigrant groups included Bosniaks (40,071), Serbs (38,964), Croatians (35,642), Albanians (6186), Macedonians (3972), and Montenegrins (2667; SURS 2016). The majority of immigrants and their descendants live in larger cities. Between the 1991 and 2002 censuses, the number of individuals declaring themselves as belonging to one of these ethnic categories decreased for all the ethnic categories listed, except for the Albanians and Bosniaks. The reasons for this primarily lie in the differences between the census methodologies used (Šircelj 2003; Josipovič and Repolusk 2007a).

In 1981, the number of persons with unclear ethnicity increased significantly for the first time; they identified themselves regionally as "Yugoslavs" or were undeclared. Their number increased from 37,701 in 1981 to 68,333 in 1991 and to as many as 188,992 in 2002. In the 2002 census, 48,588 individuals declined to answer the question about nationality, and this information was not recorded for 126,325 individuals (SURS 2016).

Deviations between the censuses are much smaller in terms of information on native languages. In 2002, 1,723,434 individuals (87.7%) declared Slovenian as their native language and 153,760 individuals (7.8%) listed Serbian, Croatian, Bosnian, Montenegrin, Serbo-Croatian, or Croato-Serbian as their native language (SURS 2016).

In 2002, 1,248,717 or 63.6% of individuals declared a religious affiliation. Catholics (57.8%) predominated by far, followed by Muslims (2.4%), Orthodox (2.3%), and Protestants (1.0%). Atheists accounted for 10.1%, 15.7% of individuals refused to provide an answer, and for 10.6% of individuals, this piece of information remained unknown (SURS 2016).

Catholics predominate heavily in all Slovenian regions. Nearly 98% of Slovenians that declared their religious affiliation in the census identify themselves with Catholicism, and the rest are predominantly Lutherans.

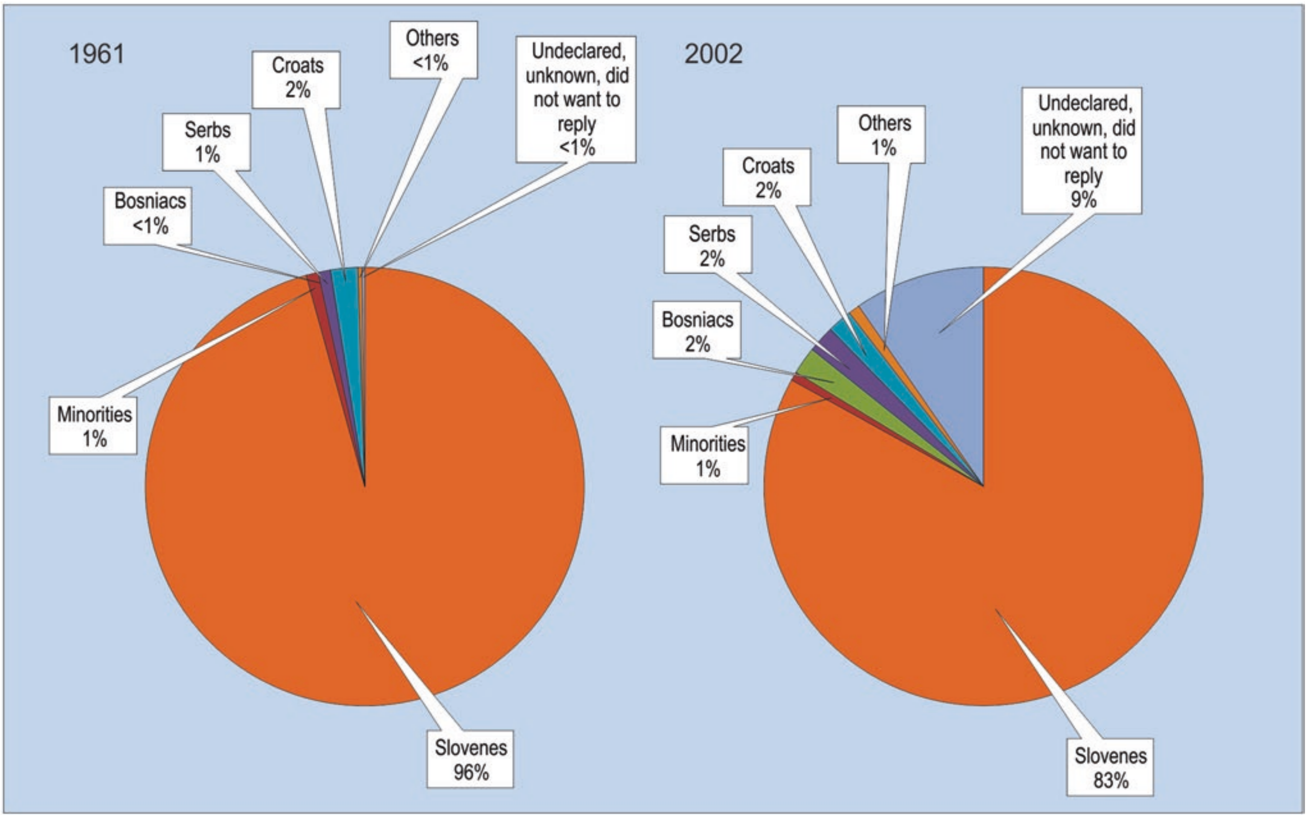

Fig. 10.8 Changes in the ethnic structure of Slovenia's population between 1961 and 2002

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11 The Settlement System in Slovenia

David Bole, Maruša Goluža, Jernej Tiran, Peter Kumer, Maja Topole, and Janez Nared

Abstract

Slovenia's settlement system is characterized by small settlements, a dispersed pattern of settlement, an absence of medium-sized towns, and small-scale (sub)urbanization of the countryside. This is the result of historical events, especially the agrarian character of Slovenian territory until the twentieth century and its polycentric development after the Second World War. The morphology of rural settlements is closely connected with natural conditions because it adapts to the features of four European macroregions. Under communism and during suburbanization, the countryside was "invaded" by semi-urban houses, and the towns experienced rapid growth, with apartment buildings often blending in with older rural and more recent houses. Growth is especially evident in settlements in the suburbanized countryside surrounding towns, where a mixed type of settlements (sub) urbanized on a small scale and rural settlements is emerging, whereas as a rule peripheral rural settlements are shrinking. The towns remain the centers of economic production: small towns have largely transformed themselves into modern industrial centers, and medium-sized and large towns have transformed into places of service and creative industries.

Keywords

Geography of settlements · Suburbanization · Settlement morphology · Urban growth · Urban economy

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11.1 Settlement System Characteristics

Slovenia's proverbial diversity is also confirmed in geographical works (e.g., Perko et al. 2017), whether the focus is on dynamic terrain, biodiversity, or the settlement system. What makes Slovenia's settlement system unique is its smallness and lack of balance because it does not fully follow Zipf's law or the rank-size rule, which is a consequence of absent or underdeveloped medium-sized regional centers due to the introduction of the communal polycentric system after the Second World War (Nared et al. 2017). International urban-rural typologies usually place Slovenia among the least urbanized European countries. Based on an older OECD typology (2011), which classifies LAU2 units (i.e., municipalities) based on population density, 44.8% of the Slovenian population lives in a rural environment. According to this indicator, only Ireland and Lithuania are more rural. According to a more recent methodology that classifies inhabitants based on the density of settlement within a 1-km grid (EUROSTAT 2017), Slovenia even comes in second (with 51.6% of rural residents), right behind Lithuania. Small settlements are especially typical of the Dinaric plateaus and lowlands and the alpine and Pannonian plains. Over the past century, rural settlements, which in the past were greatly affected by natural conditions and the period of colonization (Drozg 1998b), have been under the strong influence of industrialization (Drozg 1998c) and pronounced suburbanization in recent decades (Ravbar 1997).

In terms of directing the settlement system, significant improvements were made in the 1960s and 1970s with the implementation of local government reform and the introduction of regional policy and the concept of Slovenia's polycentric development. Local government reform introduced a single-tier communal system, in which municipalities became a constitutional category in 1963 and their powers increased further with the 1974 amendment to the constitution (Nared 2017). The promotion of more balanced spatial and economic development was also facilitated by a

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D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_11

new law on promoting less-developed areas (Nared 2003), but a more important role was played by the polycentric development policy. At the strategic level, the main framework of polycentrism was set around 1964 as part of preparations for the first Slovenian Regional Spatial Plan, which envisaged 5 or 13 regional centers (Drozg 2005). In 1974, the concept shifted toward the development of 64 local (i.e., municipal) centers (Drozg 2005). Another planning document—the Long-Term Plan for the Socialist Republic of Slovenia, 1986–2000 (Dolgoročni … 1986)—gave priority to the economic development of regional centers or to moderate concentration rather than complete dispersion, but its implementation was a failure (Drozg 2005). Slovenia's Spatial Development Strategy (Strategija … 2004) is the last important strategic document in terms of directing the development of settlements. It mentions polycentrism from the perspective of improving access to assets of public importance and does not regard settlements merely as production centers but as centers of services and of social and transport infrastructure (Drozg 2005).

The analysis of central Slovenian settlements (Nared et al. 2016; Nared and Razpotnik Visković 2016; Nared et al. 2017; Nared and Miklavčič 2017) defined central settlements based on services of general importance, focusing on four key services: education, healthcare, public administration, and the judiciary.

Of the total 6000 settlements in Slovenia, 703 had at least one of the functions mentioned above. However, because some of them are small, the level of centrality was also defined by the population of an individual settlement, whereby the central settlement had to have at least two functions or a population of at least 500. Because of the lack of spatial differentiation, some settlements were additionally combined into contiguous settlements (Nared et al. 2016), based on which a total of 360 central settlements were defined (Fig. 11.1). The study showed that the Slovenian settlement system consists of Ljubljana and Maribor as national centers of international importance; Celje, Nova Gorica, Koper, Novo Mesto, and Kranj as centers of national importance; Domžale, Kamnik, Ptuj, Velenje, Jesenice, Murska Sobota, Trbovlje, Piran, Slovenj Gradec, Izola, Škofja Loka, Brežice, and Krško as centers of regional importance; 38 centers of intermunicipal importance; 55 centers of local importance; and 248 centers of vicinal importance. Other settlements were not identified as central.

As studies have shown, the structure of central settlements of a higher rank is fairly stable, and major changes only occur with central settlements of a lower rank. As a national center, Ljubljana stands out greatly in terms of infrastructure, whereas regional centers in particular have poorer infrastructure than expected, especially in comparison to intermunicipal and municipal centers. This is especially evident when comparing centrality in terms of the provision of services of general importance and centrality in terms of the population in a given settlement. Especially underserviced are settlements in the suburbanized countryside surrounding major urban centers, whereas centers in more sparsely populated parts of southern and eastern Slovenia predominate among the overserviced settlements. Nared (2017) confirmed that the decisive role in constructing the settlement system was played by both local government reforms: the first in the 1960s and 1970s and the second after 1994. Both afforded additional functions to municipal centers, making municipalities important bearers of development.

11.2 The Morphology of Settlements

The agrarian function—tied to land, the system of field division, and agricultural activity—was the primary function of the majority of Slovenian settlements. Within rural settlements, the traditional typology differentiates between isolated farms, which own land in a single piece and are common in the hilly pre-Alpine and Alpine regions; hamlets with 3–15 homes that stand on their own or make up scattered settlements; scattered settlements, typically found in the winegrowing hills; and compact settlements. Compact settlements comprise clustered villages, which are common in both lowlands and uplands, and long ribbon villages, typical of larger plains commonly found in the Pannonian regions (Drozg 1998b). Although they were less common, non-farming settlements also existed from the Middle Ages onward; their residents engaged in mining, ironworking, fishing, smithing, wooden ware production, and other nonagricultural activities.

Traditional Slovenian architecture adapted artfully to the diverse natural conditions. It excels in functional sophistication, high-quality design, conformity with the built environment, and well-thought-out siting of structures that aids in protecting the cultivated land (Deu 2001, 2004). The following four traditional types of rural houses have developed: the Alpine type (the Upper Carniolan, Bovec, Škofja Loka–Cerkno, and Carinthian versions), the Littoral type (the Karst, Istrian, and northern Littoral versions), the Pannonian type (the Mura Valley and White Carniolan versions), and the central Slovenian type (the east-central Slovenian, west-central Slovenian, and Inner Carniolan versions) (Drozg 1995, 1998a; Fig. 11.2).

Yugoslav policy after the Second World War promoted a decentralized concentration of residential areas. The planners at that time dedicated significant attention to planning towns, whereas the countryside was left to spontaneous development. Abandonment of tradition often led to a degradation of villages and the landscape. The 1960s and 1970s saw the emergence of suburbanized settlements, which were heavily

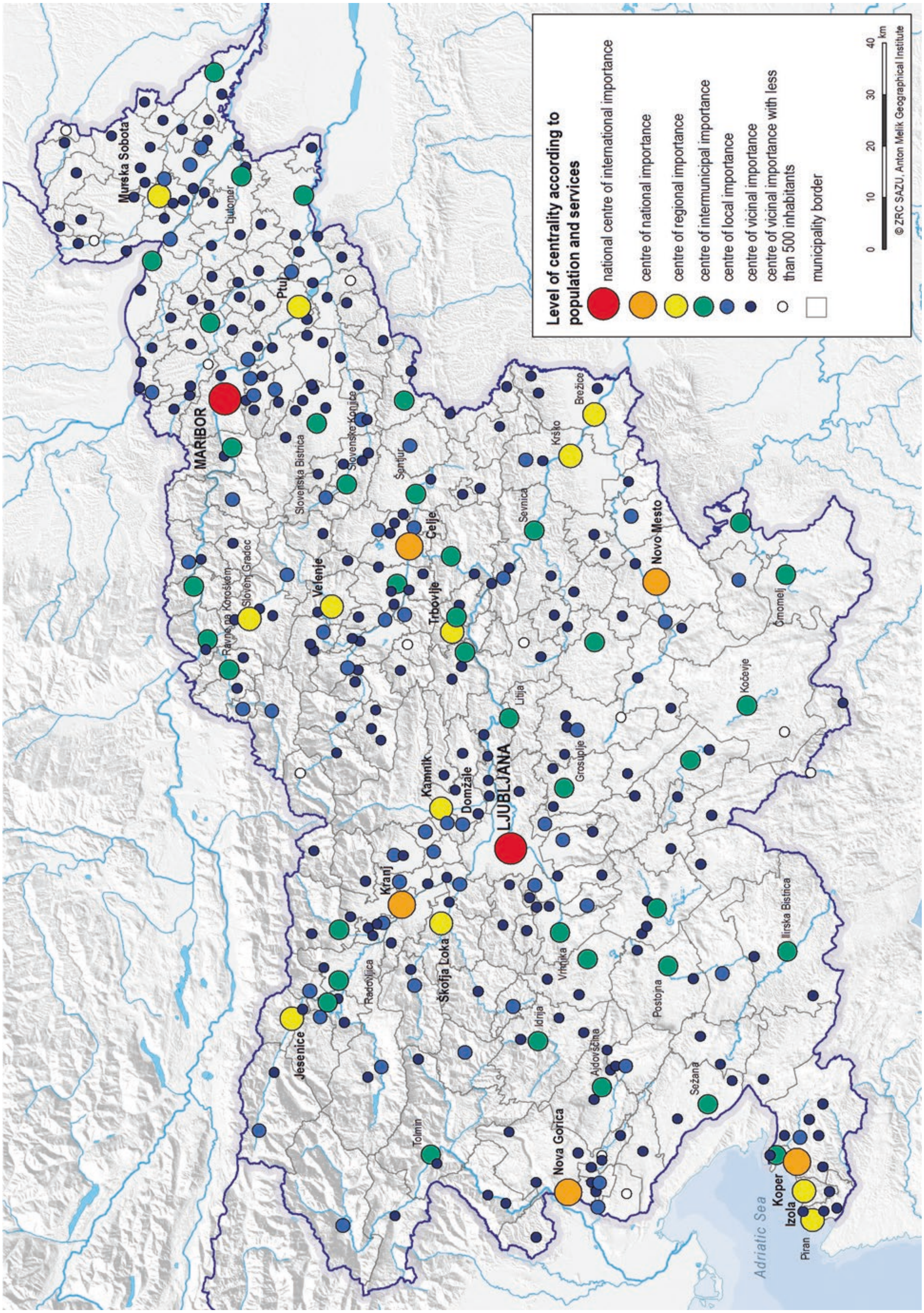

Fig. 11.1 Slovenia's central settlements in 2016. (Nared et al. 2017)

Fig. 11.2 Four traditional types of Slovenian rural houses: (1) Alpine, (2) Littoral, (3) Pannonian, and (4) central Slovenian. (Photo by Maja Topole, GIAM ZRC SAZU Archive)

transformed villages with a linear transport network. A uniform semi-urban house modeling the urban house spreads across all of Slovenia, appearing alien in the countryside (Drozg 1998a, b). This is also one reason why there are hardly any rural settlements left today; one speaks of urbanized villages instead.

Since 1945, the former rural settlements near large towns or employment and service centers have been growing in terms of population and the area of built-up land. In many ways, including in terms of morphology, they are becoming like urban areas. They are subjected to greater changes than towns (Ravbar 2007). In turn, remote hilly regions are stagnating or even deteriorating in terms of their economy, demographics, and physiognomy (Klemenčič 1991). These trends intensified after Slovenia's independence in 1991 and its shift to a market economy. During the first decades of independent Slovenia, the growth in built-up areas, especially residential ones, was relatively higher in parts of settlements that were not densely populated (Ravbar 2006; Bole et al. 2007).

Slovenia has only recently begun recognizing the importance of preserving the typical visual appearance of a place, its design, and the immediate surroundings and engaging in comprehensive structural, economic, and sociocultural renewal of villages. Many researchers already drew attention to this issue during the 1980s and 1990s (Vrišer 1982; Drozg 1989, 1995). Today Slovenia is promoting the concept of building, expanding, and renovating existing structures, paying increasing attention to landscape features (Strategija … 2004). The conservation of cultural heritage, including cultural landscapes, is key to preserving identity and the most economical way of protecting farmland.

Slovenian towns are very small, and up until the mid-twentieth century, they experienced modest development in terms of construction. Drozg (1998d) distinguishes three basic types of Slovenian urban layout: the medieval, classicist, and modernist type (Fig. 11.3). The medieval and modernist layouts can be identified in approximately three-quarters of towns, whereas the classicist type appears to a notable extent in only the three largest Slovenian towns: Ljubljana, Maribor, and Celje. The layout of the medieval town centers was very uniform: a closed-wall square or a thoroughfare expanded into a square, both densely built up. The classicist layout mostly appears in the form of blocks with orthogonal thoroughfares and working-class neighborhoods and to a minor extent also neighborhoods with detached houses (Drozg 1998d). The modernist layout was most strongly influenced by functionalism and its zoning concept (Drozg 1998d) and the Scandinavian concept of a residential neighborhood (Malešič 2015).

The majority of towns, especially the small ones, are characterized by a morphologically indistinct center and neighborhoods of apartment buildings or single-family

Fig. 11.3 The majority of Slovenian towns feature a distinct medieval and modernist layout and great morphological contrasts, such as in the case of Tolmin. (Photo by Alexandra Lande, Shutterstock.com)

houses distributed in a series of rows (Drozg 1998d). There are great morphological contrasts between complexes of apartment buildings on the one hand and single-family, predominantly detached houses, on the other (Drozg 1999). The share of single-family houses is relatively high: 44.9% of the urban population lives in single-family houses or duplexes (SURS … 2015). Hence, the average population density is also low, but it notably increases with the size of the town (Pelc 2015). A low level of urban development is also reflected in other elements of the physical structure, such as the small share of dense construction along thoroughfares and around parks. In general, the urban character of the town's physical structure is more pronounced in Ljubljana, in the towns in the Littoral, and in newer towns built after 1945 and less in the towns of eastern Slovenia (Drozg 1998d). There are very few examples of planned high-density development of single-family buildings, such as terraced, semidetached, or one-story houses. There is also a clear similarity with more recent construction in the countryside, with the same house layouts and types also appearing in towns. An important element of today's townscape is also the remnants of village centers and rural houses, which in Ljubljana can even be found close to the city center (Tiran et al. 2016).

Like other post-communist towns across Europe, Slovenian towns have also undergone spatial transformation since 1991. After the shift to a market economy, private capital became the main factor in the physical transformation of towns. Urban sprawl continues, especially close to the freeway network—that is, in locations that can be easily accessed by car (Rebernik 2010; Bole 2015). At the same time, there is a visible tendency to compact the urban fabric and growth from the inside. This is also promoted by Slovenia's Spatial Development Strategy (Strategija … 2004), mostly in the form of residential development generated by high demand. Residential areas are most often developed in the form of apartment buildings on small plots of land with an extremely high built-up factor and a lower share of green areas compared to older neighborhoods of apartment buildings (Rebernik 2010). Degraded land—which is largely the result of deindustrialization and industrial decentralization and which accounted for approximately 15% of urban land at the end of the 1990s—is also an important element of the morphological structure of Slovenian towns (Koželj et al. 1998). Over the past two decades, these areas have been intensely redeveloped, whereby they were primarily converted into residential developments and shopping centers (Rebernik 2010).

11.3 Growth and Decline Processes

Slovenia is characterized by a low level of urbanization because the share of urban population has remained the same for the past 30 years (Šuklje Erjavec et al. 2016). Despite this, for decades, the share of farmers in Slovenia has only been about 5%. The majority of people living in rural settlements work in industry and services. The reasons for this go back to the 1960s and 1970s, when, due to accelerated or even "forced" industrialization for ideological motives, Slovenia experienced urbanization that was fed by increased migration from the countryside (Ravbar 1989).

Slovenian rural settlements in the lowlands underwent small-scale urbanization, their residents mostly found work in the production and service sectors, and they worked their farmland more in the sense of part-time farmers. As part-time farms, the households usually earn a major portion of their income from nonagricultural activities (Klemenčič 2002). A typical character of Slovenian settlements developed, whereby they retain rural features in the physical sense, but they look more like urbanized settlements in the social geographical sense. This process was also significantly contributed to the high volume of Slovenian commuters, who were initially tied to public transport and later on to extensive or above-average use of cars, even in comparison to the European average (Bole and Gabrovec 2014). Ravbar's (1997) classification of groups of settlements after Slovenia's independence shows that it was primarily (sub)urbanized settlements near towns that sprang up (Fig. 11.4). These are a special type of settlement in an otherwise rural landscape that are close to major towns and are characterized by distinctly favorable economic development. Their morphology is also very typical, being a combination of rural and modern suburbanized characters. A different type of rural settlement is common in remote and hilly areas; it is composed of smaller settlements and is demographically threatened.

The small-scale urbanization of the countryside is also a consequence of the fact that Slovenians generally do not like to live in towns, even though they depend on them economically (Uršič 2010). Natural amenities are the most important factor in selecting one's place of residence and are significantly more important than the cultural amenities typical of more urban environments (Kozina 2016). The gap between the urban and rural environment is increasing and also manifests itself at the ideological level and in voting preferences (Vehovar and Tiran 2017). Local government reform and the absence of a regional level of government after independence continued or even enhanced the aspirations for the decentralization and strengthening of smaller settlements, considering that a number of new municipalities with new powers were

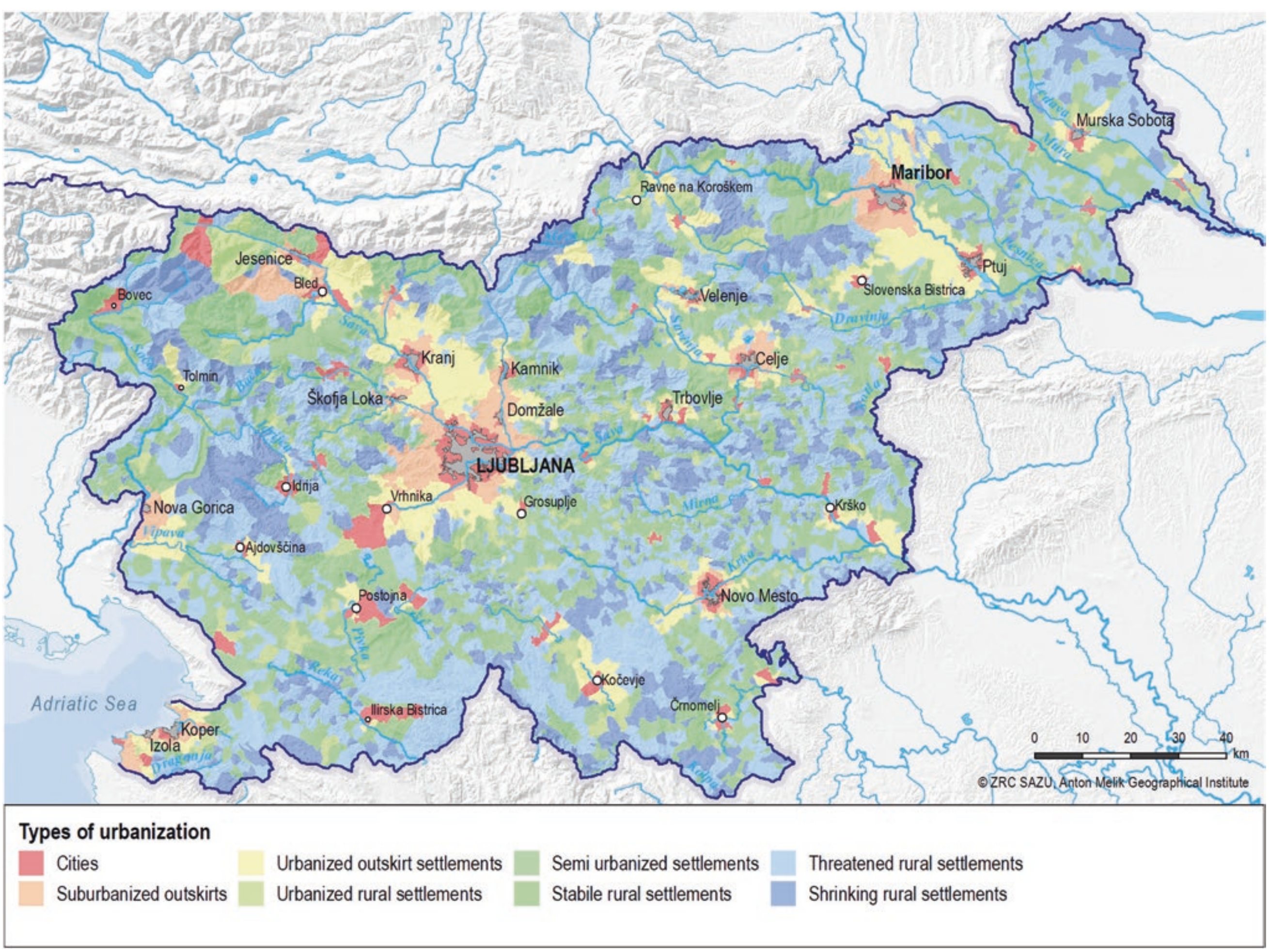

Fig. 11.4 Types of urbanization after Slovenia's independence

created. Small-scale suburbanization, where even the smallest towns are surrounded by suburbanized countryside, has already passed into its secondary phase in Slovenia (Rebernik 2003). This means that in certain urban regions, economic activities are also moving into the surrounding countryside alongside its residents, especially in the form of industrial zones (Pichler-Milanović 2014). In the case of Ljubljana, the suburbanization of economic activities primarily entails relocation of the secondary sector, and less the relocation of the private service sector, but it does not entail relocation of the public sector (Bole 2008).

Because of the (sub)urbanization characteristics mentioned above, the definition of towns in Slovenia is also somewhat complicated. According to European criteria, there are only two towns with a population over 50,000: Ljubljana (288,000) and Maribor (100,000). However, because of the past communist social planning and the principles of polycentrism at the local level, smaller local centers also acquired an urban character, which was in line with the social and ideological conditions of that time (Drozg 2005). Because of the "equalization" of urban and rural conditions, a minor economic revolution occurred during the 1960s and 1970s: smaller local centers, many of them were previously completely rural, obtained factories and services of general importance, such as health centers and schools. Despite having smaller populations, these "augmented" settlements became important gravitational centers for providing jobs and basic services to the residents of the surrounding countryside. This is how small towns developed, and they continue to be a special feature of the Slovenian urban system today (Bole 2008). Because the concept of polycentrism has never been comprehensively realized at the regional level, regional centers (i.e., medium-sized towns) have not developed to a similar extent.

Therefore, towns are defined in various ways and are usually smaller than in other European countries. According to the national statistics office, there are 104 urban settlements, in which the smallest has a population of only around 1400 (Pavlin et al. 2003). The latest study, which serves as material for the new spatial development strategy, identified 57 centers that could be defined as towns (Nared et al. 2017). Various other studies have sought to define towns from a research perspective. Zavodnik Lamovšek et al. (2008) used formal, morphological, and functional criteria to define 93 towns, among which the smallest had a population of only a few thousand. There were exceptionally a few medium-sized towns with a population of approximately 30,000 or more.

11.4 The Post-Communist Urban Economy

The economy of Slovenia's urban system is characterized by a transition from the industrial to postindustrial stage of development (Bole 2012). This transition has accompanied the transformation from the former communist regime to a market-oriented democratic society. Therefore, the postindustrial phase is inevitably intertwined with post-communist discourse. The economic transition has undoubtedly led to major changes in Slovenia's urban landscape. During this transition, it has faced severe external constraints resulting in deindustrialization and tertiarization (Bole 2008).

A socioeconomic analysis of Slovenia's urban system (Bole 2008) has shown that there are 64 urban settlements in Slovenia (urban character has been defined through the concept of centrality), with the smallest urban settlement having a population of only 2200. Industrial employment constitutes 36% of all employment, private services 38%, and public services 21%. A general rule is the smaller the settlement, the larger the industrial employment. More than half of all urban settlements maintain a predominantly industrial profile despite the deindustrialization that took place after the 1990s. Some have failed to successfully restructure from communism to a market economy, which has resulted in a decline in the number of residents and jobs (Bole 2008, 2012; Kos 2007; Dijkstra and Poelman 2014). Due to developmental decline, these towns—for example, Trbovlje—are undergoing deurbanization. In spite of this, small towns in Slovenia cannot be characterized as shrinking towns (Wiechmann and Bontje 2015). Medium-sized towns with about 30,000 inhabitants are either stable industrial centers (e.g., Velenje and Novo Mesto), in the process of deindustrialization and tertiarization (e.g., Kranj), or stable service-orientated centers (e.g., Koper and Nova Gorica). Ljubljana is a growing city experiencing primary and secondary suburbanization (Rebernik 2003). The economic domination of Ljubljana and other tertiary and polyfunctional centers has caused a decline in the importance of a large number of small towns (Bole 2012), which have often transformed into commuter towns (Nared et al. 2016). Maribor, on the other hand, had significant shrinkage problems in the past but has recently started redevelopment activities for degraded land and transformation of commercial and residential areas in the inner city (Rebernik 2009). The towns with the largest shares of employment in manufacturing include Idrija (the automotive industry, electricity, and technological systems), Ajdovščina (timber, food-processing, and textile industries), Novo Mesto (the automotive and pharmaceutical industries), Velenje (energy, metal-processing, and construction), Slovenj Gradec (metal processing, the automotive industry, and wood processing), and Kranj (electronics, rubber, footwear, and textiles; Bole 2008).

Taking into account that Slovenia entered the "creative path" later than countries in western Europe (Stryjakiewicz et al. 2014; Kozina and Bole 2017a, b), the country is experiencing a strong rise in professions in the creative industry, which currently accounts for 1.5% of jobs (Murovec et al. 2012). The creative sector has contributed greatly to changes in post-communist cities through its specific

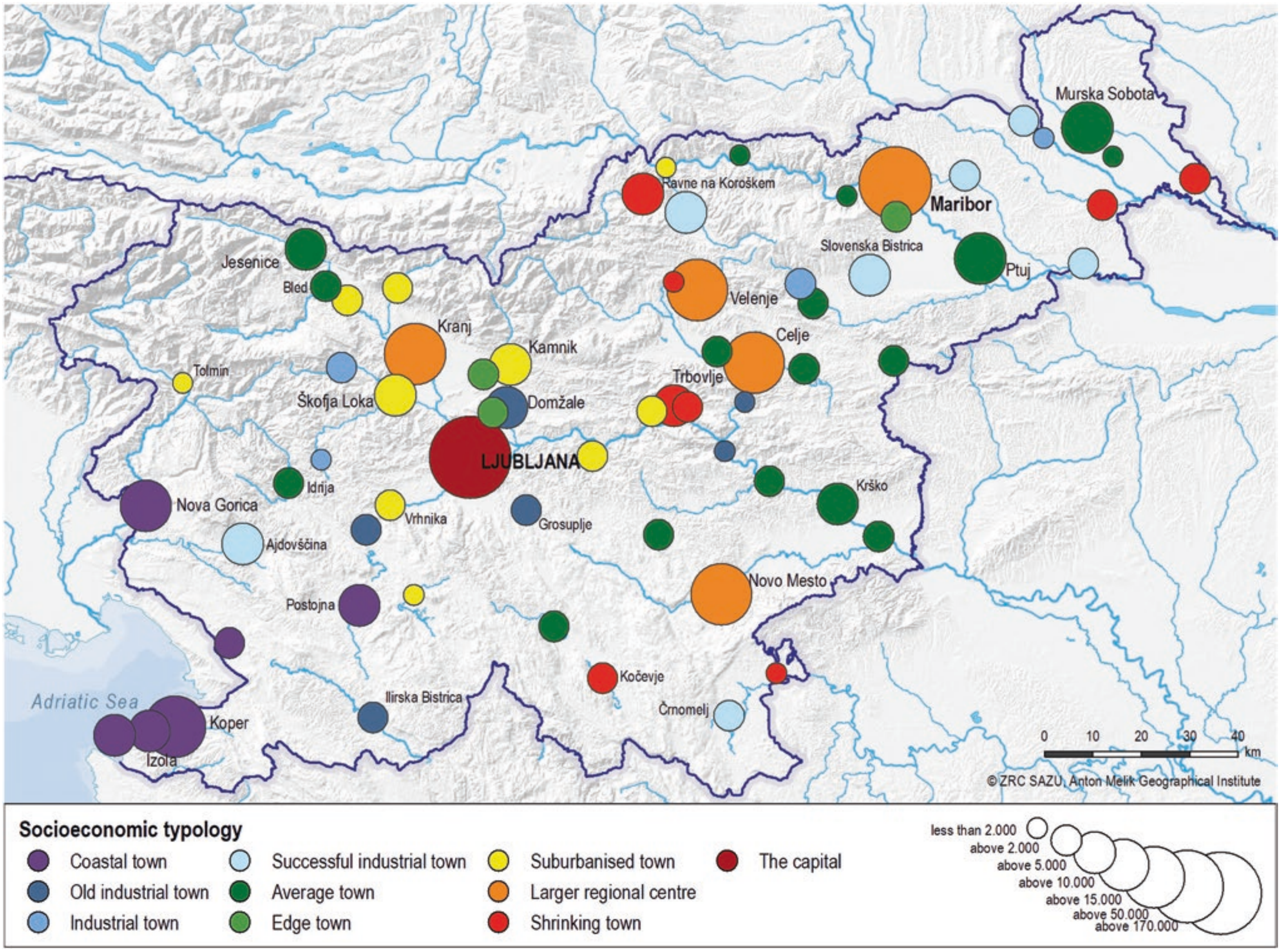

Fig. 11.5 Socioeconomic typology of Slovenian towns

characteristics: specifically, a high level of networking, their tendency to cluster, or the heterogeneous milieu they need (Chapain et al. 2010). Creative industries are clustered in central Slovenia, most clearly in Ljubljana. The most prominent increase in jobs in the creative industries is evident in southeastern, southwestern, and central Slovenia (Kozina 2016).

Bole (2008) identified eight types of Slovenian towns according to socioeconomic criteria (Fig. 11.5): coastal towns (Sežana, Postojna, and Nova Gorica) with a predominantly retail and tourism sector with a large share of private investors; old industrial towns (Radeče, Logatec, Grosuplje, and Domžale) with companies mostly established before 1991 and slow economic growth; industrial towns (Železniki, Zreče, Žiri, and Radenci) with a small number of large manufacturing industries and a large share of employment in manufacturing; successful industrial towns (Ajdovščina, Slovenska Bistrica, Črnomelj, and Slovenj Gradec) with a large number of old industries but also a large share of employment; average towns (Murska Sobota, Ptuj, Jesenice, Idrija, and Sevnica) with a large share of manufacturing industries and medium-sized companies established with domestic capital after 1991; "suburbanized" towns (Tolmin, Radovljica, Tržič, and Cerknica) with a decreasing number of jobs, industrial decline, and an increasing number of daily commuters; large regional centers (Kranj, Novo Mesto, Maribor, and Celje) with a large number of medium and large companies and jobs for the wider region; shrinking towns (Hrastnik, Kočevje, Lendava, and Ljutomer) that were once successful industrial towns with an increasing number of unemployed people and an economy based on the old manufacturing and mining industry; and the capital (Ljubljana) with large and heterogeneous employment opportunities and a strong tertiary and administrative sector. Edge towns (Komenda, Trzin, and Hoče) are a type of town that has appeared in the recent decades. These usually form near highways and have a highly specialized function focused on small-scale retail services or high-tech businesses. They are often based in municipality-designated business parks.

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12 Slovenian Economy

Janez Nared, David Bole, Nika Razpotnik Visković, and Jernej Tiran

Abstract

This chapter presents the basic characteristics of the Slovenian economy. A discussion of its historical development since early industrialization is followed by a presentation of the importance of the interconnection between social and economic development after the Second World War, when the communist authorities perceived industry as the chief driver of development and hence industrial development became an important part of social and spatial planning. After Slovenia's independence, deindustrialization and tertiarization came to the fore, thoroughly transforming the country's economic structure. After transition into a postindustrial society, the previously predominating secondary sector now employs less than a third of the workforce, and the service sector employs more than two-thirds (67.2%). The chapter continues by presenting the international embeddedness of the Slovenian economy, the features of rapidly growing tourism in Slovenia, and the role of part-time farms.

Keywords

Economic geography · Industrialization · Deindustrialization · Sectorial overview · Tourism · Part-time farms

12.1 Introduction

Before industrialization, subsistence farming and handicraft predominated in Slovenia, with handicraft concentrated in towns and cities. Individual industries began to emerge in the first half of the nineteenth century, first in textiles, iron, paper, and metal processing (Vrišer 1998). The first factories were based on local raw materials, which alongside industrialization also fostered the development of mining, and as early as the nineteenth century, foreign capital also began to flow into Slovenia. The new cement works, brickworks, lime works, and woodworking, chemical, textile, leather, tobacco, and food industries significantly expanded the range of industries, and, in spatial terms, the new companies largely sprang up along the newly built railroads in the industrial crescent (Fig. 12.1) that extended from Jesenice via Kranj, Ljubljana, Zagorje, Trbovlje, Hrastnik, Celje, and Maribor to the Mežica Valley (Vrišer 1998).

Major organizational and spatial reorganization of the economy only occurred after the Second World War with the transition to a planned economy and the policy of polycentric spatial development.

12.2 The Legacy: Social Planning and Industrialization

The communist period from the end of the Second World War to 1991 was characterized by a planned, centralized, and "collectivized" economy. Forming the basis for social and economic development, and subsequently also spatial development, industry played an important developmental role. Its organization relied on completely different bases than in the capitalist countries, and its role was emphasized for completely political and ideological reasons (Musil 2005). The greatest difference compared to capitalism was the absence of market forces and private initiative, which had an important impact especially on the development of urban regions. This development was largely based on industry (Hamilton 2005). Within Yugoslavia, Slovenia was characterized by above-average industrialization because immediately before the Second World War, industrial workers accounted for more than a third of its urban population, especially in con-

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© Springer Nature Switzerland AG 2020
D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_12

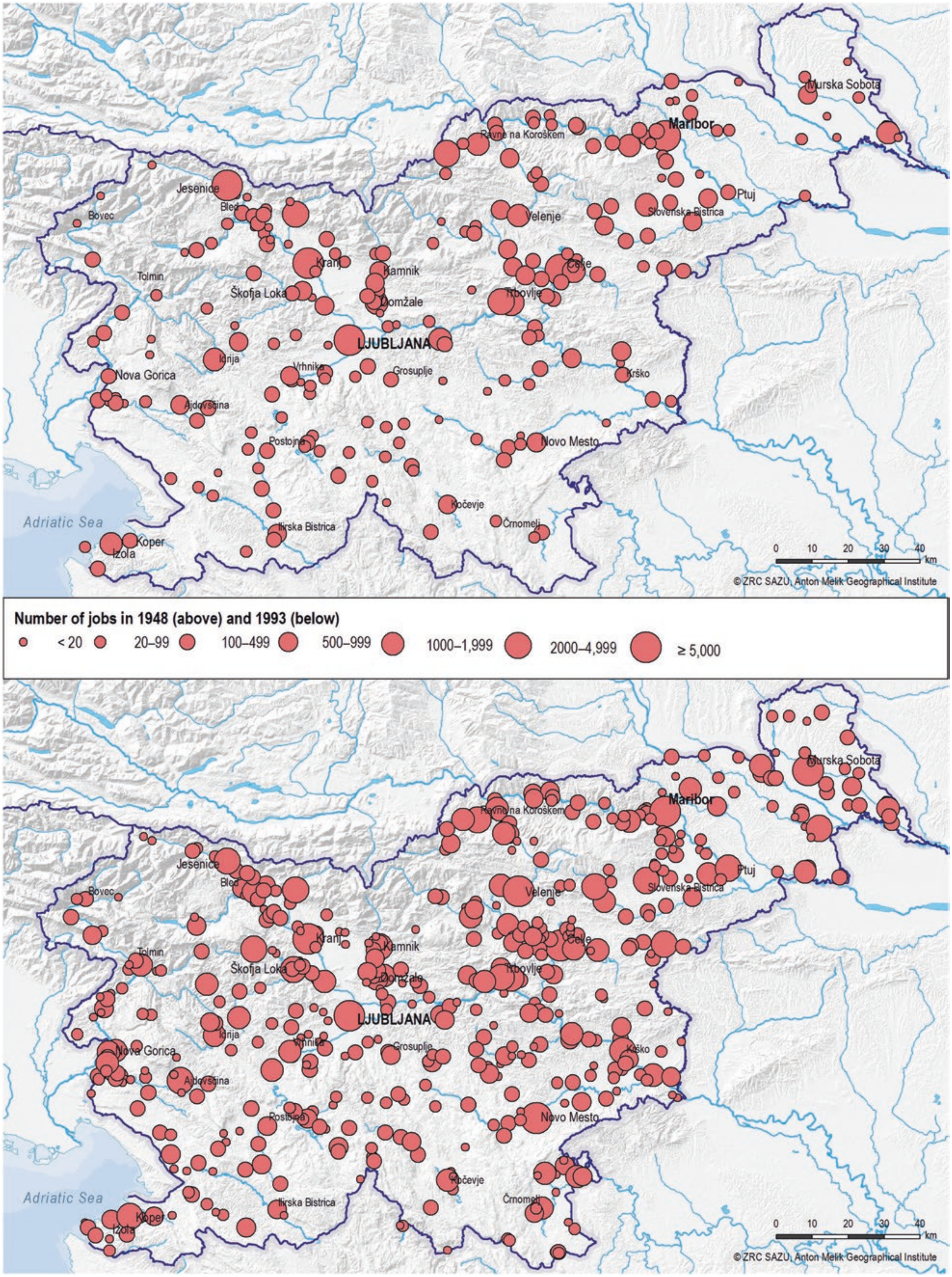

Fig. 12.1 Settlements with industrial jobs in 1948 and 1993. (Vrišer 1998)

trast to southeastern Yugoslavia, which had a predominantly agrarian economic basis (Vrišer 1977).

With the emergence of communism, industrialization and urbanization acquired a completely different form compared to the period before the war. Postwar political and planning documents mentioned industrial development as a key element, which was reflected in both the urban system and spatial structure. In a centrally planned economy, which envisaged that industrial growth would decisively contribute to socioeconomic development, industrialization was heavily deconcentrated. Industrial jobs were to cover the entire territory and ensure "equality" in terms of job accessibility, thereby facilitating more balanced development (Drozg 2012; Nared 2018). Especially in Hungary, Czechoslovakia, Yugoslavia, Poland, and East Germany, there was an effort to reduce regional disparities by locating industry in formerly under-industrialized or nonindustrialized areas. In Yugoslavia and hence also in Slovenia, as part of Yugoslavia, some completely agrarian rural settlements obtained factories. Accordingly, large industrial plants were often placed in completely inappropriate environments with insufficient workforce, production tradition, or know-how (Zapletalova 2007; Drozg 2012; Nared 2018). Dispersed industrialization had a strong impact especially on already industrialized older towns, such as Maribor and Ljubljana, which were forced to consign a large portion of the added value generated in industry for the "new industrialization" of the countryside (Fig. 12.1).

Musil (2005) reports that later (after 1970), the urbanization and industrialization strategies slightly relaxed and became less utopian in the majority of communist countries. Something similar also occurred in Slovenia: economic planning increasingly took into account the basic features of economic progress, such as the importance of geographical concentration of economic activities and better regard for the basic locational factors; establishing links with western companies was also common, especially in the automobile industry. Hamilton and Carter (2005) presented the external forces affecting the urban development of communist countries, including Slovenia, up to the 1989 collapse of the communist model. They mention moderate polycentric concentration, whose primary aim was to develop regional centers, a more liberal policy of forming links with the West, an international division of labor within individual communist countries, and so on.

Because of the emphasized role of industry, during communism, regions focused heavily on the secondary sector, except for some regions that had a predominating public administrative function. Services were in the background due to the population's low purchasing power and a general lack of products or services for private consumption (Rebernik 2008). Services relied on the public sector, represented by a strong bureaucratic machinery, education, and healthcare. Except for rare cases, trade, crafts, and tourism were heavily neglected and only developed in certain places with a special function, such as tourism centers (e.g., Bled and Piran) or health resorts (e.g., Rogaška Slatina). The tertiary sector began to grow more notably during the 1980s, especially in larger towns with strong population pressures and significantly increased needs for services (Vrišer and Rebernik 1993).

12.3 Deindustrialization and Tertiarization

In the former communist countries, changes in the economic sectors were exceptional and characterized by the demise of the manufacturing sector and the subsequent growth of the service sector or, in short, deindustrialization and tertiarization. The collapse of the communist economic model and the privatization of public enterprises brought the postcommunist countries closer to those with an established capitalist tradition, but, as noted by Pavlinek (2003), this was a completely different "path-dependent" development, which even today still comprises characteristics of both a centrally planned and capitalist economy and is therefore referred to as "state capitalism."

Deindustrialization was the most conspicuous form of economic restructuring. It is often sought to portray this as a distinctly negative process, which is frequently accompanied by broader, negative socioeconomic processes, such as unemployment, economic crises, and increased income inequality. Hence it is important to point out that deindustrialization essentially entails a transformation of the industrial sector, which is forced to change under the modern conditions of technological progress and trade internationalization (Rowthorn and Ramaswamy 1999). Thus, deindustrialization is the main process marking the transition to a postindustrial society and also the main process that characterized the transformation of postcommunist countries like Slovenia.

Industry was in a poor situation for various reasons. The technology used at the factories was completely outdated, and productivity was low, considering that during communism industry also had a political and social function, rather than merely an economic one. Hidden unemployment was common, with factories hiring workers for the sake of social contentment rather than actual labor demands (Bole 2008). Entry into a market economy pushed such factories into an unfavorable position, and workers began to be laid off to reduce production costs and increase productivity. Wars broke out in the former Yugoslavia, and some important markets disappeared. In some places privatization was only partially successful because the state retained controlling interests in the companies, and the management structure also remained the same, consisting of the same people that had already managed companies during communism (Pavlinek 2003). Another major problem was the structure of the communist industrial sector, which was largely based on labor-intensive industries, which were in general global recession (e.g., the metal, mechanical, textile, and footwear industries; Lorber 1999).

A general decline in the number of industrial employees can be seen in Fig. 12.2. The share of people working in industry and mining practically dropped to half over the 30 years observed, with more than two-thirds of all employees now working in the service sector. However, as shown in Fig. 12.3, the decrease in industrial employees is the result of positive deindustrialization, where productivity increases, unemployment decreases, and the scale of production remains approximately the same. Despite everything, among all of the postcommunist countries, Slovenia has been the fastest to catch up with the rest of Europe (Bohle and Greskovits 2007); its industries are mostly larger and export-oriented, as well as strong in technological innovations and patents (Nared et al. 2017). Only Slovenia and the Czech Republic had a per capita income above 80% of the EU-27 average (Smith and Timár 2010). Based on empirical data, such as the Gini coefficient or the income-consumption ratio between the richest and poorest 20%, Slovenia is among the countries with relatively low inequality (Kosec Zorko 2009). Bohle and Greskovits (2007) divided postcommunist European countries into three political-economic regimes: neoliberal, embedded neoliberal, and neocorporatist. Slovenia is the only one that can be classified in the last category and is characterized by a firmly institutionalized balance between marketization and both kinds of social protection, whereby business, labor, and other social groups are accepted as partners in shaping that balance.

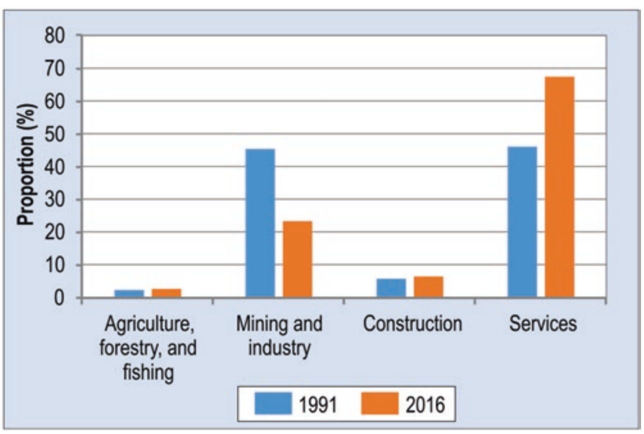

Fig. 12.2 Percentage of people employed by economic sector in 1991 and 2016. (SURS 1992, 2017a)

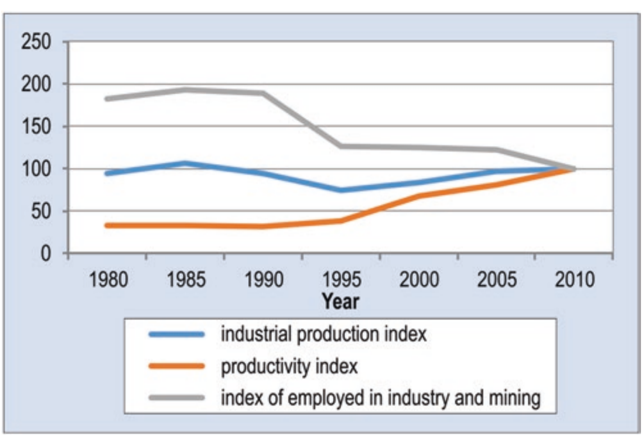

Fig. 12.3 Industrial production, productivity, and employment indexes in Slovenia from 1980 to 2010 (2010 index, 100; SURS 2017b)

Changes in the economic sectors probably also had an impact on the spatial structures of towns and regions, especially because of the great influx of foreign and partly also domestic developers that sought to establish themselves in the new market system as quickly as possible. These projects largely targeted the urban periphery in the form of greenfield development, which is alarming from the perspective of sustainable spatial development (Bole 2010). Developers are prepared to invest fewer funds in decaying brownfield areas within built-up urban areas, in which they are often assisted by vague and inappropriate spatial legislation.

12.4 Overview by Sector

As a result of deindustrialization and tertiarization at the end of the 1980s and the beginning of the 1990s, which marked the transition into a postindustrial society, today more than two-thirds (67.2%) of employees work in the tertiary sector. The share of the secondary sector, which includes manufacturing, mining, and construction and was still predominant even in the early 1990s, has fallen below one-third (29.5%), and only 3.3% of employees are now employed in the primary sector (agriculture, hunting, forestry, and fishing; SURS 2016a). Ratios between the sectors in terms of the gross added value are very similar, with the tertiary, secondary, and primary sectors generating 68.5%, 29.1%, and 2.4% of added value, respectively (SURS 2016b). It was only in 2015 that the total gross added value broke the record of 2008 from before the economic crisis, rising to €37.6 billion in 2017 as a result of favorable economic conditions (EUROSTAT 2017a). A more detailed analysis by activity (Fig. 12.4) shows that manufacturing predominates in terms of the number of employees (22.8%), followed by trade (13.4%), education (8.4%), human health and social work activities (7.2%), construction (6.4%), and professional, scientific, and technical activities (6.3%). Among them, the share of employees working in the public sector accounts for 17.4%, which is slightly below the OECD average (OECD 2017).

Among the service activities, trade is the one that has restructured and strengthened the most since 1990, causing the

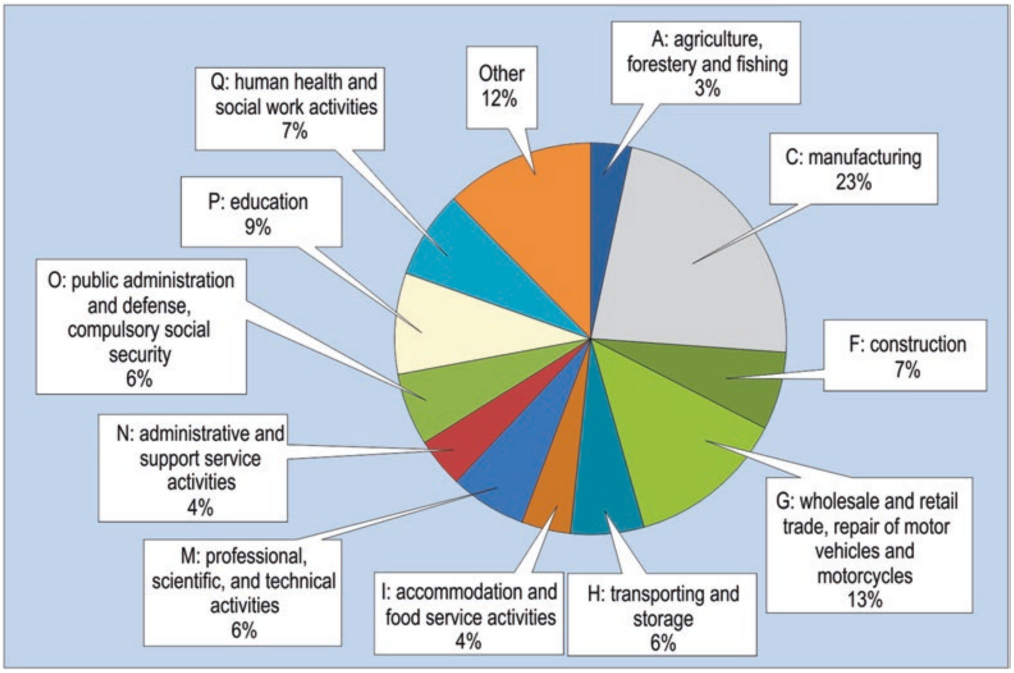

Fig. 12.4 Employment by activity (with NACE codes) in 2016, clockwise. (SURS 2016a)

most visible changes in the landscape. Today's shopping centers cover 2.4 million m^2. The per capita retail sales area grew from 0.42 m^2 in 1989 to 0.76 m^2 in 2001 and 1.18 m^2 in 2017 (SURS 2004; Žlogar 2017), which ranks Slovenia in the upper half of the European countries (Raičevič 2017). Novo Mesto and Ptuj are at the forefront in terms of retail area density, offering more than 3 m^2 per capita (Žlogar 2017).

Despite the deindustrialization trends, industry has remained one of the most important economic activities. The current data on employment by activity show that Slovenia has one of the largest proportions of employment in industry in the EU-28: at 22.5% it ranks fourth after the Czech Republic, Slovakia, and Poland (EUROSTAT 2015). In 2015, industry contributed 65.6% to all Slovenian export (falling from 74.7% in 2008; SURS 2015). Industrial companies are among the most successful in the country because various scales (total revenue, net profit, and number of employees) mostly rank companies in the automobile industry (e.g., Revoz/Renault), the pharmaceutical industry (e.g., Krka), and the electrical appliance industry (e.g., Gorenje). Among industries, Slovenia is the most specialized in manufacturing of fabricated metal products (except machinery and equipment) because its share in nonfinancial business economic value added in 2014 (5.2%) was the highest in the EU (EUROSTAT 2014). Some indicators such as industrial production, sales revenues in industry, and stocks of industrial products have been improving since 2011, which indicates a renewed importance of industry since the economic crisis of 2008 (SURS 2017c). On the other hand, in 2010 and 2015, only 14% of products created in Slovenian manufacturing were highly technologically complex (SURS 2017d), which points to Slovenia's low position in the global manufacturing chain and the predominance of intermediate rather than finished products.

Agriculture predominates strongly in the primary sector, with the total share of those employed in forestry and fishing under 10%. The gross added value of agriculture in Slovenia in 2010 accounted for 1.2% of GDP and stood at the EU-27 average. On the other hand, Slovenia was among the countries with the highest share of people working on farms (i.e., 10%). Even though the intensity of agricultural production is on the increase, some indicators point to unfavorable natural and social factors hindering agriculture: thus, Slovenia ranked second among the EU-27 in terms of labor input per hectare. Plant production accounts for the largest share in agricultural production (i.e., 53%), whereas the share of livestock production is 44%. Above-average shares of cattle, fodder crops, fruit, wine, and olive oil, which are higher than in other EU countries, stand out among individual groups of agricultural products. Even though Slovenia is among the countries with the least arable land area per capita, it ranks fourth among EU hop producers, with 5% of its area used for growing hops (SURS 2013).

The analysis of Slovenia's employment structure shows that jobs in the service sector predominate in 167 municipalities (78.8%), followed by jobs in the secondary sector, which predominate in 41 municipalities (19.3%), and jobs in the primary sector, which prevail in 4 municipalities (1.9%). The types of municipalities by employment sector are presented in Fig. 12.5.

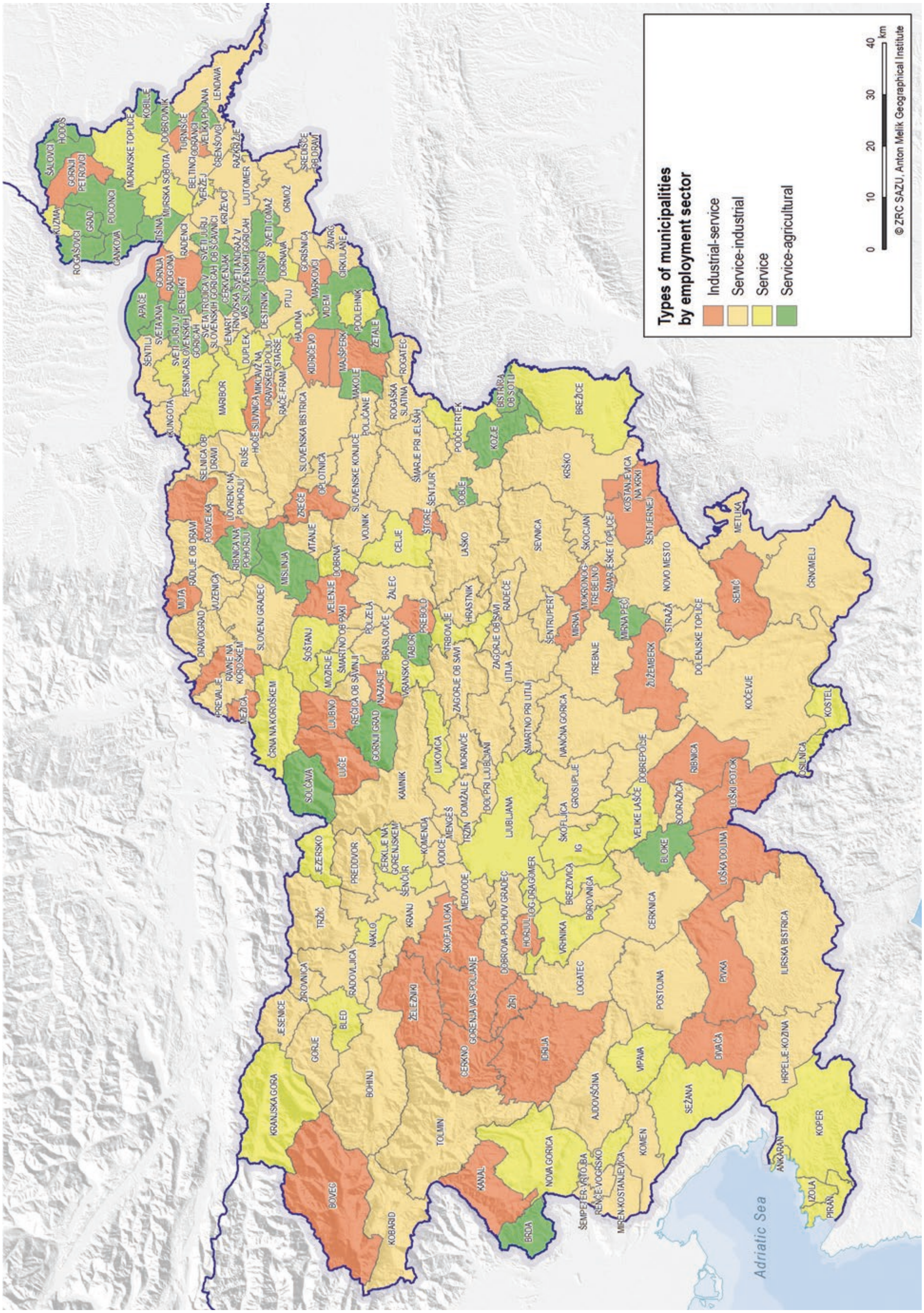

Fig. 12.5 Typology of municipalities in terms of employment by sector created with cluster analysis using Ward's method and the Euclidean-squared distance

In terms of employment structure, the majority of municipalities (i.e., 93) can be classified under the "service-industrial" type, which is characterized by a below-average but nonetheless largely predominant share of employees in the service sector, a slightly above-average presence of the primary sector, and an above-average share of jobs in the secondary sector. They are evenly distributed across Slovenia, and smaller municipalities with centers of intermunicipal or local importance predominate among them. Here one can also find regional centers with important industrial plants, such as Novo Mesto with its automobile and pharmaceuticals industry and Kranj with its rubber industry.

The "service" type (44 municipalities) with a predominant share of jobs in the service sector can be found in major towns that also serve as national or regional centers with functions of general importance (e.g., Ljubljana, Maribor, and Celje), municipalities with well-developed tourism (e.g., Kranjska Gora, Brežice, and Piran), smaller deagrarianized municipalities without major industrial enterprises (e.g., Kuzma and Veržej in northeast Slovenia and Vransko), and municipalities in the immediate gravitational area of major towns (e.g., Ankaran, Trzin, and Brezovica). Some municipalities were strong industrial or mining centers in the past but were subject to strong deindustrialization after 1990 (e.g., Trbovlje and Maribor). In some municipalities, the share of tertiary sector employment even accounts for 80% or more.

The 36 "service-agricultural" municipalities make up a special group characterized by an above-average share of primary sector employment (30% on average). They predominate in northeastern Slovenia, especially in the Pannonian hills; beyond that, they can only be found in the traditionally agricultural Gorica Hills and some areas remote from employment centers, such as Bloke. In four smaller municipalities in eastern and northeastern Slovenia, the share of primary sector employment even predominates.

The "industrial-service" municipalities (39) with a predominant share of industry are generally more represented at the "fringes" and not in the central urban parts of the country. This is partly a consequence of communist policies of industrial dispersion to rural areas in the later stages and partly due to deindustrialization trends in large- and medium-sized towns in the country in the 1990s. Current industry is mostly located in smaller towns that managed to transform former communist-style factories into successful ventures. Interestingly, many of those towns are in more remote, hilly areas, not connected with highways or railways, reflecting their endogenous development and transition (Kolektor or Hidria in Idrija or RIKO in Ribnica). Rarely, new industrial development was spurred due to foreign industrial investment, which is characteristic for other postcommunist central European countries such as Slovakia, Hungary, or the Czech Republic (Pavlinek 2004). Only 2 of 16 medium-sized towns (with populations between 20,000 and 60,000) are highly industrialized: Velenje (population 33,000; 59% industrial jobs) with the Gorenje household appliances factory and a functioning coal mine and Škofja Loka (population 23,000; 47% industrial jobs), where there is a mix of older factories that have managed to modernize (e.g., paper and furniture manufacturing) and foreign companies that have moved their production from elsewhere (e.g., Knauf Insulation).

12.5 Slovenia in the Global Market

Although Slovenia was a constituent republic of communist Yugoslavia, its economy also formed links with western European market-oriented economies already very early on. Consequently, its transition from a planned economy to market economy was not as severe, and companies managed to make up for the lost markets in the other former Yugoslav republics relatively quickly.

In terms of GDP as an indicator of a nation's economic situation, Slovenia is still below the EU average. At €19,600 per capita in 2016, it stood at 67% of the EU average, compared to the period before the 2008 economic crisis, when it had already reached 72%.

This points to a relatively weak recovery from the economic crisis, considering that unlike the EU economy, which began recovering 2 years after the crisis, the Slovenian economy only recorded somewhat stronger growth after 5 years (Fig. 12.6). A major reason for this was the heavy dependence on international markets, with exports accounting for 77.7% of GDP (EUROSTAT 2017c), which is significantly above the EU-28 average of 43.9%. Since 2009, a strong export orientation has also been reflected in a positive balance of trade (EUROSTAT 2017d), with the majority of goods being exported to Germany (20.7%), Italy (11.0%),

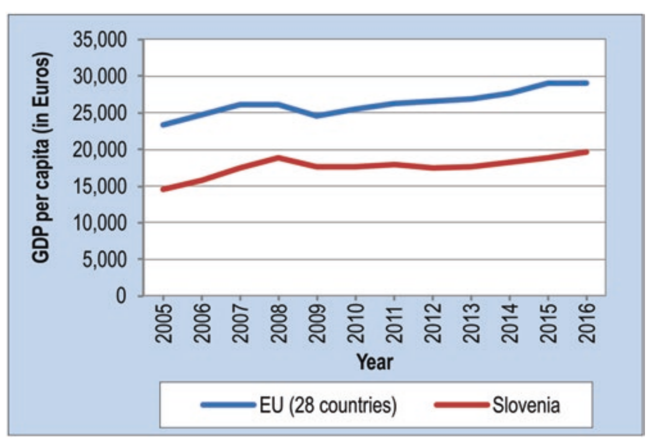

Fig. 12.6 Gross domestic product per capita at market prices. (EUROSTAT 2017b)

Croatia (8.3%), Austria (7.9%), and France (4.7%; SURS 2017e). The largest export sectors include the pharmaceuticals industry (Krka and Lek), home appliance industry (Gorenje and BSH Hišni Aparati), automobile industry (Revoz, Mahle Letrika, and Akrapovič), metal products industry (SIJ, Impol, and Talum), and electrical industry (Kolektor, Hidria, and Domel; Delo 2017).

In terms of foreign direct investment, Slovenia is at the tail end of the European countries (EUROSTAT 2017e), although it has recently managed to attract several important investments (by multinational corporations such as Magna, Yaskawa, and Sumitomo Rubber Industries).

Slovenia is important from the logistics point of view, especially because of its location along the fifth and tenth EU transport corridors, and the Port of Koper (Fig. 12.7) as an important logistics center for the transshipment of large containers and dry bulk goods. Between 2010 and 2015, the port increased its transshipment rate by 36.6%, ranking Slovenia second among European maritime freight transport countries in terms of transshipment growth, directly behind Cyprus (EUROSTAT 2017f), and enhancing its role as an important central and eastern European port.

12.6 In Focus: Tourism in Slovenia

Because of the great landscape diversity and the related opportunities for developing leisure activities, several types of tourist resorts have developed in Slovenia: health, mountain, seaside, and urban. Due to the diverse range of products and activities they offer, each one of them attracts different domestic and international visitors, and in the past each of these resorts has also shown a different degree of resistance to developments during political and economic crises (Komac et al. 2013).

Health resorts have the longest tourism tradition in Slovenia. Their beginnings, connected with the curative mineral water of Rogaška Slatina (Fig. 12.8), go back as far as the eighteenth century (Horvat 2014). Among all tourism areas, health resorts record the majority of overnight stays, and their popularity is increasing, thanks to renovated and modernized accommodation and entertainment facilities as well as wellness or health services. These help providers successfully deal with the large seasonal fluctuations in tourist arrivals typical of other types of tourism resorts. Recreational infrastructure at these health resorts also has a positive impact on the development of smaller private tourism providers, such as vacation farms in the surrounding area. They generate a modest share of all overnight stays (Slovenian … 2017), but they are important for the development of the countryside and its social capital (Mavri and Černič Istenič 2014).

It is mountain tourism that predominates in Slovenia rather than rural tourism, which relies on vacation farms, and it is primarily not centered around the winter season. Because of the relatively low elevations of Slovenian ski resorts and unreliable snow conditions, the winter season merely complements the summer season, during which the attractiveness of mountain resorts primarily relies on the abundance of recreational opportunities in the mountains (Cigale and Gosar 2014; Fig. 12.9). Mountain resorts were

Fig. 12.7 Port of Koper. (Photo by Samo Trebizan, Shutterstock.com)

also the resorts that recorded the majority of international overnight stays in 2016 (Slovenian … 2017).

Seaside resorts also have a long tourism tradition going back to the nineteenth century. Among all tourism resorts, they are the ones that most pronouncedly adapt their range of services to international trends: initially, "climate tourism" was at the forefront, followed by "3S tourism" (sea, sand, and sun) in the second half of the twentieth century, and the increased importance of nautical, conference, and gambling tourism in the twenty-first century. Despite adapting and

Fig. 12.8 The Rogaška Slatina health resort in eastern Slovenia with Mount Saint Donatus (*Donačka Gora*) in the background. (Photo by Cortyn, Shutterstock.com)

Fig. 12.9 Panoramic view of Lake Bled with the Karawanks in the background. (Photo by Alberto Loyo, Shutterstock.com)

expanding their range of services, it took the seaside resorts the longest to financially recover after the breakup of Yugoslavia (Komac et al. 2013), and they also failed to overcome the distinct seasonal fluctuations.

The majority of tourists visit Slovenian towns not exclusively for leisure or because of the towns' urban appeal. Their motives are often connected with attending conferences, shopping, or accompanying activities, such as sports events (in Maribor), the nearby coast (in Koper), and gambling (in Nova Gorica; Cigale and Gosar 2014). Ljubljana is an exception in this regard, having ranked among the five most important tourist destinations in the country ever since Slovenia's independence and taking first place in the number of overnight stays in 2016 (Slovenian … 2017). The European Green Capital Award won by Ljubljana in 2016 boosted the city's international profile, and through selected providers, the city is also involved in the Slovenia Green tourism campaign.

Slovenia has joined the general global trend of increasing tourism travel: it belongs to the EU countries that have been recording the greatest increase in tourist arrivals and overnight stays, especially international ones (EUROSTAT 2017g). Despite continual growth and current optimism, the 1991 experience shows that Slovenian tourism is extremely sensitive to economic and political changes and the threat of excessive national dependence on this activity. Because of severed ties with the former Yugoslav markets and conflicts in the wider region, in 1991 the number of arrivals and overnight stays dropped to the 1970 level. Health resorts were the fastest to recover in terms of arrivals and overnight stays, especially thanks to the quickly regained trust of domestic guests, whereas at seaside resorts recovery took place for nearly two decades (Komac et al. 2013).

12.7 In Focus: A Country of Part-Time Farms

Agricultural income has been incapable of ensuring the long-term economic stability of small- and medium-sized European farms for decades. Slovenian farms are no exception: around 2000, 75% of them generated part of their income through nonfarming activities (Udovč et al. 2006), which is why the term "part-time farm" has become established for them.

Slovenia is no exception in terms of its high share of part-time farms, but it is characterized by an exceptionally complex combination of natural-geographical and social-geographical factors that have had an impact on this.

One of them is exceptional land fragmentation, both in terms of size and space. This was caused by unfavorable farming conditions: mountainous, hilly, and karst areas cover nearly three quarters of Slovenia. On the one hand, land fragmentation is the result of society's progress and capability to adapt to natural conditions, which has also changed the perception of ownership (Blaznik et al. 1970). In prefeudal times, common land predominated because its cultivation demanded interdependence, and so all members of the community engaged in it. The more advanced the farming techniques became through the use of advanced tools, the more the production shifted toward an individual owner or a small family, thereby also fragmenting and dividing rural properties (Blaznik et al. 1970).

Farm division continued through improved farming techniques and increased productivity, as well as inheritance rules, which allowed or even demanded the division of farms among all of their heirs (Maček 2007). The enhanced peasant freedoms during the Theresian and Josephinian reforms (in the second half of the eighteenth century), under the Illyrian Provinces (from 1809 to 1813), and ultimately with the 1848 abolition of serfdom, and consequently the opportunity to purchase farmland, pushed many farmers into debt, which they tried to repay by selling off pieces of their land (Lazarević 1994), which continued the spatial fragmentation of farm estates (Fig. 12.10).

The next period that strongly influenced the economic structure of Slovenian farms was the agrarian reform after the Second World War. By introducing the maximum area that an individual could own (i.e., 10 ha), the authorities radically changed the structure of the land ownership between 1945 and 1953, while at the same time exacerbating the social and economic situation of farmers, many of whom began to seek additional sources of income in the emerging industry in nearby urban centers. This marked the beginning of the final deagrarization of the Slovenian countryside and the transformation of farmers into part-time farmers.

Part-time farmers were subject to strong public criticism during the second half of the twentieth century. Farming was considered one of the least respectable professions, and a general belief became established in society that their double activity (i.e., on the farm and outside it) was harmful and impermissible (Razpotnik Visković and Serućnik 2013). Part-time farmers were blamed for neglecting farmland and destroying the traditional farming cultural landscape—which, however, proved to be unfounded (Klemenčič 1974). Hence, today's part-time farms can be discussed not only within the context of deagrarization and the loss of the landscape's agrarian character but also from the opposite perspective. In areas where farming conditions are so meagre that they cannot ensure the economic and demographic survival of full-time farms, part-time farms have assumed the key role in preserving settlement in the landscape, thus maintaining the human, social, and economic potential of these areas.

Fig. 12.10 Land fragmentation. (Photo by Jure Korosec, Shutterstock.com)

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13 Culture in Slovenia

Mimi Urbanc, Mateja Šmid Hribar, and Peter Kumer

Abstract

Slovenian culture has been decisively shaped by its geopolitical position in contact with natural, social, political, and cultural milieus in the heart of Europe and more recent global trends, migration, and the country's accession to the European Union. Slovenia's ethnic, linguistic, and religious character is relatively homogeneous, especially in rural areas. Towns are more diverse because, in addition to ethnic Slovenians, the Slovenian language, and Catholicism, they also include other ethnic groups, languages, and faiths. The Slovenian language has been a basic pillar of nation-building and the drive toward independence. In their leisure time, Slovenians are involved in various societies, mostly volunteer firefighting and mountaineering, and outdoor activities such as gardening, picking berries and mushrooms in the woods, and hiking. Slovenia is distinguished by great diversity in cuisine, folk culture, and cultural landscapes; these are marked by diverse landforms, land use, and land fragmentation, various types of settlements, and a large proportion of forested land. The mountains, sea, karst caves, and churches in prominent locations play a significant role in shaping national identity.

Keywords

Cultural geography · Lifestyle · Creativity · Cultural landscapes

13.1 Ethnicity

Despite its geographical position at the crossroads of Slavic, Germanic, Romance, and Hungarian influences (Perko 2001, 2004), Slovenia's ethnic identity is quite homogeneous; its ethnic diversity is below the EU and global averages (Alesina et al. 2003). In addition to the majority of ethnic Slovenians (83.1% of the total population, or 92.3% of those that self-identified by ethnicity; SURS 2002), there are two recognized minority groups: Italians (0.1% of the population) in the southwest and Hungarians (0.3%) in the northeast (Žurej 2004). The Roma (0.2%) are another indigenous ethnic group; they live scattered throughout the country. By far the most members of other ethnic minorities are immigrants from various other parts of the former Yugoslavia (SURS 2002).

Slovenian policy with regard to minority ethnic groups exists at three separate levels. The historical minorities (the Hungarians and Italians) are provided complete legal protection, the Roma receive selective protection, and the "new" minorities receive only basic, rudimentary protection (Komac 2007). This can easily be seen at the level of political representation. Members of the Italian and Hungarian minority groups have double voting privileges (general and special) at the local and national levels. This special voting privilege allows them to elect their own representatives to municipal councils and also to elect their own representative as a member of Slovenia's parliament. The Roma have the right to elect their own representatives to municipal and city councils where they live, whereas members of other ethnic minorities have no special mechanism for having their voice heard in public affairs. This and many other issues affect their level (or lack) of integration into society as a whole.

The Roma population is clustered in rural settlements in northeastern and southeastern Slovenia (near Murska Sobota, Novo Mesto, Črnomelj, and Kočevje) as well as some other towns (Ljubljana, Maribor, Velenje, Celje, Jesenice, and Radovljica). Historical sources indicate that Roma people

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D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_13

have lived in Slovenian territory since the fifteenth century. They immigrated from various directions: from the east through Hungarian territory, from the south through the Balkans, and the Sinti people from the north through Austrian territory. Various legislation and programs aim to improve their living conditions and social and economic status. However, Roma communities and settlements are still marginalized. Some aspects, such as education, have seen more rapid improvement, whereas other issues, especially legalizing Roma settlements and improving their infrastructure, continue to persist (Laterner 2015; Zupančič 2018).

Jesenice, an industrial town in northwestern Slovenia, is the most ethnically diverse town in Slovenia. Immigrants, mostly from the former Yugoslavia, account for 32.7% of its population (Slatnar 2015). The largest immigrant community is Bosnian (Žitnik Serafin 2009). The first such immigrants, attracted by industrial development, arrived early in the twentieth century and most intensively in the 1960s and 1970s. In the 1980s the growth of immigrant communities prompted spatial segregation based on ethnicity, which then became apparent in social life (Na Jesenicah … 2016). The process did not create much tension because the town is known for its cultural diversity and healthy intercultural dialogue.

Rakova Jelša and Sibirija are the most ethnically mixed neighborhoods in Ljubljana. Overall, Ljubljana has an above-average share of immigrant population (Žitnik Serafin 2009). In 1991 around 25% of the country's non-Slovenian population lived in Ljubljana: 6.2% Serbs, 4.0% Croats, and 2.9% Bosnians, and the rest undeclared. In 2011, 17.5% of Ljubljana's residents were newcomers to Slovenia. Today only 8% of the city's population claims foreign citizenship because most immigrants obtained Slovenian citizenship after the country became independent (Rebernik 2015). Rakova Jelša and Sibirija, on the southern outskirts of the city, are the only neighborhoods where the proportion of non-Slovenian population exceeds 50%. This ethnic area, with mostly industrial workers, began forming in the 1970s, with the strongest influx of newcomers between 1975 and 1982. At that time, shantytowns arose. Single-family dwellings then became the largest area of illegally constructed housing in Ljubljana (Rebernik 2015). In addition to the multiethnic character and low socioeconomic status of the population, both neighborhoods suffer from substandard infrastructure and low-quality living standards (Tiran 2016) and have all the characteristics of an ethnic ghetto (Krevs 2002).

13.2 Language and Literature

Slovenian belongs to the western subgroup of the South Slavic languages. It is close to the Kajkavian and Chakavian dialects of Serbo-Croatian, and more distant from the Shtokavian dialect, which the Bosnian, Croatian, Montenegrin, and Serbian standard languages are based on. Slovenian also has many features in common with West Slavic languages (Toporišič 1998), which include Czech, Slovak, Polish, and Sorbian. Standard Slovenian was formed in the eighteenth century, mostly based on the Upper and Lower Carniolan dialect groups, the latter being a dialect spoken by Primož Trubar (1508–1586), author of the first printed books in Slovenian.

Despite various linguistic influences—especially German and Serbo-Croatian, historically (Janich and Greule 2002), but also English today—Slovenian has preserved some special features (Table 13.1). The most notable of these is the dual, a grammatical number used for two people or things. The modern Slovenian alphabet has 25 graphemes, and stress is marked only if it is necessary to distinguish between similar words with different meanings.

Slovenian is spoken by approximately 2.5 million speakers worldwide. It is the first language of about 2.1 million Slovenians, the official language in Slovenia, and 1 of the 24 official and working languages of the European Union. There are around 140,000 Slovenian speakers that live in bordering countries: in the eastern part of Friuli-Venezia Giulia (Italy), in the southern part of Carinthia (Austria), in the western part of Vas County (Hungary), and in larger Croatian towns, where Slovenian is a minority language. Slovenian expatriates and ethnic Slovenian emigres also speak Slovenian in countries such as Germany, Austria, Switzerland, France, Sweden, the United States, Canada, Argentina, and Australia (Janich and Greule 2002).

Table 13.1 Overview of basic characteristics of Slovenian

Feature	Number
Graphemes	25 (Aa Bb Cc Čč Dd Ee Ff Gg Hh Ii Jj Kk Ll Mm Nn Oo Pp Rr Ss Šš Tt Uu Vv Zz Žž)
Vowels	5 graphemes, 8 phonemes
Consonants	20 graphemes, 21 phonemes
Grammatical numbers	3 (singular, dual, plural)
Cases	6 (nominative, genitive, dative, accusative, locative, instrumental)
Grammatical genders	3 (masculine, feminine, neuter)

Fig. 13.1 Slovenian dialects

Slovenian has nearly 40 dialects and countless subdialects (Fig. 13.1), making it the Slavic language with most dialect differentiation and one of the most dialect-rich languages in Europe, especially given that there are relatively few speakers covering a small geographic area (Logar 1996).

Many factors contributed to the long process whereby Slovenian split off into dialects and dialect groups. The oldest of these undoubtedly includes the migration patterns and origin of the Slavic population that moved in and the languages and dialects of the people that lived in this territory in prehistoric and ancient times: the Celts, Illyrians, and Romanized populations. During the Middle Ages, there was frequent planned colonization by non-Slavic peoples; over the centuries they assimilated, but traces of their dialects remained as local dialect features. That fact that Slovenians lived in an ethnically mixed environment for at least 1200 years is also an important factor, as well as natural borders. Contact between individual groups was hindered mainly by the Karawanks, Julian Alps, Pohorje Hills, and high karst plateaus. Dialect borders also developed in association with swamps and marshes (such as the Ljubljana Marsh) and extensive, long-uncleared woodlands (e.g., in the

Sora Basin). Administrative borders were no less important, both political and religious, especially when these borders remained unchanged for long periods and affected population movements (Logar 1996; Toporišič 1998).

In addition to Slovenian as the official majority language, Italian and Hungarian are also official languages in the municipalities where those ethnic minorities live, that is, in the west along the coast and along the border with Hungary, respectively. The right to use these minority languages is inscribed in the Slovenian Constitution and regulated by several laws, which define the rights to education in one's own language, bilingual toponyms (including newly established settlements, streets, etc.), and bilingual administrative and court proceedings. The legislation requires bilingual communication to be available for all public services and obligates businesses in officially bilingual areas to serve customers in both languages (Limon and Novak Lukanovič 2017).

Language policy and the stance toward language and its protection are important political, cultural, and social issues. This is why quotas for Slovenian music broadcasts were first introduced in 2001 (Zakon o medijih 2001) and then redefined in 2016 following extensive public debate (Zakon o spremembi Zakona o medijih … 2016). This law requires daily radio programs to contain at least 20% Slovenian music or music produced by Slovenian composers and performers. Recently there has been a new wave of criticism regarding the Act Amending the Higher Education Act (Zakon o spremembi Zakona o visokem … 2017), specifically the section that discusses language, because it features an article about easing access to education in foreign languages (i.e., English) at the university level. For now Slovenian remains the only language of instruction in university programs, and education in English is only allowed in limited amounts under specific conditions.

Language has played a special role throughout Slovenian history, and it is still considered one of the foundations of national identity. "It is the common linguistic and cultural consciousness that has given rise to the idea of a unified Slovenian national body. The idea of Slovenians joining together is an explicitly cultural project, and it has remained so for a long time" (Kovačič-Peršin 2000). The English historian A. J. P. Taylor (cited in Grdina 1999) argued that some nations, or at least their embryonic beginnings in the Habsburg Monarchy, were created by people of the pen. This is definitely true for Slovenians, who placed culture on the altar of their identity formation (Seton-Watson 1977). Thus, it is no surprise that public discourse in Slovenia, or its cultural landscape, is visibly marked by memorialized literary culture (Fig. 13.2), whereby literary memorialized culture is not limited only to the most visible literati but also encompasses a wide range of writers (Dović 2012).

Fig. 13.2 Public space (monuments, names of streets and squares, names of institutions) and public affairs (images on currency, two cultural national holidays, and many events commemorating personalities of literary culture) reflect the importance of literary culture. Among cultural saints, the Romantic poet France Prešeren is first to be singled out. The words of the Slovenian national anthem are based on the seventh stanza of his *carmen figuratum* poem *A Toast*. (Photo by MilanTomazin, Shutterstock.com)

13.3 Religion

Historically, religion was very significant in shaping Slovenia's linguistic, political, and national identity and an important element (Fig. 13.3) in shaping cultural landscapes (Kučan 1998). There are 50 religious groups active in Slovenia today (Register … 2017). The constitution prescribes the separation of church and state, but the traditional Slovenian faith is mainly Roman Catholic. Only in the most northeasterly part of the country is the Lutheran church (Augsburg Confession), which took root during the Protestant Reformation of the sixteenth century, the dominant faith. The Reformation played an important role in the development of Slovenian literacy; in 1550 the first two books in

Fig. 13.3 The many churches set on hilltops or in the middle of fields are a visible reminder of religious legacy and an important symbol of Slovenian landscapes. (Photo by Vesna Kriznar, Shutterstock.com)

Slovenian were published (*Catechismus* and *Abecedarium*) and in 1584 the first Slovenian translation of the entire Bible. This explains why Reformation Day, October 31st, has been a national holiday since 1992.

Migration from other Yugoslav republics brought members of the Orthodox and Muslim faiths to Slovenia. It is a little-known fact that the first mosque on Slovenian territory, in Log pod Mangartom, was established as early as 1916. It was built by Bosniaks, members of the Fourth Bosnian-Herzegovinian Infantry Regiment of the Austro-Hungarian Army, who fought on the Isonzo Front during the First World War. In 2014 construction of a mosque in Ljubljana started, but due to a lack of funds, it remains unfinished.

Today the importance of religion and number of believers are falling. Compared to other central and eastern European countries, secularization in Slovenia is strengthening (Toš 2014). In a 2007 survey, 65.1% of respondents identified themselves as members of a church or a religious group, and 62.8% agreed that churches and religious groups promote interpersonal relationships (Zulehner et al. 2014), which is a sign that religion is viewed at a personal level. Data from the Catholic Church (Letno poročilo Katoliške … 2016) also indicate a drop in church membership from 78.7% of the population in 2007 to 74.3% in 2015.

13.4 Folklore and Folk Culture

The spirit of folk tradition or folk culture is reflected in customs, literature, folk dances, and folk songs. Folk dances and folk songs are called folklore, and they are most often performed by folk groups (Fig. 13.4; Ramovš 1980). Folklore is based on religious (Christian and pre-Christian) and regional traditions. Its motivations are the preservation of traditional values and revival of the past. It is a culture of amateurs that pursue authenticity, professional reconstruction, and an artistic approach. There are around 500 folk groups for adults and children in Slovenia. Some of these, the “original” folk groups, maintain traditions of local or regional origin, but other groups, mostly in urban centers, have song and dance repertoires extending beyond regional and often also ethnic boundaries (Terseglav 1989). There are many ethnological events based on folk traditions, whose main goals are to attract tourists and provide entertainment and a sense of community by reinterpreting folk culture in modern form (Kozorog 2014).

A new genre of folk-pop music, dominated by polkas and waltzes and based on alpine folk music tradition and its accompanying fashions, began developing in the early twentieth century. This development was strongly influenced by

Fig. 13.4 Many folkdance groups and ethnological events awaken and preserve folk dance and the musical legacy. (Photo by Božena Legat)

an ensemble founded in 1953 and led by the brothers Slavko and Vilko Avsenik. Their musical style, outstanding ensemble, stage performances, and style of dress became the primary vehicle of ethnic musical expression for Slovenia, Austria, Germany, Switzerland, and northern Italy, inspiring hundreds of ensembles in Slovenia and abroad. In German-speaking countries, this genre is known as Upper Carniolan music (Germ. *Oberkrainer Musik*) and in the United States as Cleveland-style polka. The Avsenik ensemble has enjoyed an exceptional international career (10,000 live performances) and numerous awards including 31 gold, 1 diamond, and 2 platinum albums and 1 European Oscar Award (Ramšak 2015). Nationally the ensemble has been understood as domestic and Slovenian, thus preserving national identity (Barber-Keršovan 1981) and building Slovenia's alpine character (Ramšak 2015). The most popular Avsenik song is the polka "On Mount Golica" (Sln. *Na Golici*; Germ. *Trompeten-Echo*), which is considered the single most-played instrumental composition in the world (Rahten 2017).

Folk-pop music is a special phenomenon because it is a group experience in both performance and reception. Many ensembles and musicians, which also include young people, follow the Avseniks' musical tradition or playfully combine it with other musical genres. A folk-pop ensemble is an obligatory part of public festivals and family parties and celebrations not only in Slovenia but also among Slovenian emigres in Canada, the United States, Australia, and Argentina. The production of piano accordions and diatonic accordions is also connected with this genre (Ministry of Culture 2017).

13.5 Cuisine

Foods and dietary habits reveal cultural patterns and beliefs about life. They are closely connected to Slovenia's multiethnic and turbulent history and today's global trends toward fast, uniform food. Although these trends have not bypassed Slovenia, in recent years cuisine as the art of preparing and decorating food has flourished, demonstrating that traditional foods using local ingredients can be interpreted in imaginative and original ways (such as vanilla ice cream with pumpkin seed oil; Fig. 13.5, top left). This is certainly aided by international recognition, such as the prestigious title "World's Best Female Chef" (Armstrong 2017) bestowed upon Ana Roš in 2017, which put Slovenia on the global culinary map (Fig. 13.5, top center). Open Kitchen, a unique culinary marketplace begun in 2013 that operates every Friday from spring to fall in Ljubljana and sometimes other locations, offers a special experience. Restaurants from all around Slovenia are represented there. The event received several tourism awards.

Like landscape diversity, or possibly because of it, traditional Slovenian cuisine is also diverse. There is no such thing as a typical "national" dish, but there are many typical regional and local dishes. There are 24 different culinary regions in Slovenia, each one with its own typical dishes (Bogataj 2012). Mediterranean cuisine is thought to be the healthiest diet, and it is known for featuring vegetable dishes and fruit. Slovenian Istria features outstanding olive oil, fish, and shellfish. The Karst is noted for its dry-cured ham

Fig. 13.5 Slovenian cuisine has been influenced by landscape diversity, cultural richness, changing political situations through turbulent history, and in modern time by global trends. Vanilla ice cream with pumpkin seed oil, vanilla cream pastry, Karst prosciutto, steamed rolled dumplings, buckwheat groats, Carniolan sausage, potica, Prekmurje layered pastry, and a dish prepared by Ana Roš. (Photos by Natalie Barth, Minoli, Madebyindigo, padu foto, Dusan Zidar, Dani Vincek, Visionsi, Tomo Jesenicnik, Shutterstock.com; Mateja Šmid Hribar, GIAM ZRC SAZU Archive)

(Fig. 13.5, top right). Another dish, steamed rolled dumplings (*štruklji*) (Fig. 13.5, center left), are spread throughout most of the country and are served in numerous sweet and savory variations (with ricotta or tarragon, buckwheat with walnut filling, etc.). The alpine areas boast of buckwheat groats (*žganci*; Fig. 13.5, center) with sauerkraut and the alpine pastures for their milk and dairy products. White Carniola is known for roast lamb and suckling pig. Throughout Slovenia's countryside, butchering season, with its various homestyle fresh, wet-cured, and dry-cured meat products, has special significance and is still the main secular celebration for many farmsteads. Carniolan sausage (Fig. 13.5, center right), which was declared a "living masterpiece" in 2013, is a true Slovenian delicacy. Piran salt, which is produced using traditional procedures in the Sečovlje and Strunjan saltpans, was given the same title in 2015.

Desserts are another category with great variety. The best-known original Slovenian pastry is *potica*, a rolled, filled sweet bread (Fig. 13.5, bottom left), which appears on every holiday menu. The basic form has a yeasted dough with a walnut filling, but in the summer, when there is an abundance of herbs, tarragon is used instead. Bled is famous for its vanilla and cream pastry (*kremšnita*; Fig. 13.5, bottom center), and Prekmurje has its special layered pastry (*gibanica*; Fig. 13.5, bottom right).

Cuisine also includes drinks. Sometimes this is simply a glass of water, other times a shot of fruit brandy or honey liqueur, but most often a meal is completed by a select wine. Slovenians are proud of their drinking water and wealth of water resources, and so it is no surprise that the Slovenian constitution protects the right to drinking water (Lukič 2016; Leifels and Delaire 2017). Home distilling fruit brandies from pears, apples, and plums has a long tradition, which is unfortunately being lost due to complicated tax regulations (Kozorog 2016). Wine growing and winemaking are on the rise, however. Even though Slovenia is an insignificant wine producer at the global scale, it is becoming better known and respected as a producer of boutique wines (Kerma and Gačnik 2015). There are three wine growing regions in

Fig. 13.6 Beekeeping has left traces in folk art. Painted beehive panels are a valued hive decoration, and the hives themselves are a characteristic element of farm architecture. (Photo by Miha Pavšek, GIAM ZRC SAZU Archive)

Slovenia, each with different grape varieties, climates, and cellaring techniques, which contribute to a diverse range of wines. The main holiday related to wine is Martinmas, November 11th, when the must becomes wine. The celebration features roast duck or goose, flatbread dumplings, and red cabbage.

Honey merits special attention. It is not only used as food and medicine, but it has great symbolic and cultural meaning (Fig. 13.6). The indigenous bee *Apis mellifera carnica* (Sušnik et al. 2004) is one of the most widely kept honeybee races in the world. Beekeeping in Slovenia began developing in the eighteenth century, quickly gaining prominence. Many amateur and professional beekeepers maintain the tradition, and beekeeping is even offered as a course of study in some schools and museums. The UN declaration of May 20th as World Honeybee Day in response to Slovenia's initiative also testifies to the cultural significance of beekeeping.

13.6 Active Lifestyle

Slovenia's rugged terrain, extensive and accessible forests, and exceptional natural beauty promote various outdoor activities. One of the most popular ways to enjoy leisure time outdoors is hiking and mountaineering (Fig. 13.7). The development of mountaineering and hiking societies, which began in the late nineteenth century (Mikša and Zorn 2016), proceeded in parallel with the national awakening and resistance to Germanization. The national symbolism from art and literature was transferred to the physical sphere, especially conquering mountain peaks. By scaling and naming mountain peaks before German climbers, Slovenians affirmed a symbolic ownership of the mountains and areas lying below (Kučan 1998). These were the prevailing conditions in 1893, when the Slovenian Hiking Society was established; even more than one's relationship to the mountains and nature, membership in this society expressed a relationship to one's homeland and Slovenian identity (Strojin 1999). Members of hiking societies volunteered their time to maintain and mark numerous trails, also setting up a whole network of mountain lodges, which made the mountains more accessible to visitors. The greatest boom in mountain lodge construction took place after the Second World War. All of this contributed to popularizing hiking, which became a widespread form of outdoor recreation. The Alpine Association of Slovenia states that in 2017, Slovenia had 181 serviced mountain stations and around 20 unserviced bivouacs.

Slovenian law requires forests to be publicly accessible, a fact Slovenians are very proud of. In addition to walks and relaxation, forests also offer numerous opportunities to forage for blueberries, wild strawberries, raspberries, lingonberries, chestnuts, and mushrooms, to be used in appropriate quantities in line with regulations. Wooded areas near urban centers are visited particularly frequently, as well as others during chestnut and mushroom collecting times. Sometimes there are too many visitors, and they collect too much, which leads to conflicts between the owners and users (Kumer 2017a).

Another popular leisure activity is gardening. Most Slovenians aspire to live in a detached house with a garden (Sendi 2017), which is an important aesthetic element in rural and suburban settlements. Urban gardening has also seen recent growth (Glavan et al. 2016); in addition to private gardens, there are also community, therapeutic, and educational gardens (Kozina et al. 2019). Production of homegrown fruits and vegetables means that gardens offer diverse,

Fig. 13.7 It is said that at least once in their lives all Slovenians climb Mount Triglav (2864 m), the highest mountain in Slovenia and whose silhouette adorns the national flag and the obverse of the national 50-cent coin. (Photo by Miha Pavšek, GIAM ZRC SAZU Archive)

fresh foods, bring people together, contribute to social inclusion, have a positive impact on health and wellbeing, and contribute to preserving and sharing traditional techniques and local heirloom varieties. One outgrowth of these activities is a new informal civil initiative called Crops2Swap (*Zelemenjava*), promoted by volunteers, in which participants exchange garden produce, seeds, seedlings, recipes, and experience (Zidar and Leskošek 2015).

13.7 Gender Matters

Slovenia ranks eighth in gender equality according to the 2016 Global Gender Gap Index (Global Gender … 2016). Among EU member states, Slovenia's gender equality is above average (The Policy … 2015). The gender pay gap, for example, is one of the lowest in the EU (Gender Pay … 2017). The feminist movement is the civil society movement with the longest tradition in Slovenia (Jogan 2001). In 1946, women's right to vote was enshrined in the constitution of Yugoslavia (The Policy … 2015).

There are many notable Slovenian women, both historical and contemporary, that have made a significant impact. One special example is the traveling female merchants from Slovenian Istria known as the *Šavrinke* "women from the Šavrini Hills" (or Koper Hills). Thanks to their weekly travels throughout central Istria (today part of Croatia) and Trieste (today in Italy) from the late nineteenth century to the mid-twentieth century—a period marked by crisis, war, and poverty—they were key providers for their families (Ledinek Lozej and Rogelja 2012; Ledinek Lozej et al. 2017). At the end of the twentieth century, when Slovenian Istria was seeking to anchor its regional identity within the newly established country, the *Šavrinke* became one of the symbols of Slovenian Istria (Urbanc 2011).

Nowadays women often find places in areas that have traditionally been male domains, such as forestry. Generally speaking, men have always been the favored heirs of real estate, whereas women have been compensated for their share. However, due to structural changes in society (rural outmigration, urbanization, and abandoning agriculture) and inheritance practices in forestry (fragmentation of property to all legal heirs), the share of female forested property owners (almost half) now almost equals the proportion of women in the general population (Bogataj 2010; Medved et al. 2010), which brings Slovenia to first place in Europe (Follo et al. 2016). Female forest owners seem to be more environmentally and socially oriented as a result of their social role in society (Kumer and Štrumbelj 2017).

13.8 Values and Civil Engagement

In recent decades Slovenia has gone through a transition process not only economically (Buchen 2016) but also in values, norms, and ethics (Potočan et al. 2007). Distrust and skepticism with regard to social and political institutions is a predictable legacy of communist rule and an important social issue in transitional European countries (Mishler and Rose 1997). Individualism, as a characteristic of any modern society, is gaining importance, although Slovenian society is still characterized by strong interpersonal ties and relationships (Vehovar 2009) and informal networks (Pichler and Wallace 2007). Although Poortinga (2006) and Pichler and Wallace (2007) argue that civic participation and social capital in postcommunist European countries is lower than in the West, Slovenians are very engaged in nongovernmental organizations. In line with differences in lifestyle between urban and rural areas (Kumer 2017b), people from rural areas seem to be more engaged in clubs than urban people (Nared 2007; Fig. 13.8).

In terms of membership, the largest volunteer association is the Federation of Pensioners Associations (which includes more than 11% of the total population), followed by the Slovenian Firefighters Association (8% of the total population) and the Alpine Association of Slovenia (almost 3% of total population; see Table 13.2 for details). The Alpine Association and Firefighters Association boast more than a century of tradition. The latter, which runs volunteer firefighting in parallel with professional firefighters, also plays a very important role in disaster management (Kastelic 2010). Slovenians are very generous and socially sensitive when it comes to charity and neighborhood support. Organizations such as the Red Cross, Karitas, and Slovenian Philanthropy have played an important role in alleviating poverty and mitigating social suffering and disturbances, including the migrant crisis in 2015 and 2016. Last but not least, civil initiatives have become an important type of civic engagement since independence.

Civic engagement in the arts is well represented in choral societies, which have achieved many international awards. There are around 10,000 vocal groups (children's, youth, adult, professional, and church) in Slovenia (Kljun 2015).

13.9 Cultural Landscapes

Slovenia's cultural landscapes reflect varied natural geography, social geography, and cultural characteristics, as well as turbulent political events, and so they are very diverse. Rural landscapes are the focus here for two reasons: first, they comprise the greater part of Slovenia because uncultivated and built-up regions cover less than one-tenth of its land, and, second, they are distinguished by their diversity, incorporation into the natural environment, and strong ecological, cultural, and emotional value.

The basic outline of Slovenian cultural landscapes was created in the Middle Ages (Urbanc 2002), and this legacy is still quite evident (land division, high-elevation solitary farmsteads; Fig. 13.9, top left and center). Economic and social developments in recent decades have triggered rapid changes in the appearance and function of these landscapes. The process is twofold: in basins and valleys, intensive and monoculture farming is leading to the development of a uniform type of landscape without distinguishing regional or local features, and the rural landscape is giving way to construction that meets the needs of other sectors and urbanization (Fig. 13.9, top right). The boundaries between cities and the countryside are already quite indistinct in Slovenia (Perko and Urbanc 2004). On the other hand, hilly and remote areas with less favorable natural conditions are facing land abandonment, resulting in spontaneous forest overgrowth (Gabrovec and Kladnik 1997) and the loss of cultural landscapes.

The most noticeable visual characteristic across the country is the small-scale structure with a variety of elements (Fig. 13.9, center left and center). Some of these are present throughout all of Slovenia, and others have certain regional characteristics, but all of them demonstrate accommodation to natural features (Fig. 13.9, center right) and reflect a survival strategy within dynamic and unpredictable social and political events and many years of experience with folk architecture. Perhaps the most noticeable elements of vernacular architecture are the typical farmhouses and hayracks (Fig. 13.9, bottom left). Despite the modern uniformity of houses, some regional farmhouse characteristics are still seen in contemporary housing (Drozg 2002). These include roof slopes and weighting down roofing with stones as ways of adapting to weather conditions. In the alpine part of Slovenia, where there is abundant winter snowfall, roofs are steeply sloped (43°–50°) and gabled, and they have large overhangs (Fig. 13.9, bottom center). In the Mediterranean part of Slovenia, roofs have been adapted to withstand the frequent, strong winds by attaching the roof to the rafters and weighting the roof down with stones (Fig. 13.9, bottom right).

Hayracks, open wooden structures for drying crops (Fig. 13.9, bottom left) in a wet climate, can be found in numerous variations in most of the country. Their shape demonstrates people's creative power and their connection to the local landscape. They reflect a particular time and level of technological development. Today they are threatened by more advanced methods for drying and storing fodder. Now their central role is their symbolic meaning in shaping the idyllic cultural landscape and strengthening national identity (Kučan 1998). Regional hayrack designs are reproduced in vacation homes, shelters, garden gateways, and road signs.

The smallest village element is the isolated farm (Fig. 13.9, top center), which mostly appears in hilly areas with poor natural conditions for farming. These arose during the last phase of colonization (Petek 2005). They are usually large farms, arranged along sunny fields high above the

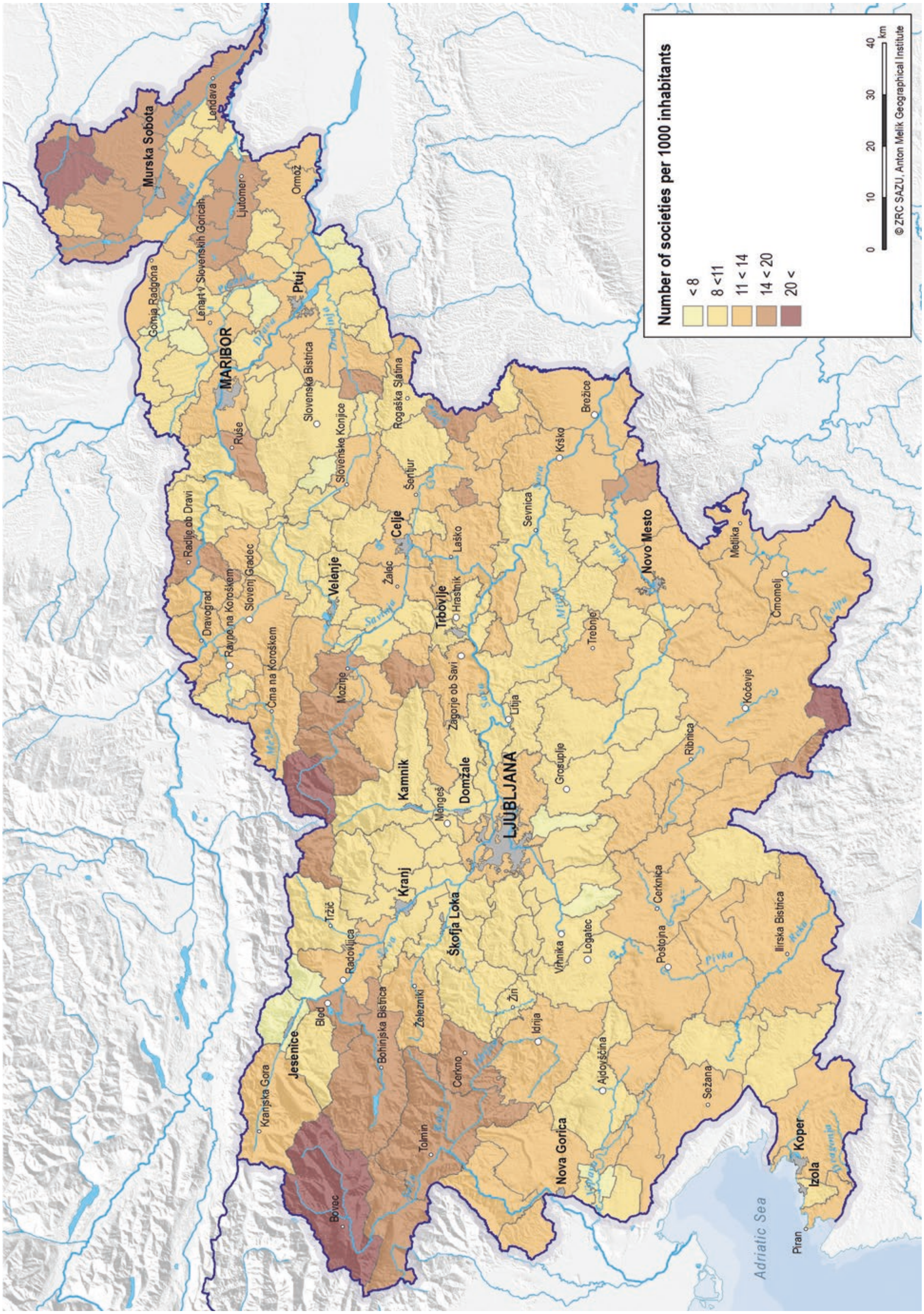

Fig. 13.8 Number of clubs or societies per 1000 inhabitants in Slovenian municipalities in 2017. (Source: Ministry of the Interior 2017)

Table 13.2 Numbers of members and clubs/societies of the largest Slovenian volunteer associations

Name	Number of members	Number of societies/ clubs	Source
Federation of Pensioners Associations	>230,000	>600	CNVOS (2017)
Slovenian Firefighters Association	>160,000	>1300	CNVOS (2017) and Kebe (2002)
Alpine Association of Slovenia	>55,000	>290	CNVOS (2017) and Čujež (2017)
Slovenian Hunters Association	>20,000	–	Letno poročilo Lovske … (2014)
Scout Association of Slovenia	>5000	–	World … (2006)
Slovenian Olympic Committee	–	>8000	Šugman et al. (2003)
Speleological Association of Slovenia	>3000	50	Lajovic (2015)

mountain valleys. A linden tree grows in the location with the most beautiful view at many homesteads (Šmid Hribar 2011). These farms' sustenance was traditionally based on forestry and livestock farming, but in recent decades, especially in areas developed for tourism, farming and tourism have been developed together.

13.10 Creative Placemaking in Ljubljana

Ljubljana has emerged in recent decades as a regionally important alternative, subversive cultural center (Ehrlich 2011). Its cultural scene revolved around the "punk rock spring" in the early 1980s. It provided the initial spark for the new wave movement, which had strong implications for the social and political changes that unfolded in Yugoslavia during that decade (Mulej 2016). The phenomenon of punk rock subsequently differentiated and dissolved into a broader alternative cultural scene (Mulej 2011).

The first arts- and culture-based placemaking occurred with the 1990 establishment of the Network for Metelkova

Fig. 13.9 Cultural landscapes in Slovenia are characterized by small-scale land fragmentation, dispersed settlement in less-favored areas, urbanization in plains and basins, individual elements, and adaptation to the natural environment. (Photos by MX441 Photography, zkbld, Flystock, Neja Hrovat, cmartinezcano, JRP Studio, zkbld, Fabio Lotti, Shutterstock.com; Jure Tičar, GIAM ZRC SAZU Archive)

Fig. 13.10 In recent decades, Metelkova has turned into a Slovenian hotspot for contemporary culture and arts. (Photo by Peter Kumer, GIAM ZRC SAZU Archive)

(*Mreža za Metelkovo*) initiative encompassing various artists and activists, which endeavoured to get of the military barracks on Metelko Street (*Metelkova ulica*), at that time the headquarters of the Yugoslav People's Army (Bibič Faninger 1999; Nabergoj 2013). In 1993, when the barracks were cleared out, these activists, heavily influenced by the squatting movement in the Netherlands and hoping to "demilitarize and democratize Slovenia," occupied the area and established the first informal arts district in Slovenia. With its openness, political freedom, and informality, Metelkova promoted creativity in the district and became a magnet for marginalized groups (LGBTQ, migrants, and the disabled, to name only a few), providing a safe place to socialize. However, like any other arts district driven by a bottom-up approach, Metelkova (Fig. 13.10) has slowly transformed into a formal cultural center that has become an important tourist attraction. International media recognize it as an important regional hotspot for alternative culture (Niranjan 2015).

Rog is an abandoned bicycle factory on the left bank of the Ljubljanica River. It has been squatted in since 2006 by various artists and activists (Ehrlich 2012), mostly millennials, who have temporarily altered the space (Stam 2016; Tosics 2016). Rog hosts several artists' studios, an informal immigrant support center and venues for arts and sports events. This arts district is now facing a conflict with the city council, which claims that Ljubljana does not need another Metelkova (Zabukovec 2016) and wants to transform Rog into a "Contemporary Arts Center" including a hotel, apartments, and a shopping mall (Ehrlich 2012).

Šiška Cinema (*Kino Šiška*) is city-designated arts district established in 2008 with the opening of the Urban Culture Center in order to decentralize cultural activities in Ljubljana and "transform Ljubljana into a culturally and creative city attractive to citizens, tourists, and investors" (Ehrlich 2012). This arts district is housed in a former movie theater, which was renovated as part of the infrastructure projects prioritized by the city council (Center … 2009; Ehrlich 2012). The planned arts agglomeration was continued by transforming the neighboring building into art studios in 2011 (Krajčinovič 2011) and the accompanying parking lot into a public square.

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Part III

Regional Geography

14 Slovenia's Landscapes

Drago Perko and Rok Ciglič

Abstract

Geographers have produced four landscape typologies of Slovenia to date. The best-established typology is the one from 1996, which relies on natural landscape elements and divides Slovenia into nine landscape types. Great landscape diversity in a small territory is the main geographical feature of Slovenia, and it also has an important impact on its economic and other activities. The population increasingly perceives it as an element of identity. The importance of landscape diversity is also highlighted in certain EU documents.

Keywords

Regional geography · Landscape · Landscape type · Landscape typology · Landscape diversity · Landscape hotspot

14.1 Slovenia at the Crossroads of Europe

Four extensive European geographical units – the Alps, the Pannonian Basin, the Dinaric Alps, and the Mediterranean – meet and intertwine in Slovenia, as do Germanic, Hungarian, Slavic, and Romance cultural influences (Perko 2004, 2007; Perko and Urbanc 2004; Kladnik et al. 2009; Ciglič and Perko 2012). For this reason, Slovenia is renowned for its great geographical variety, as well as its rich natural and cultural heritage. High landscape diversity is an easily noticeable feature of Slovenia and often decisively affects all other aspects of the country's diversity.

Researchers began more actively dealing with geographical and similar divisions of Slovenian territory in the mid-twentieth century, but only a few focused on landscape typologies. Most of them worked on regionalizations, combinations of regionalization and typology, or classifications that were merely based on an individual landscape element, such as climate, land use, or house types.

14.2 Landscape Typologies of Slovenia

In extremely diverse countries, such as Slovenia, landscape classifications present a great challenge to scholars, and Slovenian geographers have therefore produced only four proper landscape typologies to date.

The first landscape typology of Slovenia was produced in 1946 by Anton Melik (1890–1966), who divided Slovenia and its immediate vicinity into 18 basic units or types in terms of land forms, rocks, and climate (Melik 1946).

In 1996, Drago Perko defined 48 spatially separate homogenous landscape cores by overlapping the digital layers of elevation, inclination, rocks, and vegetation in GIS; he manually outlined the borders between them and combined them into 9 landscape types and 4 landscape type groups (Kladnik 1996; Perko 1998, 2001b, 2007).

In 2002, Metka Špes et al. (2002) classified Slovenia into 60 landscape units and joined them into 13 landscape types. These types differ according to vulnerability and responses to anthropogenic influences. At the highest level (the country level), the following biophysical characteristics were ranked as most important: relief (with elevation), lithological composition (percent of carbonate rock), and climate (average annual temperature and precipitation). At lower levels (the regional or local level), they ascribed the highest importance to relief and also took into account characteristics corresponding to an individual area (e.g., lithological composition in southwest Slovenia).

In 2014, Drago Perko et al. used a geographical information system to produce a typology with several layers and with various numbers of types based on the spatial overlap of 195 relief units, 938 lithological units, and 65 vegetation

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© Springer Nature Switzerland AG 2020
D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_14

units, which makes it useful for various areas and purposes. The most general and simple among them includes 24 landscape types (Perko et al. 2015).

14.3 Perko's 1996 Landscape Typology

The best-established landscape typology among all four is the one from 1996 with nine landscape types combined into four landscape type groups (Fig. 14.1). This was also the first partly computerized typology of Slovenia. Its scientific bases were first presented in 1998 (Perko 1998). It has also been published in all major geographical works on Slovenia issued after Slovenia's independence: the 11th volume of *Enciklopedija Slovenije* (Encyclopedia of Slovenia, 1997), *Geografski atlas Slovenije* (Geographical Atlas of Slovenia, 1998), the regional volume *Slovenija: Pokrajine in ljudje* (Slovenia: Regions and People, 1998), *Nacionalni atlas Slovenije* (National Atlas of Slovenia, 2001), *Popisni atlas Slovenije 2002* (2002 Census Atlas of Slovenia, 2007), and the atlas *Slovenia in Focus* (Fridl et al. 2007). Since 2008, it has also been part of Slovenian tax legislation and has been used for rating land according to the Rules on Determining and Administering Land Rating.

The process of creating the 1996 landscape typology started in 1995. Perko entered the following four data layers into the geographic information system: surface inclination, elevation, lithology, and vegetation types. The inclination and elevation data were based on a 100 m digital elevation model, and the lithology and vegetation data were obtained through digitization of a 1:250,000 lithological map with 37 basic units (Verbič 1998) and a vegetation map with 62 basic units (Zupančič et al. 1998) converted to a 100 m raster grid. All four layers were then generalized and simplified into seven classes.

The surface elevation classes are 0<200 m, 200<400 m, 400<600 m, 600<800 m, 800<1200 m, 1200<1600 m, and 1600 m and more.

The surface inclination classes are 0°<2°, 2°<6°, 6°<12°, 12°<20°, 20°<30°, 30°<45°, and 45° and more.

The rock types are clay, silt, and sand; gravel, rubble, conglomerate, and breccia; claystone, sandstone, and conglomerate; sandstone and marl (flysch); limestone and dolomite; metamorphic rocks; and igneous rocks and tuffs.

The vegetation types are downy oak, sessile oak, and hophornbeam; hornbeam, pedunculate oak, and red pine; beech; beech and fir; beech and hophornbeam; beech, chestnut, and oaks; and fir, spruce, and highland vegetation.

Perko filtered every layer three times using the modus inside of a moving 11 × 11 cell square window, after which he overlaid (intersected) all four layers together. Altogether 2401 different combinations were theoretically possible.

Perko again filtered the intersected layer three times using the modus described above, obtaining 48 larger and spatially separate homogenous cores with the same combination of elevation, inclination, lithology, and vegetation. He printed the cores on a 1:250,000 map and, with the help of experts for individual parts of Slovenia, manually plotted the boundaries, mostly in morphological boundaries and larger watercourses. In the end, he combined these 48 manually delineated landscape units into 9 landscape types, which he merged further into 4 landscape type groups.

The nine landscape types are Alpine mountains, Alpine hills, Alpine plains, Pannonian low hills, Pannonian plains, Dinaric plateaus, Dinaric lowlands, Mediterranean low hills, and Mediterranean plateaus.

The four landscape type groups are Alpine landscapes, Pannonian landscapes, Dinaric landscapes, and Mediterranean landscapes.

Most of Slovenia (63.3%) is characterized by hilly and mountainous Alpine and Dinaric landscapes running from northwest to southeast and descending to lower and gentler Pannonian and Mediterranean landscapes toward the northeast and southwest.

14.4 Alpine Landscapes

Alpine landscapes run from west to east, covering 42.1% of Slovenia. Of these, 35.8% are Alpine mountains, 54.6% are Alpine hills, and 9.6% are Alpine plains. To the east they drop in elevation and gradually change into Pannonian landscapes, to the south they change into Dinaric landscapes, and in the Soča Valley to the southwest they come close to Mediterranean landscapes.

The **Alpine mountains** dominate northwestern Slovenia (Fig. 14.2) along its borders with Italy and Austria. They cover 15.1% of Slovenia and are mostly made of carbonate rocks, especially limestones and dolomites. Rivers carved out deep valleys that were transformed by glaciers during various ice ages. The forest line runs at an elevation of approximately 1600 m. As much as four-fifths of the area is overgrown with forest, which is dominated by beech, beech and fir, or beech and hophornbeam. More than two-thirds of the area is above 800 m, and two-thirds of the area has an inclination greater than 20°. Only the wider valleys are more densely populated, with extensive high-mountain zones left completely uninhabited.

Among all the landscape types, the Alpine mountains have the greatest average inclination (26.2°), the highest average elevation (1055.5 m), the highest average landscape diversity (0.1836), the second-largest share of forest (74.4%), the second-smallest share of orchards (0.5%) and meadows and pastures (12.7%), the second-lowest population density (29.3 people per km^2), the smallest amount of insolation

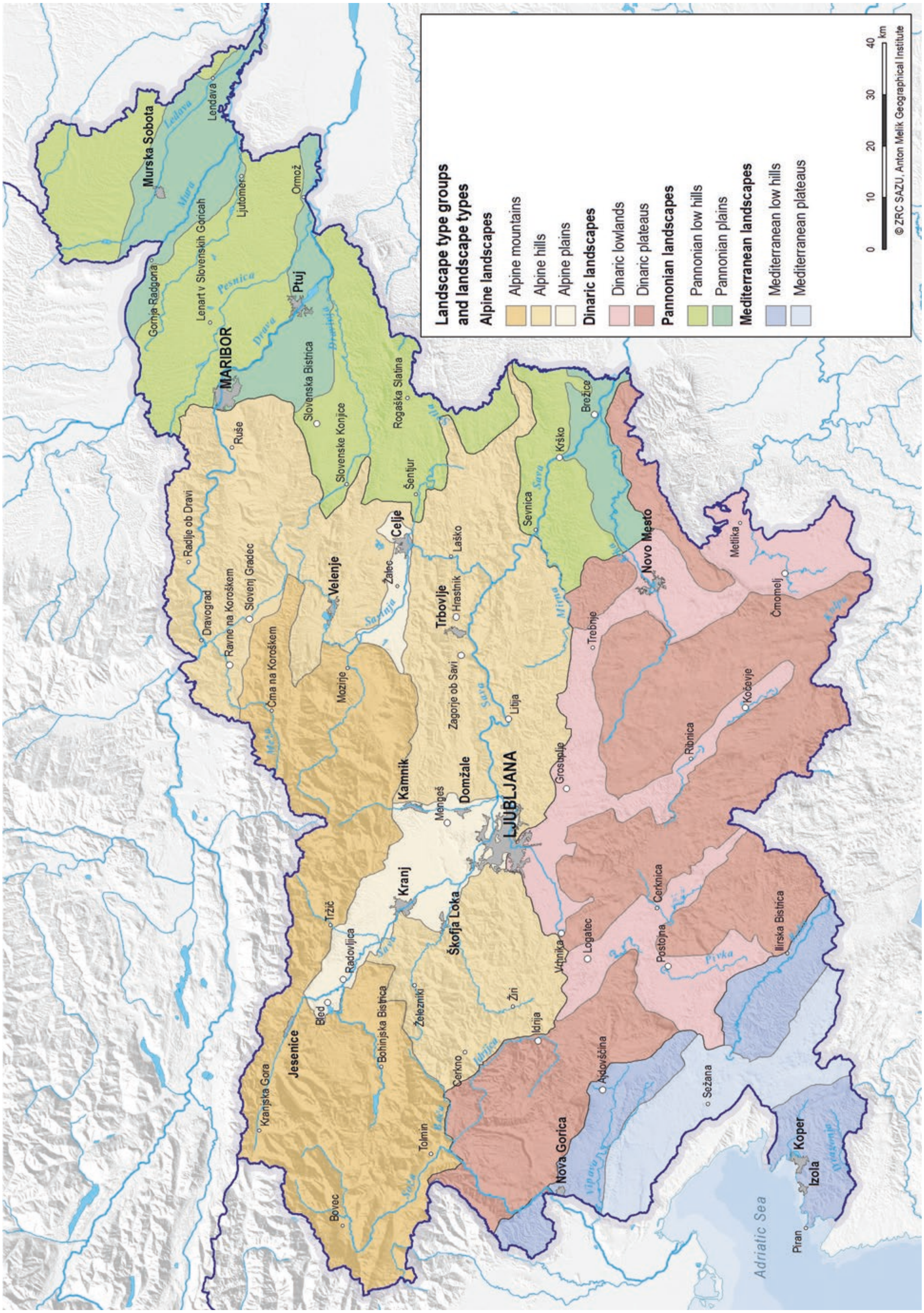

Fig. 14.1 Slovenia's landscape types

Fig. 14.2 The largest Slovenian mountain range is the Julian Alps, with Mount Triglav as the highest peak in the country. (Photo by Miha Pavšek, GIAM ZRC SAZU Archive)

(3706 MJ/m^2), the smallest shares of vineyards (0.0%) and fields (0.5%), and the lowest settlement density (9.9 settlements per 100 km^2). The population is increasing only slightly (by only a tenth since 1931), and the population density is one-third that of the Slovenian average (Table 14.1).

To the south and east, the Alpine mountains are enclosed by a wide band of **Alpine hills** (Fig. 14.3). These cover 23.0% of Slovenia. They are mostly made of silicate sandstone and conglomerate, metamorphic rock, and dolomite and limestone. More than two-thirds of the area is covered with forest. Various combinations of beech forests predominate: forests with beech only; forests with beech, chestnut, and oaks; and forests with beech and hophornbeam. Four-fifths of the area lies at an elevation between 400 and 800 m, and nearly two-thirds has an inclination between 12° and 30°.

The Alpine hills are characterized by isolated farms spaced far apart. The large farmhouse and outbuildings are surrounded by contiguous cultivated land cleared from the forest. Small clustered villages formed in more favorable locations, with individual houses standing alone and in no particular order in a cluster. Farmland is also structured in a similar way. An increasing number of farmhouses are changing into vacation houses owned by townspeople, some farms engage in rural tourism, and some remote villages are falling into decline. Animal husbandry, forestry, and jobs in small industrial centers in the valleys provide the main sources of income.

Among all the landscape types, the Alpine hills have the second-greatest average inclination (18.9°) and the second-highest average landscape diversity (0.1824). The population has increased by one-third since 1931 and by just under 5% since Slovenia's independence. The population density is nearly three times higher than in the mountains (Table 14.1).

The **Alpine plains** cover 4.0% of Slovenia (Fig. 14.4). They were formed by rivers that filled the basin floors with gravel and sand, creating terraces. Older terraces, where gravel already consolidated into conglomerate, are karstified and overgrown with forest (especially red pine), whereas younger terraces made of gravel and overgrown with remnants of hornbeam forest are covered in fertile fields, where potatoes and corn are primarily grown. Forest covers less than a third of the area and fields cover a fourth. More than two-thirds of the area lies at an elevation between 200 and 400 m, and just under a third lies between 400 and 600 m. Just under two-thirds of the area has an inclination of less than 2°.

Among all the landscape types, the Alpine plains have the second-smallest average inclination (4.6°), the second-smallest share of vineyards (0.01%) and forest (31.8%), the second-largest share of fields (24.4%), the largest share of built-up areas (19.7%), the highest settlement density (49.6 settlements per 100 km^2), the highest population density (629.7 people per km^2), and the highest average settlement size (1270.6 people per settlement). The population has increased by almost 140% since 1931, but by not even 5%

Table 14.1 Some basic characteristics of Slovenian landscape types (data sources: Gabrovec 1996; Perko et al. 2015; Perko et al. 2017; Ministry of Agriculture, Forestry and Food of the Republic of Slovenia; Ministry of the Interior of the Republic of Slovenia; Statistical Office of the Republic of Slovenia)

Variable	Landscape type					
	Alpine mountains	Alpine hills	Alpine plains	Pannonian low hills	Pannonian plains	Dinaric plateaus
Area (km²)	3,061.77	4,659.97	819.21	2,994.52	1,296.99	3,809.32
% of area	15.10	22.99	4.04	14.77	6.40	18.79
Mean elevation (m)	1,055.45	582.38	373.09	288.77	195.59	668.09
Mean inclination (°)	26.24	18.94	4.56	10.29	1.00	15.24
Most frequent rock type	limestone 37.22%; carbonate gravel, rubble, and till 19.67%; dolomite 14.38%	silicate sandstone and conglomerate 17.26%; metamorphic rocks 16.57%; dolomite 14.87%	carbonate gravel, rubble, and till 51.70%; clay and silt 21.62%; carbonate conglomerate 15.40%	clay and silt 31.10%; marl 29.71%; sand 20.26%	silicate gravel 59.62%; clay and silt 20.65%	limestone 59.13%; dolomite 24.29%
Most frequent vegetation type	beech 49.42%; dwarf pine and other highland vegetation 12.92%; beech and fir 12.10%; beech and hophornbeam 11.48%	beech 41.85%; beech, chestnut, and oaks 31.37%; beech and hophornbeam 12.25%	hornbeam 65.33%; beech 20.69%; red pine 10.51%	beech, chestnut, and oaks 88.18%	hornbeam and pedunculate oak 44.44%; hornbeam 24.22%, pedunculate oak 17.40%; beech, chestnut, and oaks 13.23%	beech 39.01%; beech and fir 38.65%; beech and hophornbeam 10.02%
Insolation (MJ/m²)	3,705.84	3,953.62	4,080.05	4,131.55	4,178.22	3,947.64
% of fields	0.53	3.11	24.43	21.23	52.26	1.26
% of vineyards	0.00	0.17	0.01	3.00	0.22	0.24
% of orchards	0.49	2.18	1.40	3.55	1.16	0.61
% of meadows and pastures	12.68	21.74	21.17	22.97	9.89	12.87
% of forests	74.38	68.12	31.79	43.07	22.06	83.21
% of built-up areas	1.64	4.03	19.74	5.56	11.75	1.47
Average landscape diversity	0.183556	0.182367	0.174393	0.154415	0.143597	0.144251
% of hotspot area	12.46	14.10	15.84	6.31	5.31	3.20
% of coldspot area	1.21	3.35	11.37	3.80	16.98	16.37
Population in 1931	82,906	263,809	210,332	258,404	182,780	102,324
% of population in 1931	5.93	18.88	15.05	18.49	13.08	7.32
Population in 1961	89,621	292,985	314,339	256,737	240,575	77,143
% of population in 1961	5.63	18.41	19.75	16.13	15.12	4.85
Population growth index, 1931–1961	108.79	112.32	144.28	100.08	131.59	75.18
Population in 1991	92,224	338,344	493,606	252,074	295,713	63,940
% of population in 1991	4.69	17.21	25.11	12.82	15.04	3.25
Population growth index, 1931–1991	111.95	129.98	226.56	96.04	164.49	62.36
Population growth index, 1961–1991	102.90	115.71	157.03	95.96	125.01	82.95
Population in 2011	89,581	354,244	515,870	251,208	288,940	65,565
% of population in 2011	4.37	17.28	25.16	12.25	14.09	3.20
Population density in 2011 (people per km²)	29.26	76.02	629.72	83.89	222.78	17.21
Population growth index, 1931–2011	108.74	135.81	236.77	97.92	158.04	63.90
Population growth index, 1991–2011	97.13	104.49	104.51	101.96	96.08	102.46
Number of settlements in 2011	303	1528	406	1252	384	809
Settlement density in 2011 (number per 100 km²)	9.90	32.79	49.56	41.81	29.61	21.24
Average size of settlement in 2011 (people per settlement)	295.65	231.84	1270.62	200.65	752.45	81.04

(continued)

Table 14.1 (continued)

Landscape type			Landscape type group				Slovenia
Dinaric lowlands	Mediterranean low hills	Mediterranean plateaus	Alpine landscapes	Pannonian landscapes	Dinaric landscapes	Mediterranean landscapes	
1,896.93	1,061.02	673.27	8,540.95	4,291.51	5,706.25	1,734.29	20,273.30
9.36	5.23	3.32	42.13	21.17	28.15	8.55	100.00
402.83	305.11	425.22	731.90	260.61	579.91	351.74	556.83
7.61	12.66	8.94	20.18	7.48	12.70	11.22	14.62
limestone 45.69%; clay and silt 28.29%; dolomite 14.90%	flysch 71.56%; clay and silt 13.75%; limestone 10.10%	limestone 82.52%; dolomite 11.22%	limestone 17.17%; dolomite 13.40%; carbonate gravel, rubble, and till 13.34%; silicate sandstone and conglomerate 11.03%	clay and silt 30.66%; marl 20.96%; silicate gravel 19.13%; sand 14.65%	limestone 54.66%; dolomite 21.17%; clay and silt 11.07%	flysch 45.95%; limestone 37.83%	limestone 26.67%; clay and silt 13.13%; dolomite 12.39%
hornbeam and fir 32.42%; beech 28.03%; hornbeam and pedunculate oak 13.65%; beech and fir 11.97%	downy oak 26.45%; beech, chestnut, and oaks 25.66%, sessile oak 20.77%; beech 10.72%	downy oak and hophornbeam 69.80%; beech 20.64%	beech 42.53%; beech, chestnut, and oaks 19.17%; beech and hophornbeam 10.82%	beech, chestnut, and oaks 65.53%; hornbeam and pedunculate oak 16.37%; hornbeam 10.03%	beech 35.36%; beech and fir 29.78%; hornbeam and fir 12.80%	downy oak and hophornbeam 31.20%; downy oak 16.82%; beech, chestnut, and oaks 16.04%; sessile oak 15.07%; beech 14.57%	beech 29.53%; beech, chestnut, and oaks 24.94%
4,123.22	4,372.86	4,381.01	3,876.93	4,145.64	4,006.00	4,376.02	4,012.84
9.02	6.18	1.51	4.23	30.61	3.84	4.37	9.71
0.40	6.03	1.21	0.09	2.16	0.30	4.16	0.94
1.26	5.37	0.46	1.50	2.83	0.83	3.46	1.76
28.02	1.81	24.23	18.44	19.02	17.91	19.08	18.47
53.51	57.89	68.74	66.88	36.72	73.33	62.1	61.90
7.02	7.80	3.61	4.68	7.43	3.31	6.17	5.01
0.154634	0.149312	0.129215	0.182028	0.151146	0.147703	0.14151	0.162362
5.17	3.86	0.29	13.68	6.00	3.86	2.48	8.33
11.90	14.18	27.46	3.35	7.78	14.89	19.34	8.90
137,160	129,568	30,367	561,090	439,367	238,274	158,919	1,397,650
9.81	9.27	2.17	40.15	31.44	17.05	11.37	100.00
176,766	120,570	22,787	696,945	497,312	253,909	143,357	1,591,523
11.11	7.58	1.43	43.79	31.25	15.95	9.01	100.00
130.30	93.65	75.52	124.21	113.19	106.56	90.21	113.87
245,552	160,791	23,742	924,174	547,787	309,492	184,533	1,965,986
12.49	8.18	1.21	47.01	27.86	15.74	9.39	100.00
180.97	124.89	78.68	164.83	124.52	129.89	116.12	140.66
138.88	133.36	104.19	132.70	110.01	121.89	128.72	123.53
287,376	172,369	25,036	1,032,122	574,203	381,404	212,550	2,200,279
14.02	8.41	1.22	46.91	26.10	17.33	9.66	100.00
151.50	162.46	37.19	120.84	133.80	66.84	122.56	108.53
211.83	133.88	82.97	171.04	122.94	148.12	124.22	146.69
117.06	107.20	105.45	103.77	98.73	114.04	106.98	104.28
833	380	135	2,237	1,636	1,642	515	6,030
43.91	35.81	20.05	26.19	38.12	28.78	29.70	29.74
344.99	453.60	185.45	429.01	330.16	214.95	383.31	340.00

Fig. 14.3 The Sava Hills along the Sava River are the most extensive Slovenian hill range. Mount Kum in the upper left corner, at 1220 m, is the highest peak, with a mountain lodge, a television transmitter, and Saint Agnes's Church. The snowy peaks of the Kamnik–Savinja Alps rise in the back. (Photo by Matevž Lenarčič, GIAM ZRC SAZU Archive)

Fig. 14.4 The Sava Plain with forest-covered conglomerate and cleared gravel river terraces near the small town of Radovljica in the northwestern part of the Ljubljana Basin (in the foreground) lies between the Julian Alps, the Karawanks with Mount Stol (2236 m), and the Kamnik–Savinja Alps in the background. (Photo by Marjan Garbajs, GIAM ZRC SAZU Archive)

since Slovenia's independence (Table 14.1). The settlements on the plains are large and heavily urbanized.

14.5 Pannonian Landscapes

The Pannonian landscapes are densely populated and intensively cultivated, with forests covering barely a third of the area. They are located in southeast and eastern Slovenia, and they run along the Croatian border up to the Austrian and Hungarian border to the north. They cover 21.2% of Slovenia, of which 69.8% of the landscapes are Pannonian low hills and 30.2% are Pannonian plains. They gradually change into Alpine landscapes in the west and into Dinaric landscapes along the Krka River to the south.

The wine growing **Pannonian low hills**, called *gorice* "hills" by the locals, approach the Alpine hills toward the west (Fig. 14.5). They cover 14.8% of Slovenia and are made of poorly consolidated rock, especially clay, silt, sand, and marl, which is why landslides pose a great threat. They are found almost entirely at an elevation between 200 and 400 m, with predominant inclinations ranging from 6° to 20°.

Scattered settlements with farmland between the houses predominate. The houses usually stand on top of rounded ridges. On the sunny slopes below them, there are vineyards, which produce high-quality wine, and orchards, whereas shady areas are dominated by forest (mostly consisting of beech, chestnut, and oak), which covers more than a third of the entire area. Farmers primarily engage in wine growing and fruit production. Wind-driven rattles, which stand in the middle of vineyards and scare away birds, are a typical architectural element. Many houses on top of the ridges have been converted into vacation houses. The population barely changed after 1931.

Among all the landscape types, the Pannonian low hills have the second-lowest average elevation (288.8 m) and the second-largest share of orchards (3.6%) and vineyards (3.0%; Table 14.1).

The **Pannonian plains** lie between the Pannonian low hills and along the meandering and slow Mura (Fig. 14.6), Drava, and Krka rivers, on which numerous mills used to operate. The plains are important for arable farming, and they cover 6.4% of Slovenia. Just under two-thirds lie at an elevation between 100 and 200 m, and more than a third lie between 200 and 300 m. Nearly the entire area has an inclination of less than 2°.

Today forest covers barely a fifth of the area, which is the least in Slovenia. Only the frequently flooded areas are still overgrown with pedunculate oak forests. For more economical use of farmland, people built their homes and outbuildings only along the main roads, resulting in large, long ribbon villages, in which buildings are spaced evenly in a row on one or both sides of the road. Single-story houses are typical and large storks' nests on top of chimneys are a common sight. Extensive farmland spreads out behind the houses, and in some places it is divided into selions. Farmers

Fig. 14.5 The Slovenian Hills, with extensive vineyards between the Drava to the west and the Mura to the east, are Slovenia's largest Pannonian low hills. On the northwest edge of the hills there is a famous heart-shaped vineyard road. (Photo by Andrej Safaric, Shutterstock.com)

Fig. 14.6 The Mura Plain along the Mura River is the most characteristic example of a Pannonian plain. Extensive farmland is interrupted by floodplain forests growing close to the watercourses. (Photo by Jože Pojbič, GIAM ZRC SAZU Archive)

primarily engage in arable farming and animal husbandry. Thermal and mineral water springs to the surface along tectonic faults, providing a basis for the development of spa tourism.

Among all the landscape types, the Pannonian plains have the smallest average inclination (1.0°), the lowest average elevation (195.6 m), the second-lowest average landscape diversity (0.1436), the largest share of fields (52.3%), the second-largest share of built-up areas (11.8%), the smallest share of forest (22.1%) and meadows and pastures (9.9%), the second-highest population density (222.8 people per km^2), and the second-largest average settlement size (752.5 residents per settlement). From 1931 until Slovenia's independence, the population increased by two-thirds, since which it has decreased by 4% (Table 14.1).

14.6 Dinaric Landscapes

Toward the south, the Alpine and Pannonian landscapes gradually change into Dinaric landscapes, which extend from Italy to the west to Croatia to the south and east in a northwest–southeast direction. They cover 28.2% of Slovenia, of which 66.8% are Dinaric plateaus and 33.2% are Dinaric lowlands.

The **Dinaric plateaus** cover 18.8% of Slovenia and are composed almost entirely of limestone and dolomite. They are the most wooded area in Slovenia, with forests covering more than four-fifths of the territory (Fig. 14.7). Beech forests, beech and fir forests, and beech and hophornbeam forests predominate.

Two-thirds of the area lies at an elevation between 500 and 1000 m. Surface watercourses are rare, and drought and forest fires are common. Forestry and the related woodworking industry are the traditional economic activities. Small clustered villages with buildings arranged in an irregular pattern predominate. Farmers engage in forestry and animal husbandry.

Among all the landscape types, the Dinaric plateaus have the second-highest average elevation (668.1 m), the second-smallest amount of insolation (3948 MJ/m^2), the largest share of forests (83.2%), the second-smallest share of fields (1,3%), the second-lowest settlement density (21.2 settlements per 100 km^2), the lowest average settlement size (81.0 residents per settlement), and the lowest population density (17.2 people per km^2). From 1931 until Slovenia's independence, the population decreased by two-fifths, after which it has increased by 2%. The population density is less than one-fifth that of the Slovenian average (Table 14.1).

The **Dinaric lowlands** extend between the Dinaric plateaus, covering 9.4% of Slovenia (Fig. 14.8). They are composed of limestone and dolomite corrosion plains and wider karst poljes covered with clay and silt. Two-thirds of the area lies at an elevation between 200 and 600 m. Forests cover more than half of the area. The Dinaric lowlands play an important transport role in connecting central and southeast Europe.

Fig. 14.7 Mount Snežnik (1796 m) rises above the extensive wooded and karstified Dinaric plateau along the Croatian border. (Photo by Marjan Garbajs, GIAM ZRC SAZU Archive)

Fig. 14.8 The Inner Carniola lowland with well-known intermittent Lake Cerknica is one of the largest Slovenian lowlands. (Photo by Jože Hanc, GIAM ZRC SAZU Archive)

Among all the landscape types, the Dinaric lowlands have the largest share of meadows and pastures (28.0%) and the second-highest settlement density (43.9 settlements per 100 km^2). From 1931 until Slovenia's independence, the population increased by four-fifths and by another fifth after that. The population density is one and a half times the Slovenian average (Table 14.1).

14.7 Mediterranean Landscapes

Mediterranean landscapes extend across southwest Slovenia along the Adriatic and in its hinterland, between Italy to the northwest and Croatia to the south. They cover 8.6% of Slovenia, of which 61.2% of the landscapes are densely populated flysch Mediterranean low hills and 38.8% are sparsely populated low karst Mediterranean plateaus. Toward the east, they gradually change into Dinaric landscapes, and to the north, in the Soča Valley, they approach Alpine landscapes.

They are characterized by Mediterranean settlements with buildings standing close to or touching one another. The houses are made of stone and have one or two stories. Every village has at least one square with a shared stone well. Because the villages now have good water supply systems, the wells only have aesthetic value. The most striking settlements are the ones standing on top of hills. The houses are made of local stone and usually stand on the sunny side of the hill parallel to the contour lines. Some villages are enclosed by walls and are densely built-up, which makes them similar to medieval towns. A good example is the village of Štanjel, which has been protected as a first-rate architectural monument of Slovenian cultural heritage.

The **Mediterranean low hills**, called *brda* "hills" by the locals, cover 5.2% of Slovenia (Fig. 14.9). They are mostly composed of flysch. More than three-quarters have an elevation below 600 m, with an inclination predominantly between 6° and 20°.

In the extreme southwest, they extend down to the 47 km Slovenian Adriatic coast, where there is a high concentration of population and various activities. This is where the following three cities with typical Mediterranean centers are located: Koper (the largest Slovenian port), Izola (known for fishing), and Piran (a major tourist attraction). The Gulf of Piran cuts the farthest into the mainland. On its northern side lies Portorož, the largest Slovenian tourism resort, and extensive salt pans extend next to the delta-like mouth of the Dragonja border river not far away. Today salt only continues to be extracted in a small part of the salt pans, whereas the abandoned part is exceptionally interesting from a natural science perspective because it is home to halophytes and a wide variety of bird species. Also interesting is the nearby cliff in Strunjan, which is considered the tallest flysch cliff along the Adriatic coast.

Among all the landscape types, the Mediterranean low hills have the largest share of vineyards (6.0%) and orchards (5.4%) and the second-largest amount of insolation (4373 MJ/m^2). From 1931 until Slovenia's independence, the

Fig. 14.9 The Mediterranean low hills descend steeply toward the Adriatic. In the foreground are the Sečovlje salt pans. (Photo by Istvan Csak, Shutterstock.com)

Fig. 14.10 The Karst Plateau is the largest Slovenian Mediterranean plateau and is the cradle of karst studies. Here it is seen in autumn colors with the Vipava Valley and high Trnovo Forest Plateau in the background. (Photo by JRP Studio, Shutterstock.com)

population increased by a fourth, after which it has grown additionally by less than a tenth (Table 14.1).

The **Mediterranean plateaus** cover 3.3% of Slovenia (Fig. 14.10). They are composed almost entirely of limestone and are therefore heavily karstified. More than three-quarters of the area they cover lies at an elevation between 200 and 600 m at an inclination predominantly below 12°. Forests cover more than two-thirds of the area, and the share continues to grow further due to afforestation. Downy oak and hophornbeam forests heavily predominate.

From 1931 until Slovenia's independence, the population decreased by a fourth, after which it has grown by 5%.

Among all the landscape types, the Mediterranean plateaus have the greatest amount of insolation (4381 MJ/m^2), the second-largest share of meadows and pastures (24.2%), the smallest share of orchards (0.5%), the smallest average landscape diversity (0.1292), the second-smallest settlement density (20.1 settlements per 100 km^2), and the second-smallest average settlement size (185.5 residents per settlement; Table 14.1).

14.8 Landscape Diversity

Slovenia is located in a naturally diverse part of Europe (Ciglič and Perko 2013a). In 2017, the landscape diversity of Slovenia (Fig. 14.11) was calculated for the first time by using a geographic information system. As a base layer, a geomorphologically tested 25 m digital elevation model from the Surveying and Mapping Authority of the Republic of Slovenia (Podobnikar 2002) was used, which provides 32,436,693 square cells with an area of 625 m^2. Vector layers with geomorphological, lithological, and vegetation types were added and converted to a 25 m raster grid.

The geomorphology layer is based on a 1:250,000 map of geomorphological units (Perko 2001a). The map has 195 units, which were combined into seven geomorphological types (Perko et al. 2015): plains, rough plains, low hills, rough low hills, high hills, rough high hills, and mountains.

The lithology layer is based on a vector map of rock types of Slovenia produced by the Geological Survey of Slovenia and primarily based on 1:25,000 vectorized geological maps of Slovenia. The map has 938 units, which were combined into 15 lithological types (Perko et al. 2015): clay and silt; sand; carbonate gravel, rubble, and till; silicate gravel; claystone and siltstone; carbonate conglomerate; silicate sandstone and conglomerate; sandstone and marl (flysch); marl; carbonate and clastic rocks; limestone; dolomite; metamorphic rocks; tuffs and tuffites; and igneous rocks.

The vegetation layer is based on a 1:250,000 map of potential natural vegetation (Zupančič et al. 1998), which was produced by the ZRC SAZU Jovan Hadži Institute of Biology. The map has 62 different units, which were combined into 15 vegetation types (Perko et al. 2015): downy oak and hophornbeam; downy oak; sessile oak; hornbeam and pedunculate oak; pedunculate oak; hornbeam and fir; hornbeam; beech; beech and fir; beech and hophornbeam; beech, chestnut, and oaks; fir; spruce; red pine; and dwarf pine and other highland vegetation.

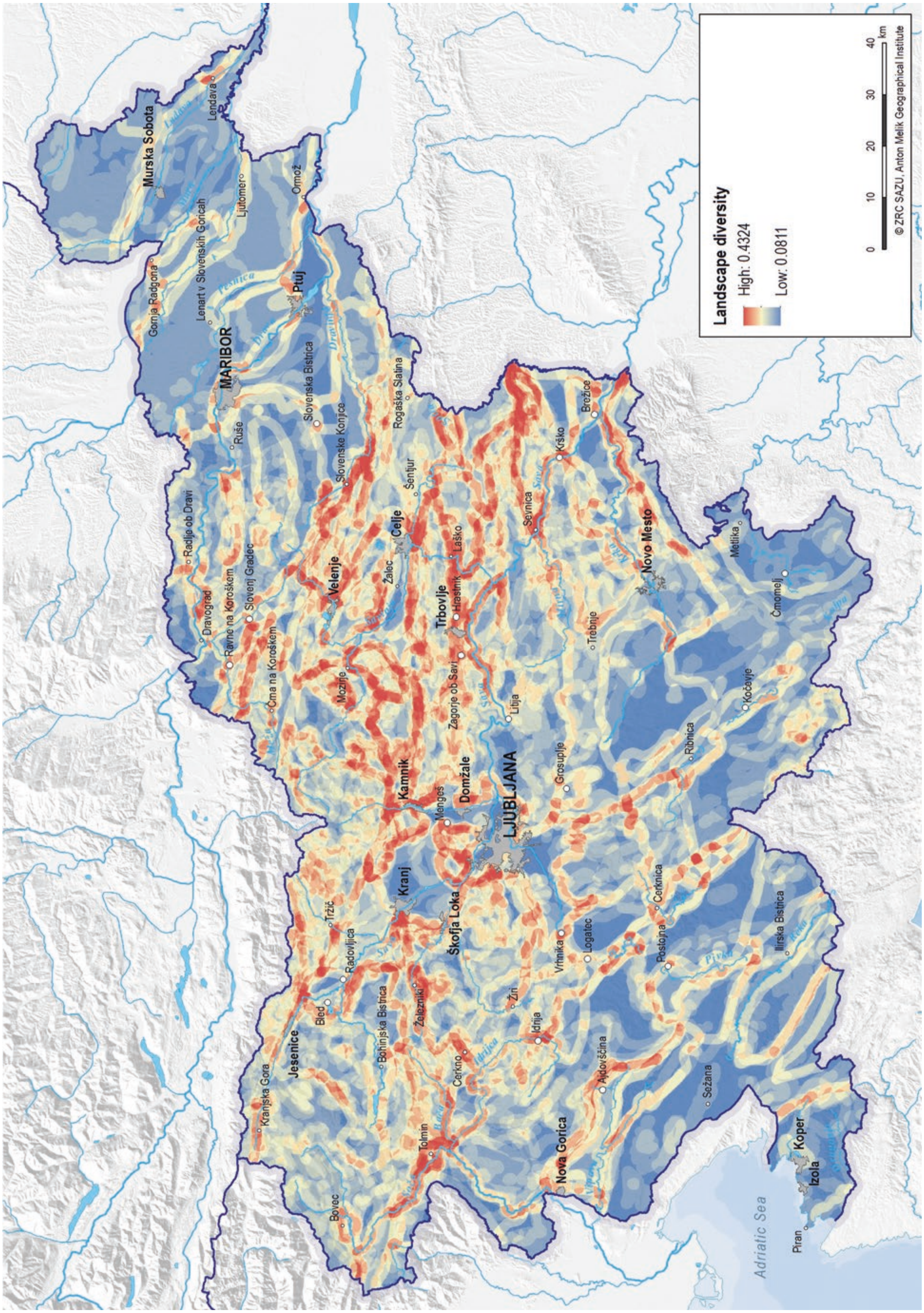

Fig. 14.11 Landscape diversity

These three natural landscape elements are the most significant for the internal structure, function, and appearance of Slovenian landscapes. They are so strongly linked with other natural landscape elements that the choice of only these three elements is enough to create a quality natural landscape typology (Perko et al. 2015).

Using a moving window, the ratio between the number of geomorphological, lithological, and vegetation types that occur within a radius of 1 km and the total number of all possible types for each cell was calculated. Such a ratio is called the landscape diversity.

The minimum ratio is 3:37 or 0.0811 if only 1 geomorphological type, 1 lithological type, and 1 vegetation type occur in a 1 km radius, and the maximum ratio is 37:37 or 1.0000 if all 7 geomorphological types, 15 lithological types, and 15 vegetation types occur simultaneously in a 1 km radius. In reality, the minimum calculated value was 0.0811 and the maximum was 0.4324.

The one-tenth of Slovenia with the highest landscape diversity was defined as landscape hotspots, and the one-tenth with the lowest landscape diversity was defined as landscape coldspots (Perko et al. 2017). The total area of the landscape hotspots is 1688.85 km^2, and the total area of landscape coldspots is 1805.69 km^2. The largest hotspot covers 12,453 hectares, and the largest coldspot covers 16,187 ha.

More than two-thirds of the landscape hotspot areas are located in Alpine landscapes and the fewest in the Mediterranean landscapes. Almost half of the landscape coldspots are located in Dinaric landscapes and the fewest in Alpine landscapes.

Among all the landscape types, the Alpine plains have the largest share of landscape hotspots (15.8% of the total area they cover), and the Mediterranean plateaus have the smallest (0.3%). In turn, the Mediterranean plateaus have the largest share of landscape coldspots (27.5% of their entire territory), and the Alpine mountains have the smallest (1.2%). The largest share of areas that are neither hotspots nor coldspots is typical of the Pannonian low hills (89.9%; Table 14.1).

Landscape hotspots are often accompanied by indistinct small-scale natural phenomena, whereas landscape coldspots are accompanied by more typical large-scale natural phenomena, such as small underground caves in Alpine landscapes or extensive underground caves in Dinaric landscapes.

14.9 The Importance of Landscape Diversity

Increasingly more researchers are dealing with the evaluation and importance of landscape diversity (Runhaar and Udo de Haes 1994; Bailey 1996; Bunce et al. 1996; Bastian 2000; Mücher et al. 2003; Loveland and Merchant 2004; Šímová and Gdulová 2012; Mocior and Kruse 2016). Areas where there is a mix of various natural factors are important for biodiversity, habitats, and species diversity (Dramstad et al. 2001; Hou and Walz 2013; Walz and Syrbe 2013).

Areas with higher landscape diversity may also have an advantage in economic development, especially in tourism, because "human perception respects diversity, complexity, patterns, and local character" (Erhartič 2012). Gray (2004) believes that the significance of diverse types of relief and richness of terrain details for the popularity of tourism areas is greatly underestimated. On the other hand, areas where various natural influences mix can also be areas where it is not simple to transfer best practices because of the varying responses of the landscape to human intervention. In homogenous areas, the monitoring or sampling network may be sparser, but in diverse areas, it must be denser (Bonar et al. 2011).

Thus the European Union places high importance on landscape diversity. Diversity is also regarded as an important natural resource by the "European Landscape Convention", published in 2000. It acknowledges that "the quality and diversity of European landscapes constitutes a common resource, and that it is important to co-operate towards its protection, management and planning." Diversity was already emphasized in the older EU document "Pan-European Biological and Landscape Diversity Strategy," which was published in 1996.

The landscape diversity of an area may therefore offer some advantages but also some disadvantages and challenges. The Slovenian government is very aware of this, and therefore it includes landscape diversity in the country's various development strategies (Ciglič and Perko 2013b).

The diverse natural environment is an advantage for tourism development of the country. Some countries are already using their landscape characteristics or geographical position for their tourism slogans. As an addition to the most popular Slovenian slogan "I feel sLOVEnia," there are some proposals in which the landscape diversity of Slovenia is used in more geographically designed slogans, such as "Slovenia: Europe in Miniature," "Slovenia: All of Europe in One Place," or "Slovenia: Half of Europe All Together." These slogans express that Slovenia offers almost as much as a trip across Europe, but certainly at least as much as Alpine, Mediterranean, Dinaric, and Pannonian Europe, or the coastal and inland areas of Europe (Perko and Ciglič 2015).

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Slovenia's Regions

15

Drago Perko and Rok Ciglič

Abstract

Geographers have produced many regionalizations of Slovenia to date. The most widely used geographical regionalization is based on a 1996 landscape typology and divides Slovenia into 48 regions and 4 macroregions. The average size of a region is 422 km^2. According to the EU classification of territorial units (Nomenclature of Territorial Units for Statistics, NUTS), Slovenia is divided into 2 NUTS 2 regions and 12 NUTS 3 regions and after that into 212 municipalities. The average size of a NUTS 3 region is 1689 km^2, and the average size of a municipality is 96 km^2. However, the division that continues to be most deeply rooted among Slovenians is the division into the former Austro-Hungarian provinces.

Keywords

Regional geography · Region · Regionalization · Alps · Pannonian Basin · Dinaric Alps · Mediterranean

15.1 Historical Divisions of Slovenian Territory

The pioneer in producing geographical regionalizations of the Slovenian territory was Baron Johann Weikhard von Valvasor (1641–1693), who published the encyclopedia *Die Ehre deß Hertzogthums Crain* (The Glory of the Duchy of Carniola) in 15 books in 1689. His regional–geographical descriptions of parts of Carniola were lavishly illustrated with nearly 600 copperplate engravings, including the map *Carniolia*, *Karstia*, *Histria et Windorum Marchia* (Carniola, Karst, Istria, and the Windic March) in book two.

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Based on this, the Nuremberg geographer and cartographer Johann Baptist Homann (1664–1724) created the map *Tabula Ducatus Carnioliae*, *Windorum Marchiae et Histriae* (Map of the Duchy of Carniola, Karst, the Windic March, and Istria), in which Carniola is composed of five parts (Fig. 15.1): Upper Carniola (German: *Ober Crain*), Lower Carniola (*Unter Crain*), Central Carniola (*Mittel Crain*), Inner Carniola (*Inner Crain*), and Istria (*Histereich*).

In his *Ducatus Carnioliae Tabula Chorographica* (Chorographic Map of the Duchy of Carniola) published on 12 sheets at a scale of about 1:100,000 in 1744, Joannes Disma Floriantschitsch de Grienfeld (1691–1757) also divided Carniola (Latin: *Carniolia*) into Upper Carniola (*Carniolia Superior*), Lower Carniola (*Carniolia Inferior*), Central Carniola (*Carniolia Media*), Inner Carniola (*Carniolia Interior*), and Istria (*Istria*).

Among all territorial divisions, it is the former provinces of Austria–Hungary in particular that continue to be very much alive and most deeply rooted in Slovenian consciousness, even though they are only a remnant of the administrative division of a country that has already been dead for a 100 years (Gabrovec and Perko 1999). At the beginning of the First World War, four Austrian provinces covered most of what is now Slovenia: Styria (Slovene, *Štajerska*; German, *Steiermark*), Carinthia (*Koroška*; *Kärnten*), Carniola (*Kranjska*; *Krain*), and the Littoral (*Primorje*; *Küstenland*). The Hungarian part of the empire included only 5% of the territory in the extreme northeastern part (what is now Prekmurje and traditionally part of Međimurje). Today's Slovenian cadastral districts still run nearly entirely along the borders of the former provinces (Fig. 15.2; within Carniola, borders are marked between Upper Carniola, Lower Carniola, and Inner Carniola, and within the Littoral, the borders are marked between the County of Gorizia, Trieste, and Istria. The internal division, which follows the borders of parishes and municipalities, has nothing to do with the official administrative division of Carniola, which in the early twentieth century included 11

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D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_15

Fig. 15.1 The map *Tabula Ducatus Carnioliae, Windorum Marchiae et Histriae* was created and printed in 1714 by Johann Baptist Homann (1664–1724). It is roughly 58 × 49 cm in size, and the scale used is around 1:627,666. The map includes a city view of Ljubljana and a drawing of Lake Cerknica. All parts of the duchy are marked in color: Upper Carniola (German: *Ober Crain*), Lower Carniola (*Unter Crain*), Central Carniola (*Mittel Crain*), Inner Carniola (*Inner Crain*), and Istria (*Histereich*)

districts and the city of Ljubljana, and of the Littoral, which was divided into 12 districts and the cities of Trieste and Gorizia). In some places old border stones still indicate the location of the former provincial borders (Fig. 15.3).

15.2 Modern Geographical Regionalizations of Slovenia

Several leading Slovenian geographers have produced a geographical regionalization of Slovenia, which they have improved and expanded over time (Kladnik 1996; Perko 1998, 2004, 2007; Perko and Urbanc 2004; Kladnik et al. 2009; Ciglič and Perko 2012; Ciglič 2014).

The majority of social–geographical regionalizations are functional (nodal or polarized) because they are based on the predominant gravitation of a surrounding area (the countryside) toward a specific center (a city). Their authors usually took into account the degree of centrality derived from the different significance and role of central settlements. They formed homogenous regions (i.e., uniform, indivisible regions or regions of the same type) defined in terms of a specific social characteristic (e.g., economic or population areas) less frequently, and programmed (planned) regions were even less common.

The first functional regionalization of Slovenia was produced by Svetozar Ilešič (1907–1985) in the mid-twentieth century (Ilešič 1958). For a long time, it remained the only

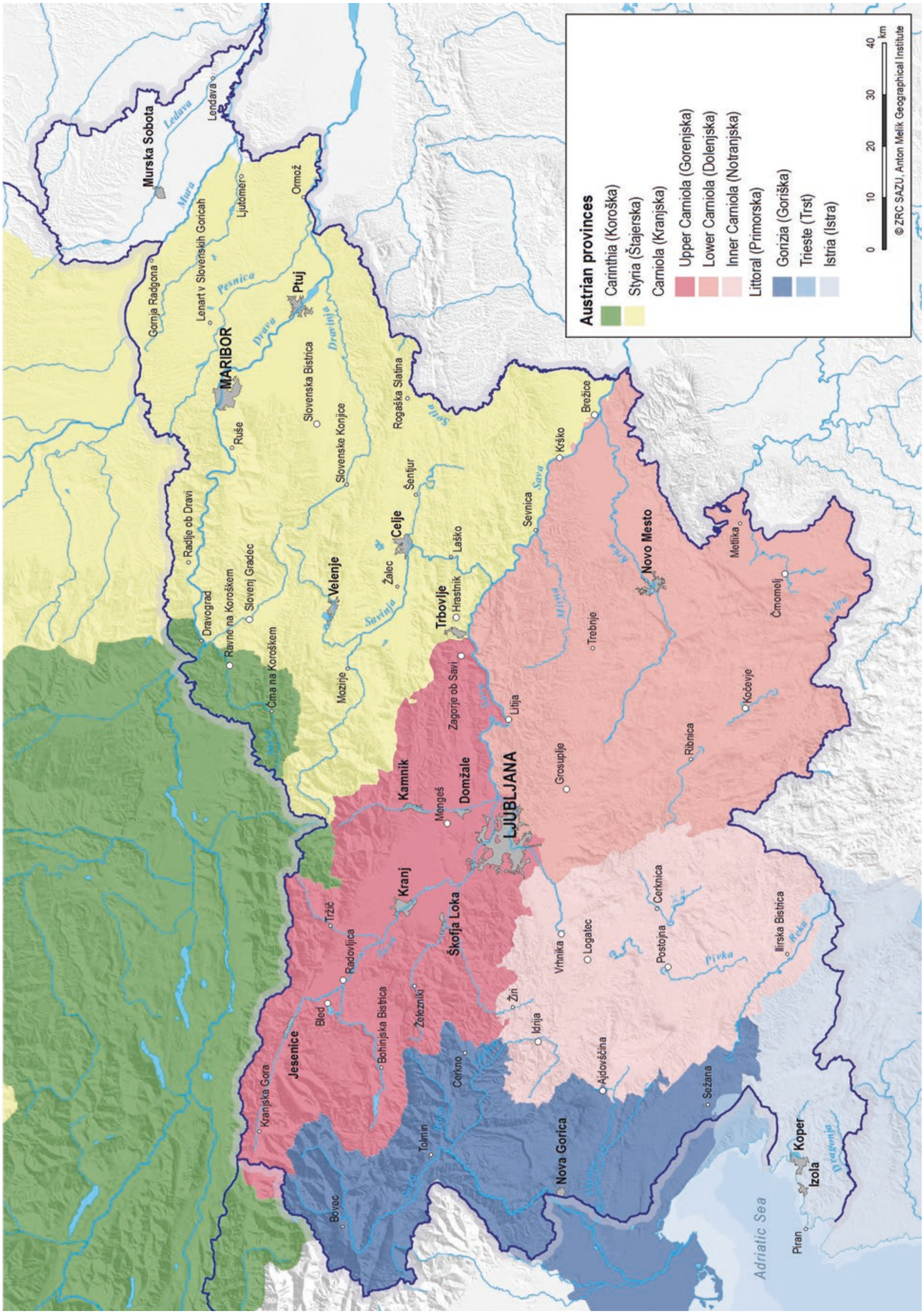

Fig. 15.2 The 1914 map of Austrian lands shows the administrative division of what is now Slovenia before the First World War

Fig. 15.3 Border stone between the former provinces of Carniola and Styria below Trojane at Zajasovnik along the Bolska River. (Photo by Jerneja Fridl)

regionalization available, and it basically served as a model example. Later, the topic was mainly tackled by Vladimir Kokole (1925–1993) and Igor Vrišer (1930–2013). By conducting research on the network of central settlements, Kokole produced a functional regionalization of Slovenia that formed the basis for the later planning regions within the regional spatial planning system (Kokole 1971). In turn, by studying the network of central settlements, Vrišer divided Slovenia into 12 regions that formed the basis for creating intermunicipal communities as a connecting link between the municipalities and the state (Vrišer 1967, 1988). However, due to rapid social changes—especially after Slovenia's independence in 1991—these social–geographical regionalizations, which were up to date and very useful at the time they were created, have already become outdated.

The first detailed division of Slovenia and the ethnic Slovenian territory across the border was produced by Anton Melik (1890–1966) as part of four extensive volumes on regional geography published between 1954 and 1960. In places, his natural–geographical criteria for dividing the territory are combined with economic and demographic criteria. He divided the majority of more densely populated units into smaller parts. He described some of the regions in two of the volumes, but he used different names and borders each time. He did not always rank the regions by hierarchy. Certain regions at the same hierarchical level were divided and others were not, and some were combined and others were not. He often did not name the region that he divided. As the pioneer of Slovenia's regionalization, he had to introduce many new, artificial names of regions, but he also used certain names that are of a more descriptive nature and unusual for regions, for example, *Rezija in gorsko sosedstvo* "Resia and neighboring mountainous area," *Osamelci okrog Skaručne* "isolated hills around Skaručna," and *Kraško obrežje* "Karst coastal area" (Melik 1954, 1957, 1959, 1960). Despite certain deficiencies, Melik's regionalization became the basis for all later natural–geographical divisions of Slovenia. He divided the present-day territory of Slovenia into 129 units: 11 submacroregions, 71 mesoregions, and 47 submesoregions.

The first comprehensive natural–geographical regionalization was published by Svetozar Ilešič in 1958. His division of Slovenia, too, extends beyond its borders, but the territory covered is already smaller than Melik's. Just like Melik before him, Ilešič used more descriptive names for some of the regions, for example, *Osrednje ravnine Ljubljanske kotline* "central plains of the Ljubljana Basin" (Ilešič 1956, 1958). Just over a decade later, Ilešič (1972) renamed a significant number of the regions. His systematic and hierarchically logical regionalization provided many new insights, but it was soon superseded by new ones, which relied more heavily on Melik's division. Ilešič divided the territory of what is now Slovenia into 65 units: 5 macroregions, 10 submacroregions, 43 mesoregions, and 7 submesoregions.

Important theoretical and practical insights into natural–geographical regionalization were provided by Ivan Gams (1923–2014). His regionalization of Slovenia was published in the secondary school geography textbook on Slovenia (Gams 1983), which was reprinted several times. This gives it special weight because it means that many years of students became familiar with it. Compared to Melik and Ilešič, Gams introduced fewer new names of regions. The number of names he used is nearly the same as what was used by

Ilešič and half of what was used by Melik. The greatest weakness of this regionalization is its unclear hierarchical classification. Gams defined 63 units: 5 macroregions, 7 submacroregions, 49 mesoregions, and 2 submesoregions.

15.3 Perko's Regionalization of 1996

In 1996, Drago Perko et al. produced a new natural–geographical regionalization of Slovenia, the goal of which was to provide a simpler, clearer, more systematic, and more straightforward regionalization than the ones produced until then. Perko reduced the number of regions to a reasonable number and decided against the use of transitional regions because most Slovenian regions are transitional to start with. He relied on the landscape typology that he produced that same year by overlapping elevation, inclination, lithology, and vegetation data layers in the geographic information system. He defined 48 spatially separate homogenous cores and manually drew borders between them; these borders were then further improved by researchers specializing in individual parts of Slovenia (Kladnik 1996; Perko 1998, 2001, 2007; Perko et al. 2015). Perko then combined these 48 (meso)regions into 4 macroregions, additionally defining the Gulf of Trieste as a special region that Slovenian territorial waters extend into.

This regionalization was first published in 1996 in *Geografski vestnik* (Kladnik 1996). It has also been published in all major geographical works on Slovenia issued after Slovenia's independence: the eleventh volume of *Enciklopedija Slovenije* (Encyclopedia of Slovenia, 1997), *Geografski atlas Slovenije* (Geographical Atlas of Slovenia, 1998), the regional volume *Slovenija: Pokrajine in ljudje* (Slovenia: Regions and People, 1998), *Nacionalni atlas Slovenije* (National Atlas of Slovenia, 2001), and the atlas *Slovenia in Focus* (Fridl et al. 2007).

The landscape typology that provided the basis for this regionalization includes nine landscape types combined into four groups:

- Group 1 (Alpine landscapes) comprises three types (Alpine mountains, Alpine hills, and Alpine plains).
- Group 2 (Pannonian landscapes) comprises two types (Pannonian low hills and Pannonian plains).
- Group 3 (Dinaric landscapes) comprises two types (Dinaric plateaus and Dinaric lowlands).
- Group 4 (Mediterranean landscapes) also comprises two types (Mediterranean low hills and Mediterranean plateaus).

The regionalization, which includes 48 regions and 4 macroregions (names in italics, Table 15.1), is as follows (Fig. 15.4):

Table 15.1 English and Slovenian names of macroregions and regions (Fig. 15.4)

English names	Slovenian names
Macroregion	*Makroregija*
Region	*Regija*
Alps	*Alpe*
Western Karawanks	*Zahodne Karavanke*
Eastern Karawanks	*Vzhodne Karavanke*
Kamnik–Savinja Alps	*Kamniško-Savinjske Alpe*
Julian Alps	*Julijske Alpe*
Cerkno, Škofja Loka, Polhov Gradec, and Rovte Hills	*Cerkljansko, Škofjeloško, Polhograjsko in Rovtarsko hribovje*
Sava Hills	*Posavsko hribovje*
Velenje and Konjice Hills	*Velenjsko in Konjiško hribovje*
Pohorje, Strojna, and Kozjak	*Pohorje, Strojna in Kozjak*
Ložnica and Hudinja Hills	*Ložniško in Hudinjsko gričevje*
Sava Plain	*Savska ravan*
Savinja Plain	*Savinjska ravan*
Pannonian Basin	*Panonska kotlina*
Goričko	*Goričko*
Lendava Hills	*Lendavske gorice*
Slovenian Hills	*Slovenske gorice*
Dravinja Hills	*Dravinjske gorice*
Haloze	*Haloze*
Mount Boč and Macelj	*Boč in Macelj*
Voglajna and Upper Sotla Hills	*Voglajnsko in Zgornjesotelsko gričevje*
Central Sotla Hills	*Srednjesotelsko gričevje*
Krško, Senovo, and Bizeljsko Hills	*Krško, Senovsko in Bizeljsko gričevje*
Mura Plain	*Murska ravan*
Drava Plain	*Dravska ravan*
Krka Plain	*Krška ravan*
Dinaric Alps	*Dinarsko gorovje*
Kambreško and Banjšice Plateaus	*Kambreško in Banjšice*
Trnovo Forest Plateau, Mount Nanos, and Hrušica Plateau	*Trnovski gozd, Nanos in Hrušica*
Idrija Hills	*Idrijsko hribovje*
Javornik Hills and Snežnik Plateau	*Javorniki in Snežnik*
Pivka Lowland and Mount Vremščica	*Pivško podolje z Vremščico*
Inner Carniola Lowland	*Notranjsko podolje*
Krim Hills and Menišija Plateau	*Krimsko hribovje in Menišija*
Bloke Plateau	*Bloke*
Big Mountain, Mount Stojna, and Mount Gotenica	*Velika gora, Stojna in Goteniška gora*
Ribnica–Kočevje Lowland	*Ribniško-Kočevsko podolje*
Little Mountain, Kočevje Rog Plateau, and Mount Poljane	*Mala gora, Kočevski rog in Poljanska gora*
Velike Lašče	*Velikolaščanska pokrajina*
Ljubljana Marsh	*Ljubljansko barje*

(continued)

Table 15.1 (continued)

English names	Slovenian names
Novo Mesto	*Novomeška pokrajina*
Lower Carniola Lowland	*Dolenjsko podolje*
Radulja Hills	*Raduljsko hribovje*
Dry Carniola and Dobrepolje	*Suha krajina z Dobrepoljem*
White Carniola	*Bela krajina*
Gorjanci Hills	*Gorjanci*
Mediterranean	*Sredozemlje*
Gorica Hills	*Goriška brda*
Vipava Hills	*Vipavska brda*
Karst Plateau	*Kras*
Brkini Hills and Reka Valley	*Brkini in dolina Reke*
Podgorje Karst Plateau, Čičarija Plateau, and Podgrad Lowland	*Podgorski kras, Čičarija in Podgrajsko podolje*
Koper Hills	*Koprska brda*

– Macroregion 1 (the *Alps*) comprises 11 regions, for example, the *Julian Alps*, the *Sava Hills*, and the *Sava Plain*.
– Macroregion 2 (the *Pannonian Basin*) comprises 12 regions, for example, the *Haloze Hills* and the *Mura Plain*.
– Macroregion 3 (the *Dinaric Alps*) comprises 19 regions, for example, the *Javornik Hills and Mount Snežnik* and *White Carniola*.
– Macroregion 4 (the *Mediterranean*) comprises six regions, for example, the *Gorica Hills* and the *Karst Plateau*.

The borders of the macroregions in the regionalization are the same as the borders of the landscape type groups in the landscape typology (e.g., the Alps macroregion corresponds to the Alpine landscapes type group), and every region in the regionalization corresponds to one of the representatives of each landscape type in the landscape typology (e.g., the Alps macroregion includes four regions or representatives of the Alpine mountains type, five regions of the Alpine hills type, and two regions of the Alpine plains type).

15.4 The Alps

The Alps are the largest and highest mountain chain in Europe. Along them runs the divide between the North Sea and the Mediterranean Sea and the dividing line between the continental and Mediterranean climates. Covering about 200,000 km^2, the Alps are more than 1200 km long and in some places up to 250 km wide. They run from France in the southwest to Austria in the northeast. The southeastern part of the Alps extends into Slovenia.

Slovenia's *Alps* macroregion lies in northern and northwestern Slovenia. It encompasses 42.1% of the country, and it is composed of mountainous, hilly, and flat regions.

There are four mountainous regions (as part of the Alpine mountains landscape type). The Karawanks (with their highest peak, Mount Stol, 2236 m) extend from the tripoint between Slovenia, Italy, and Austria in the northwest along the Slovenian–Austrian border. This distinctly elongated mountain chain is divided into two regions: the *Western Karawanks*, which averages as Slovenia's highest (1188 m) and steepest (27.3°) region, and the *Eastern Karawanks*, which gradually descend to hills toward the east. South of these mountains, the *Kamnik–Savinja Alps* descend into the Ljubljana Basin around Mount Grintovec (2558 m). Below nearby Mount Skuta (2533 m) are the remnants of the Skuta Glacier, the southeasternmost glacier in the European Alps. The romantic Logar Valley at the head of the Savinja River is especially attractive. In the northwestern corner of Slovenia, south of the Sava River, stand the *Julian Alps*, which are surrounded by wooded and karstified plateaus, especially to the southeast. Among all the Slovenian regions, they receive the least insolation (3605 MJ/m^2 per year). They rise around Mount Triglav (2864 m), Slovenia's highest mountain. Below it there is the Triglav Glacier. Triglav National Park was established to preserve the many natural wonders of this area. On the south side, the blue-green Soča River winds through its deep valley toward the Adriatic Sea. Its upper section, the Trenta Valley, is one of Slovenia's most beautiful Alpine valleys. Farther south lies Tolmin (population 3534 according to the 2011 census), the only major town in the central Soča Valley. Picturesque glacial valleys open to the north: Krma, Kot, Vrata, and Planica. The last is nicknamed the "Valley of Ski Jumps" and is the cradle of ski flying, one of Slovenia's most popular winter spectator sports. From the north side of the Julian Alps, the rivers flow to the Black Sea. The Sava Dolinka runs past Jesenice (population 13,440) and its ironworks, and the Sava Bohinjka flows from glacial Lake Bohinj, Slovenia's largest natural lake (328 ha), past the cosmopolitan tourist resort of Bled (population 5181) and Lake Bled (145 ha), which boasts a small picturesque island with a church. Together, they join to form the Sava River (Perko 2007; Table 15.2).

There are five hilly regions (Alpine hills) bounded by mountainous regions to the south and east. Furthest to the west, there rise the *Cerkno*, *Škofja Loka*, *Polhov Gradec*, *and Rovte Hills*, which are well known for lacemaking. The medieval town of Škofja Loka (population 11,969) is located here. In the central and eastern part of Slovenia are the nearly 100 km long *Sava Hills* with their largely exhausted coal deposits and Trbovlje (population 15,163), the largest of the

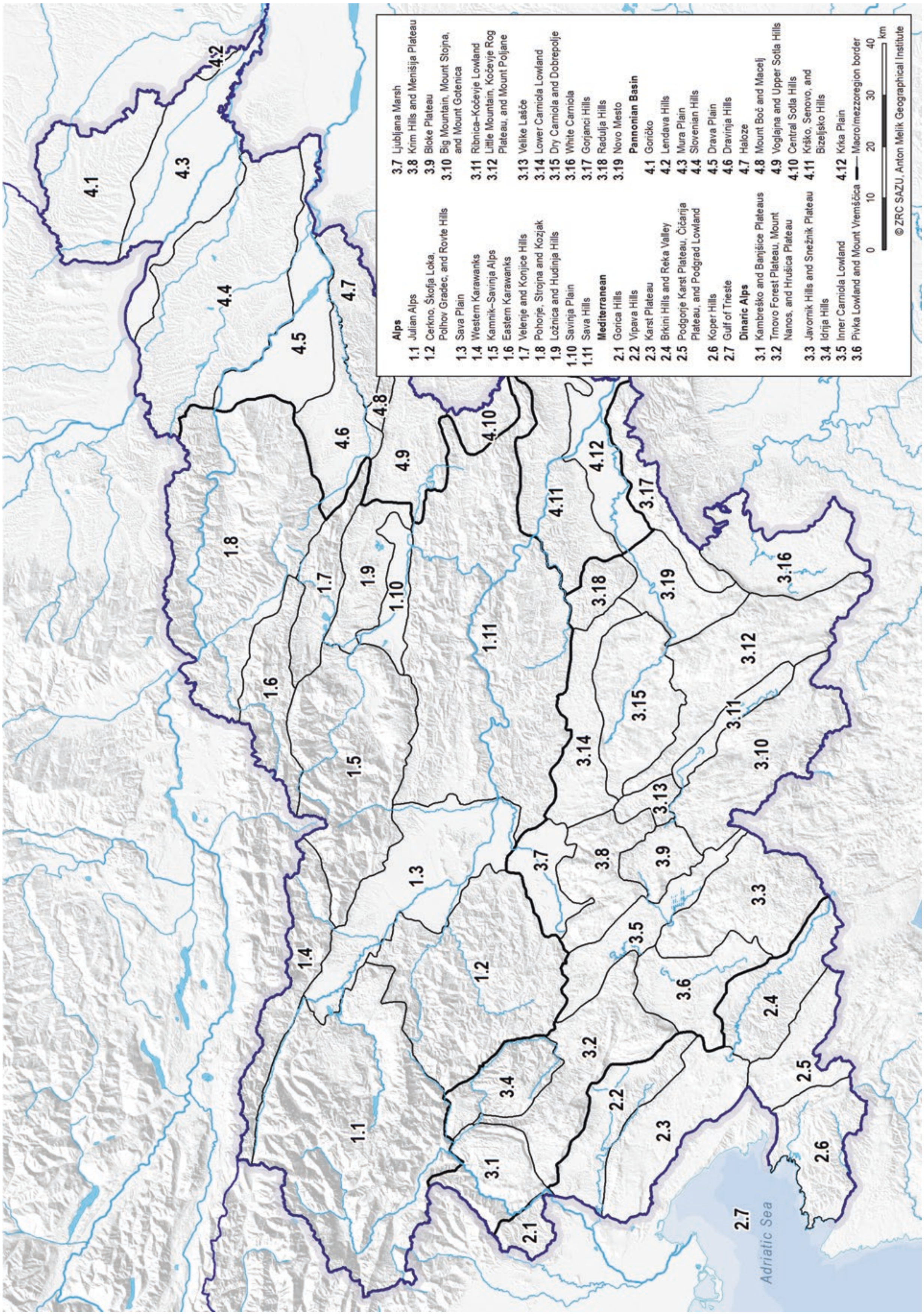

Fig. 15.4 Slovenia's regions

Table 15.2 English and Slovenian names of cohesion regions and statistical regions (Fig. 15.11)

English names	Slovenian names
Cohesion region	*Kohezijska regija*
Statistical region	*Statistična regija*
Eastern Slovenia	*Vzhodna Slovenija*
Mura	*Pomurska*
Drava	*Podravska*
Carinthia	*Koroška*
Savinja	*Savinjska*
Central Sava	*Zasavska*
Lower Sava	*Posavska*
Southeast Slovenia	*Jugovzhodna Slovenija*
Littoral–Inner Carniola	*Primorsko-notranjska*
Western Slovenia	*Zahodna Slovenija*
Central Slovenia	*Osrednjeslovenska*
Upper Carniola	*Gorenjska*
Gorizia	*Goriška*
Coastal–Karst	*Obalno-kraška*

Fig. 15.5 Ravne na Koroškem, known for its ironworks, is the largest city in Carinthia. (Photo by Marjan Garbajs, GIAM ZRC SAZU Archive)

mining towns in Slovenia's largest region (1909 km^2). To the northeast are the *Velenje and Konjice Hills*; this is on average the most diverse Slovenian region in terms of landscape (factor = 0.2123). The town of Velenje (population 25,456) with its lignite mine, which caused the ground to sink and create artificial lakes, is located here. Even further to the north are the *Pohorje*, *Strojna*, *and Kozjak Hills*, southern outcroppings of the Central Eastern Alps, where the Drava River has cut a deep valley. Ravne na Koroškem (population 6979; Fig. 15.5) with its successful ironworks is located here. Lowest of all are the *Ložnica and Hudinja Hills* on the northern margin of the Celje Basin, which already have a Pannonian character (Perko 2007; Table 15.2).

Between the mountainous and hilly regions, there are two flat regions (Alpine plains). The *Sava Plain* covers the floor of the Ljubljana Basin. It is primarily composed of gravel and conglomerate terraces, above which rise ranges of hills and isolated hills in places, such as Mount Saint Mary (*Šmarna gora*) north of Ljubljana. This area has the greatest population density in the country, where nearly one-fifth of Slovenia's population lives on just over a tenth of its territory. Here lie Slovenia's capital Ljubljana (population 272,220), the industrial city of Kranj, the old capital of Carniola and fourth-largest city in Slovenia (population 36,874), and several smaller but economically significant towns: Radovljica (population 5940), Tržič (population 3865), Kamnik (population 13,644), and Domžale (population 12,406). The Celje Basin is Slovenia's second largest basin, on the floor of which the Savinja River and its tributaries created the *Savinja Plain*. It is the most built-up (21.4%) and the least wooded (15.0%) Slovenian region. It includes Celje (population 37,520), Slovenia's third largest city, once the seat of the historically important Counts of Celje, and Žalec (population 4943), surrounded by extensive hop fields that reflect Pannonian climate influences from the east (Perko 2007; Table 15.2).

15.5 The Pannonian Basin

The Pannonian Basin lies between the Alps to the west, the Carpathians to the north and east, and the Dinaric Alps to the south. Running about 600 km from north to south and 700 km from east to west, it covers an area almost twice as large as the Alps. The western margin of the Pannonian Basin extends into Slovenia.

Slovenia's *Pannonian Basin* macroregion lies in the northeast part of the country. It covers 21.2% of Slovenia, and it is comprised of low hills and plains.

There are nine regions with low hills. The northernmost Slovenian region is *Goričko*, which is a salient between Austria and Hungary. Between 1991 and 2011 alone, it lost nearly one-fifth of its population, which is the most among all the regions. The *Lendava Hills* rise along the Hungarian border; at 17 km^2, this is the smallest Slovenian region. The *Slovenian Hills* stand between the Drava and Mura rivers; at 1034 km^2, they are the largest Slovenian Pannonian region. South of the Pohorje Hills are the *Dravinja Hills*, which toward the south, across the Dravinja River, rise once again into the slump-prone *Haloze* region, and then higher yet into the *Mount Boč and Macelj Hills* region, which stand far to the east as a kind of displaced Alpine unit. Along the northeast margin of the Sava Hills is the *Voglajna and Upper Sotla*

Fig. 15.6 Lent, the medieval center of Maribor. (Photo by Oskar Dolenc, GIAM ZRC SAZU Archive)

Fig. 15.7 Ptuj, the oldest Slovenian town, along the Drava River. (Photo by Matevž Lenarčič, GIAM ZRC SAZU Archive)

Hills region, to the east the *Central Sotla Hills* region, which has the largest share of meadows among all the regions (37.5%), and along the southeast margin the *Krško*, *Senovo*, *and Bizeljsko Hills* region, which extends to the border with Croatia (Perko 2007; Table 15.2).

Three flat regions (Pannonian plains) lie between the low hills along the slow and meandering Mura, Drava, and Krka rivers. Vulnerable to flooding, these plains are of major agricultural importance. Furthest north lies the *Mura Plain*, which at 602 km^2 is the largest contiguous flat area in Slovenia. It is the flattest area on average (0.7°) and has the greatest share of tilled fields (59.1%). The largest town on the plain is Murska Sobota (population 11,614). The nearby *Drava Plain* has the largest water area (3.7%) because of the damming of the Drava River. Maribor (population 95,171; Fig. 15.6), Slovenia's second largest city, and Ptuj (population 18,164; Fig. 15.7), its oldest inland city, are located here. Furthest to the south, at the confluences of the Sava, Krka, and Sotla rivers, is the *Krka Plain*, which is the lowest Slovenian region on average (elevation: 161 m). Here are found Krško (population 7097) with its nearby nuclear power plant, the small medieval town of Kostanjevica na Krki (population 695), and the Krakov Forest nature reserve, the remains of a once large lowland swamp forest (Perko 2007; Table 15.2).

15.6 The Dinaric Alps

The Dinaric Alps are the southeastern continuation of the Alps between the Pannonian Basin and the Adriatic Sea. They form the divide between the Black Sea and the Adriatic. They are 700 km long and almost 200 km wide at their center and cover less than half the area of the Alps. The northwestern part of the Dinaric Alps extends into Slovenia.

Slovenia's *Dinaric Alps* macroregion lies in the southern and southeastern part of the country. It encompasses 28.2% of Slovenia. It comprises 11 plateau-like regions (Dinaric plateaus) and 8 flatter regions (Dinaric lowlands and peneplains).

In the extreme northwest part of the Dinaric Alps is the region of the *Kambreško and Banjšice Plateaus*, which is crossed by the deeply carved Soča Valley. Southeast of this is a region of high Dinaric plateaus: the *Trnovo Forest Plateau*, *Mount Nanos*, *and Hrušica Plateau* region. This continues to the north into the more rugged and plateau-like *Idrija Hills*, with the town of Idrija (population 5955) with its well-known but now abandoned mercury mine (in 2012 it was added to the UNESCO list of worldwide cultural and natural heritage sites), and to the southeast into the region of the high Dinaric plateaus of the *Javornik Hills and Snežnik Plateau*, which is characterized by the smallest share of tilled fields (0.12%), the smallest share of orchards (0.02%), the smallest share of built-up land (0.17%), and the smallest share of vineyards (0.00%). On the Littoral side, it is bounded by the *Pivka Lowland and Mount Vremščica* with Postojna (population 9183) and well-known Postojna Cave and, on the inland side, by the *Inner Carniola Lowland* with many karst poljes and with well-known intermittent Lake Cerknica (300 years ago, the Slovenian polymath Johann Weikhard von Valvasor was made a member of the Royal Society in London for describing this unusual phenomenon). To the northeast above this, there rise two inland plateau regions—the *Krim Hills and Menišija Plateau* and the *Bloke Plateau*—and to the south above these *Big Mountain*, *Mount Stojna*, *and Mount Gotenica*. Further east, the *Ribnica–Kočevje Lowland* with the town of Kočevje (population 8672) also extends in the Dinaric direction. The eastern side of the region is bounded by the lowest series of Dinaric plateaus. These include the

Little Mountain, *Kočevje Rog Plateau*, *and Mount Poljane* region, which makes up the most forested landscape in Slovenia (92.2% forest), where the population decreased the most of all regions between 1931 and 2011, falling to less than fifth of its previous level. This region is the most depopulated area in Slovenia because the population is now barely one-tenth of what it was in the mid-nineteenth century. Northwest of the Ribnica–Kočevje Lowland is the largely dolomite, impermeable, and quite rugged *Velike Lašče* region. At the extreme north end of the Dinaric area, extending all the way to Ljubljana, is the *Ljubljana Marsh*, which has experienced the greatest increase in population among all the Slovenian regions due to the expansion of Ljubljana to the south. In 2011 the population was nearly seven times greater than in 1931, although without Ljubljana it would be only three times larger. Because of Ljubljana, the region also has the greatest average settlement size (2323.2 people per settlement), although without Ljubljana this figure would be less than half that number (927.9 people per settlement), and then the *Drava Plain* would be in first place among the regions (at 1647.9 people per settlement). In 2011 approximately one-fifth of Ljubljana's population lived on the northern edge of the *Ljubljana Marsh* and four-fifths of the population on the southern edge of the Sava Plain. Ancient settlement of the area is attested to by prehistoric pile dwellings, which were added to the UNESCO list of worldwide cultural and natural heritage sites in 2011. Between the *Ljubljana Marsh* and the undulating *Novo Mesto* region—centered around Novo Mesto (population 23,341; Fig. 15.8), the main city of Lower Carniola —there extends the *Lower Carniola Lowland*, which is divided into a series of karst poljes, blind valleys, dry karst valleys, ranges of hills, and small plateaus. All Dinaric lowlands are important for traffic, with karst poljes that provide the greatest proportion of arable land, but also the threat of flooding. East of the *Lower Carniola Lowland* are the *Radulja Hills* and, to the south of this, the plateau-like *Dry Carniola and Dobrepolje* region, which the Krka Valley divides into an eastern and western part. In extreme southeastern Slovenia, below the forested edge of the *Kočevje Rog Plateau and Mount Poljane*, is *White Carniola*, the most distinctive and extensive Slovenian low corrosion plain with strong Pannonian influences and with the least landscape diversity (factor = 0.1222). In the north, the land rises toward the *Gorjanci Hills*, which have ridges from the southwest toward the northeast that set it apart among the Dinaric landscapes, and along which the border with Croatia runs (Perko 2007; Table 15.2).

Fig. 15.8 Novo Mesto, the capital of Lower Carniola. (Photo by Jože Hanc, GIAM ZRC SAZU Archive)

15.7 The Mediterranean

The Mediterranean region is the area around the Mediterranean Sea, stretching almost 7000 km from Gibraltar to the Bosporus. Between Trieste and Durrës, the arm of the Mediterranean known as the Adriatic Sea runs almost 700 km between the Italian Apennines to the southwest and the Dinaric Alps to the northeast. Covering an area of 132,000 km^2, the Adriatic Sea is somewhat larger than the Dinaric Alps. The northern margin of the Mediterranean extends into Slovenia.

Slovenia's *Mediterranean* macroregion, where the temperatures do not fall below freezing during the coldest month, lies in southwestern Slovenia, along the Gulf of Trieste and its hinterland. It encompasses 8.6% of the country. It comprises two plateau regions and five regions of low hills.

Furthest to the northwest are the *Gorica Hills*, which have the most vineyards among all the regions (23.0%) and the fewest meadows and pastures (5.9%). Among all the Mediterranean regions, this region is the least exposed to the unpleasant effects of the bora wind. This is the worst in the neighboring fertile Vipava Valley, in the lowest part of the *Vipava Hills*. The border town of Nova Gorica (population 13,178; Fig. 15.9) is located at the juncture of the *Gorica Hills* and *Vipava Hills* along the Soča. Further south rises the low *Karst Plateau*, which gave its name to the discipline of karst studies because it was here, on Slovenian ethnic territory, that the study of karst phenomena created through the dissolution of permeable limestone began. Many other Slovenian terms have also been incorporated into the international terminology for karst phenomena. Cave tourism began here as well. The oldest show cave in the world is Vilenica Cave near Divača, where entrance fees were collected as early as the first half of the seventeenth century. The grayish-white color of the karst stone complements the white Lipizzaner horses at the Lipica stud farm and the

Fig. 15.9 Nova Gorica was developed after the Second World War. (Photo by Marjan Garbajs, GIAM ZRC SAZU Archive)

Fig. 15.10 The medieval center of Piran on the Adriatic coast. (Photo by Marjan Garbajs, GIAM ZRC SAZU Archive)

intensely red terra rossa soil. With an area of 429 km^2, the *Karst Plateau* region is Slovenia's largest Mediterranean landscape and the second-lowest region in terms of landscape diversity (factor = 0.1223). Beneath its relatively inhospitable surface is a fairytale underground world carved out by water. More than 7000 caves rich in stalactites, stalagmites, and other karst cave formations have been discovered to date below the Mediterranean and neighboring Dinaric Alps regions. Among these is Škocjan Caves, which was added to the UNESCO list of worldwide cultural and natural heritage sites in 1986 and is known for the world's largest underground canyon (2.5 km long and 130 m high). The karst underground is also renowned for its fauna, which has adapted to life without light. The best-known species is the olm or cave salamander (*Proteus anguinus*), which is endemic to the Dinaric Alps and is the symbol of Slovenian natural science. Southeast of the *Karst Plateau* are the flysch *Brkini Hills*, and south of these the karstified region of the *Podgorje Karst Plateau*, *Čičarija Plateau*, *and Podgrad Lowland*, which has the smallest share of surface water among all the regions (a negligible 0.004%). Closest to the sea rise the flysch *Koper Hills*, which have the largest share of orchards (9.5%) among all Slovenia's regions and the greatest insolation (4478 MJ/m^2 per year). The surrounding countryside is undergoing depopulation and overgrowth, whereas along the coast the population is growing and the economy is developing quickly. The largest coastal towns are Koper (population 24,996), Izola (population 11,223), and Piran (population 4192; Fig. 15.10). There is also an airport significant for tourism located near Portorož (population 2947; Perko 2007; Table 15.3).

The area of Slovenian territorial water in the Gulf of Trieste is 213 km^2 (according to the arbitration decision on the course of the Slovenian–Croatian border announced on June 29, 2017, by the Hague-based Permanent Court of Arbitration).

15.8 Territorial Units of the European Union

These geographical regions only sometimes correspond to the official territorial division of Slovenia, which is based on the European Union's Nomenclature of Territorial Units for Statistics (NUTS), adopted by the European Parliament on May 26, 2003. It was established by Eurostat, the EU statistical office, in order to ensure a comprehensive and consistent division of territorial units necessary for collecting, developing, and harmonizing regional statistics in the European Union.

Slovenia is represented as 1 unit at the NUTS 1 level, as 2 cohesion regions at the NUTS 2 level, and as 12 statistical regions at the NUTS 3 level (Table 15.2). The next level is the municipalities (Fig. 15.11).

The Eastern Slovenia cohesion region is composed of eight statistical regions (Mura, Drava, Carinthia, Savinja, Central Sava, Lower Sava, Southeast Slovenia, and Littoral–Inner Carniola), and the Western Slovenia cohesion region contains the other four statistical regions (Central Slovenia, Upper Carniola, Gorizia, and Coastal–Karst).

The Register of Spatial Units, which is kept and maintained by the Surveying and Mapping Authority of the

Table 15.3 Some basic characteristics of Slovenian regions

ID		101	102	103	104	105	106	107
Name	Slovenia	Julian Alps	Cerkno, Škofja Loka, Polhov Gradec, and Rovte hills	Sava plain	Western Karawanks	Kamnik–Savinja Alps	Eastern Karawanks	Velenje and Konjice hills
Area (km²)	20273.00	1542.19	978.44	675.90	331.18	888.80	299.61	241.34
% of area	100.00	7.61	4.83	3.33	1.63	4.38	1.48	1.19
Mean elevation (m)	556.83	1108.70	646.82	393.27	1187.95	959.30	920.16	626.88
Mean inclination (°)	14.62	26.99	20.97	4.96	27.33	25.05	24.72	19.94
Insolation (MJ/m²)	4012.84	3604.90	3923.19	4088.01	3913.85	3777.50	3782.87	3925.70
% of fields	9.71	0.29	1.53	22.05	0.18	0.84	1.23	2.80
% of vineyards	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.19
% of orchards	1.76	0.30	1.13	1.22	0.21	0.77	0.95	2.95
% of meadows and pastures	18.47	11.38	21.85	20.58	11.60	14.83	14.16	21.22
% of forests	61.90	70.49	72.28	35.35	80.71	76.58	80.93	65.90
% of built-up areas	5.01	1.46	2.92	19.38	2.15	1.65	1.98	5.69
Average landscape diversity	0.16	0.17	0.19	0.17	0.19	0.20	0.19	0.21
Population in 1931	1397650	34480	39255	182373	16994	20352	10553	15992
% of population in 1931	100.00	2.47	2.81	13.05	1.22	1.46	0.76	1.14
Population in 1961	1591523	30642	34954	260944	26586	20098	12295	23027
% of population in 1961	100.00	1.93	2.20	16.40	1.67	1.26	0.77	1.45
Population growth index. 1931–1961	113.87	88.87	89.04	143.08	156.44	98.75	116.51	143.99
Population in 1991	1965986	30664	39343	418223	29466	20916	11178	42329
% of population in 1991	100.00	1.56	2.00	21.27	1.50	1.06	0.57	2.15
Population growth index. 1931–1991	140.66	88.93	100.22	229.32	173.39	102.77	105.92	264.69
Population growth index. 1961–1991	123.53	100.07	112.56	160.27	110.83	104.07	90.92	183.82
Population in 2011	2050189	29020	45251	440733	28447	21657	10457	41522
% of population in 2011	100.00	1.42	2.21	21.50	1.39	1.06	0.51	2.03
Population density in 2011 (people per km²)	101.13	18.82	46.25	652.07	85.90	24.37	34.90	172.05
Population growth index. 1931–2011	146.69	84.16	115.27	241.67	167.39	106.41	99.09	259.64
Population growth index. 1991–2011	104.28	94.64	115.02	105.38	96.54	103.54	93.55	98.09
Number of settlements in 2011	6030	136	287	330	25	114	28	51
Settlement density in 2011 (number per 100 km²)	29.74	8.82	29.33	48.82	7.55	12.83	9.35	21.13
Average size of settlement in 2011 (people per settlement)	340.00	213.38	157.67	1335.55	1137.88	189.97	373.46	814.16

108	109	110	111	201	202	203	204	205	206	207	208	209	210	211	212
Pohorje, Strojna, and Kozjak	Ložnica and Hudinja hills	Savinja plain	Sava hills	Goričko	Lendava hills	Mura plain	Slovenian hills	Drava plain	Dravinja hills	Haloze	Mount Boč and Macelj	Voglajna and Upper Sotla Hills	Central Sotla hills	Krško, Senovo, and Bizeljsko hills	Krka plain
1286.67	244.35	143.31	1909.16	491.67	17.21	601.55	1033.96	425.22	281.25	241.24	73.38	293.11	101.37	461.32	270.22
6.35	1.21	0.71	9.42	2.43	0.08	2.97	5.10	2.10	1.39	1.19	0.36	1.45	0.50	2.28	1.33
714.03	363.93	277.89	482.97	275.11	226.47	183.75	268.41	234.53	318.23	316.74	464.24	307.31	304.87	275.45	160.70
18.82	12.83	2.70	18.63	6.30	9.90	0.66	8.15	0.90	7.61	18.58	22.39	11.87	12.48	13.23	1.92
3982.87	4018.44	4042.53	3944.75	4220.51	4205.56	4199.26	4182.42	4163.42	4092.25	3905.67	3947.34	4056.28	3995.59	4168.58	4154.82
2.96	8.04	35.64	3.42	32.47	13.72	59.06	29.87	53.68	17.59	5.45	2.84	13.21	14.34	10.15	34.88
0.20	0.48	0.06	0.19	0.90	15.93	0.24	4.17	0.06	1.78	3.69	0.57	1.48	3.38	3.79	0.41
2.12	4.76	2.24	2.33	2.49	4.74	1.26	4.11	0.65	3.30	3.31	2.08	3.63	3.58	3.85	1.73
18.51	28.16	23.94	23.11	12.25	11.06	6.06	21.18	7.20	26.54	25.93	15.82	35.17	37.50	25.35	22.64
71.37	51.28	15.01	66.24	48.20	43.96	22.32	33.85	17.68	40.90	58.08	76.31	38.40	36.22	50.92	28.34
3.93	6.46	21.43	4.15	3.39	10.56	9.02	6.04	16.75	9.18	3.22	2.33	7.31	4.66	5.20	9.98
0.16	0.20	0.17	0.19	0.13	0.15	0.13	0.14	0.14	0.17	0.15	0.18	0.18	0.18	0.18	0.17
66146	17731	35501	121713	35892	2980	68141	93881	89151	28664	17552	3589	28204	8835	36944	25534
4.73	1.27	2.54	8.71	2.57	0.21	4.88	6.72	6.38	2.05	1.26	0.26	2.02	0.63	2.64	1.83
83773	19089	53395	132142	31142	2799	73929	93656	137494	35819	17205	3684	29463	7148	35821	29152
5.26	1.20	3.35	8.30	1.96	0.18	4.65	5.88	8.64	2.25	1.08	0.23	1.85	0.45	2.25	1.83
126.65	107.66	150.40	108.57	86.77	93.93	108.49	99.76	154.23	124.96	98.02	102.65	104.46	80.91	96.96	114.17
98652	21852	75383	136848	23196	2208	88006	86695	177129	44064	12131	2759	35462	6005	33854	35598
5.02	1.11	3.83	6.96	1.18	0.11	4.48	4.41	9.01	2.24	0.62	0.14	1.80	0.31	1.72	1.81
149.14	123.24	212.34	112.43	64.63	74.09	129.15	92.35	198.68	153.73	69.11	76.87	125.73	67.97	91.64	139.41
117.76	114.47	141.18	103.56	74.48	78.89	119.04	92.57	128.83	123.02	70.51	74.89	120.36	84.01	94.51	122.11
99510	25777	75137	142184	18892	2345	81897	90675	171380	47953	11612	2546	37601	5690	33894	35663
4.85	1.26	3.66	6.94	0.92	0.11	3.99	4.42	8.36	2.34	0.57	0.12	1.83	0.28	1.65	1.74
77.34	105.49	524.31	74.47	38.42	136.29	136.14	87.70	403.04	170.50	48.13	34.69	128.28	56.13	73.47	131.98
150.44	145.38	211.65	116.82	52.64	78.69	120.19	96.59	192.24	167.29	66.16	70.94	133.32	64.40	91.74	139.67
100.87	117.96	99.67	103.90	81.45	106.20	93.06	104.59	96.75	108.83	95.72	92.28	106.03	94.75	100.12	100.18
218	115	76	857	84	5	142	423	104	163	80	14	189	40	254	138
16.94	47.06	53.03	44.89	17.08	29.06	23.61	40.91	24.46	57.96	33.16	19.08	64.48	39.46	55.06	51.07
456.47	224.15	988.64	165.91	224.90	469.00	576.74	214.36	1647.88	294.19	145.15	181.86	198.95	142.25	133.44	258.43

(continued)

Table 15.3 (continued)

ID	301	302	303	304	305	306	307	308	309	310
Name	Kambreško and Banjšice plateaus	Trnovo forest plateau, Mount Nanos, and Hrušica plateau	Javornik hills and Snežnik plateau	Idrija hills	Inner Carniola lowland	Pivka lowland and Mount Vremščica	Ljubljana Marsh	Krim hills and Menišija plateau	Bloke plateau	Big Mountain, Mount Stojna, and Mount Gotenica
Area (km^2)	271.70	508.21	457.65	238.92	270.10	297.41	180.24	300.21	143.98	553.17
% of area	1.34	2.51	2.26	1.18	1.33	1.47	0.89	1.48	0.71	2.73
Mean elevation (m)	549.47	832.36	968.86	648.19	571.17	607.26	296.39	632.74	743.67	736.85
Mean inclination (°)	20.05	17.67	15.14	25.15	7.48	8.31	2.66	15.24	12.74	15.10
Insolation (MJ/m^2)	3910.85	3959.97	3944.48	3706.24	4144.24	4228.14	4100.21	3884.14	3984.33	3954.08
% of fields	0.80	0.51	0.12	0.46	1.94	2.99	27.27	0.95	1.37	0.35
% of vineyards	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% of orchards	1.15	0.25	0.02	0.76	0.69	0.71	0.90	0.60	0.68	0.37
% of meadows and pastures	15.98	11.30	9.08	15.88	32.37	33.68	37.46	12.43	27.26	9.70
% of forests	78.86	86.25	90.16	80.30	58.35	58.08	16.18	83.26	68.79	88.31
% of built-up areas	2.38	1.03	0.17	1.94	5.59	4.07	17.23	2.57	1.73	1.01
Average landscape diversity	0.15	0.14	0.13	0.18	0.17	0.16	0.15	0.16	0.16	0.14
Population in 1931	15271	7940	0	14715	17736	17599	14821	6185	4533	12266
% of population in 1931	1.09	0.57	0.00	1.05	1.27	1.26	1.06	0.44	0.32	0.88
Population in 1961	11644	5919	0	12712	16931	17260	50038	4745	3293	7884
% of population in 1961	0.73	0.37	0.00	0.80	1.06	1.08	3.14	0.30	0.21	0.50
Population growth index, 1931–1961	76.25	74.55	–	86.39	95.46	98.07	337.62	76.72	72.65	64.28
Population in 1991	9328	4534	0	11628	21219	19243	81600	4691	2424	5564
% of population in 1991	0.47	0.23	0.00	0.59	1.08	0.98	4.15	0.24	0.12	0.28
Population growth index, 1931–1991	61.08	57.10	–	79.02	119.64	109.34	550.57	75.84	53.47	45.36
Population growth index, 1961–1991	80.11	76.60	–	91.47	125.33	111.49	163.08	98.86	73.61	70.57
Population in 2011	8108	4662	21	10881	26462	20426	99898	7042	2380	5413
% of population in 2011	0.40	0.23	0.00	0.53	1.29	1.00	4.87	0.34	0.12	0.26
Population density in 2011 (people per km^2)	29.84	9.17	0.05	45.54	97.97	68.68	554.25	23.46	16.53	9.79
Population growth index, 1931–2011	53.09	58.72	–	73.94	149.20	116.06	674.03	113.86	52.50	44.13
Population growth index, 1991–2011	86.92	102.82	–	93.58	124.71	106.15	122.42	150.12	98.18	97.29
Number of settlements in 2011	50	30	1	31	52	57	43	82	80	133
Settlement density in 2011 (number per 100 km^2)	18.40	5.90	0.22	12.97	19.25	19.17	23.86	27.31	55.57	24.04
Average size of settlement in 2011 (people per settlement)	162.16	155.40	21.00	351.00	508.88	358.35	2323.21	85.88	29.75	40.70

Data sources: Gabrovec (1996), Perko et al. (2015, 2017); Ministry of Agriculture, Forestry and Food of the Republic of Slovenia; Ministry of the Interior of the Republic of Slovenia; Statistical Office of the Republic of Slovenia

311	312	313	314	315	316	317	318	319	401	402	403	404	405	406
Ribnica–Kočevje lowland	Little Mountain, Kočevje Rog Plateau, and Mount Poljane	Velike Lašče region	Lower Carniola lowland	Dry Carniola and Dobrepolje	White Carniola	Gorjanci hills	Radulja hills	Novo Mesto region	Gorica hills	Vipava hills	Karst plateau	Brkini Hills and Reka valley	Podgorje Karst Plateau, Čičarija Plateau, and Podgrad lowland	Koper hills
112.66	584.19	71.35	317.92	423.70	387.89	211.77	115.82	259.37	83.02	309.83	428.78	341.52	244.49	326.64
0.56	2.88	0.35	1.57	2.09	1.91	1.04	0.57	1.28	0.41	1.53	2.12	1.68	1.21	1.61
489.12	612.52	592.23	363.74	399.38	232.06	469.81	373.15	280.82	232.38	214.87	333.01	525.60	586.93	178.63
4.41	11.89	13.73	8.78	9.59	7.21	15.18	14.70	9.24	17.32	10.89	8.07	13.39	10.46	12.40
4044.22	3997.94	3961.00	4066.23	4040.13	4165.15	3886.39	4097.44	4083.64	4194.96	4417.50	4376.43	4275.09	4389.08	4478.17
5.72	0.29	1.34	12.31	4.03	10.16	3.56	7.19	8.42	2.20	10.92	1.67	2.38	1.23	6.65
0.00	0.03	0.00	0.09	0.22	1.38	2.56	2.27	0.77	22.98	7.46	1.87	0.01	0.05	6.66
1.26	0.32	1.77	0.95	0.88	2.14	1.53	2.74	1.69	7.25	3.89	0.51	2.29	0.38	9.51
35.48	6.50	29.36	28.75	20.05	18.32	14.45	22.72	20.41	5.88	18.49	24.64	20.32	23.50	11.08
47.06	92.23	63.28	49.19	72.23	63.52	75.32	61.03	59.63	57.27	49.15	66.80	71.71	72.15	51.88
8.64	0.54	3.86	8.36	2.37	3.81	2.49	3.98	8.10	3.75	9.28	4.26	2.69	2.48	12.75
0.17	0.13	0.19	0.17	0.13	0.12	0.18	0.17	0.15	0.14	0.18	0.12	0.14	0.14	0.13
13235	8501	5085	23160	18466	22446	7940	6796	21579	8254	43636	22199	21825	7975	55030
0.95	0.61	0.36	1.66	1.32	1.61	0.57	0.49	1.54	0.59	3.12	1.59	1.56	0.57	3.94
17033	3054	3866	24528	15336	21900	6919	5637	25210	6326	45972	17417	18659	5370	49613
1.07	0.19	0.24	1.54	0.96	1.38	0.43	0.35	1.58	0.40	2.89	1.09	1.17	0.34	3.12
128.70	35.93	76.03	105.91	83.05	97.57	87.14	82.95	116.83	76.64	105.35	78.46	85.49	67.34	90.16
23042	1730	3522	32631	13362	25383	5752	4979	38860	5758	63052	19068	16254	4674	75727
1.17	0.09	0.18	1.66	0.68	1.29	0.29	0.25	1.98	0.29	3.21	0.97	0.83	0.24	3.85
174.10	20.35	69.26	140.89	72.36	113.08	72.44	73.26	180.08	69.76	144.50	85.90	74.47	58.61	137.61
135.28	56.65	91.10	133.04	87.13	115.90	83.13	88.33	154.15	91.02	137.15	109.48	87.11	87.04	152.64
23592	1571	4033	45177	14349	25933	5653	5485	41855	5751	65678	20263	15240	4773	85700
1.15	0.08	0.20	2.20	0.70	1.26	0.28	0.27	2.04	0.28	3.20	0.99	0.74	0.23	4.18
209.40	2.69	56.53	142.10	33.87	66.86	26.69	47.36	161.37	69.27	211.98	47.26	44.62	19.52	262.37
178.25	18.48	79.31	195.06	77.70	115.54	71.20	80.71	193.96	69.68	150.51	91.28	69.83	59.85	155.73
102.39	90.81	114.51	138.45	107.39	102.17	98.28	110.16	107.71	99.88	104.16	106.27	93.76	102.12	113.17
55	75	78	241	166	182	87	74	125	45	119	100	99	35	117
48.82	12.84	109.32	75.81	39.18	46.92	41.08	63.89	48.19	54.20	38.41	23.32	28.99	14.32	35.82
428.95	20.95	51.71	187.46	86.44	142.49	64.98	74.12	334.84	127.80	551.92	202.63	153.94	136.37	732.48

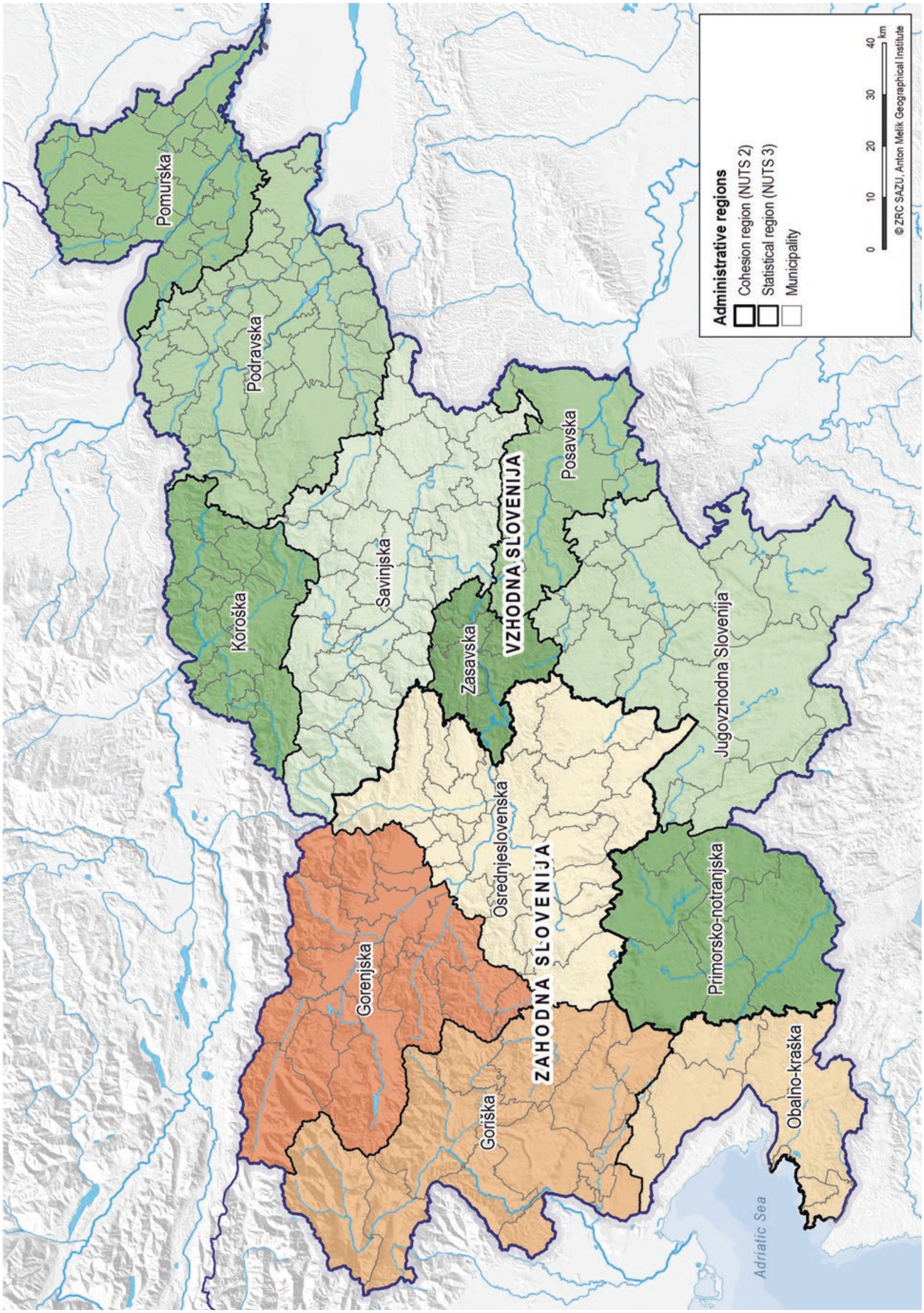

Fig. 15.11 Statistical territorial units of Slovenia

Republic of Slovenia, showed the following status as of January 1, 2018: 2 cohesion regions, 12 statistical regions, 212 municipalities, 6035 settlements, 10,396 streets, and 555,881 numbered houses.

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Slovenia on Maps

16

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Abstract

The territory of what is now Slovenia appears on even the oldest maps of Europe, as a constituent part of various sovereign states. Its geographical location, Slavic roots, and long association with the Habsburg Monarchy resulted in constant contact with central and southeast European cultural trends, including in cartography. The Slovenian lands were more frequently depicted on maps from the early sixteenth century onward. Due to its marginal political role and mapmakers' lack of familiarity with the territory, at first, it was drawn fairly superficially. This changed in the eighteenth century, when Slovenian and other researchers carried out their own field research, surveying and drawing individual parts of Carniola, Styria, Istria, and Carinthia. With the national awakening in the second half of the nineteenth century, the desire for an independent country manifested itself in the first maps of Slovenian ethnic territory. For most of the twentieth century, Slovenia appeared on maps as part of Yugoslavia, and from 1991 onward as an independent country, preserving and developing cartographic practice in line with cartographic standards.

Keywords

Regional geography · Historical geography · Historical cartography · Old maps

16.1 Depictions of Slovenia on Very Old Maps

The transport routes that connected Western Europe with the Middle East were of key importance for presenting Slovenian territory even on the oldest maps. One of these is *Tabula Peutingeriana* (Fig. 16.1), a medieval copy of a Roman Empire roadmap from the first to third centuries attributed to Castorius. The medieval map is named after the Augsburg antiquarian whose collection it became part of in 1508 (Goss 1993). Drawn on 12 parchment scrolls with a total length of 6.75 m, it emphasizes roads, places to find lodging, and distances in Roman miles (Mihevc 1998: 38).

In Antiquity and the Middle Ages, Slovenia was a constituent part of various sovereign states and was thus depicted in a very generalized manner and only sporadically identified with any of the toponyms that would later become standard. One such example is the name *Carinthia*, which appears on a medieval map of the world drawn around 1235 by a monk at the Saxon monastery in Ebstorf, Germany (Höck and Leitner 1984). Only at the start of the sixteenth century did maps of various parts of Europe first appear that depicted rivers, mountains, settlements, and other cartographic features with greater locational precision. One of these is *Histriae Tabula*, a map of Istria from 1525 by the cartographer Pietro Coppo (Fig. 16.2). His work is still viewed as the best cartographic representation of the Istrian peninsula up to the mid-eighteenth century (Longyka 2003).

The Austrian cartographic pioneer Wolfgang Lazius deserves credit for the first depictions of Slovenia. In 1561 he issued a collection of 11 maps, *Typi chorographici Provinciarum Austriae* (Chorographic Plans of Austrian Provinces; Lazius 1972). One of these maps, *Ducatus Carniolae et Histriae una* cum *Marcha Windorum* (The Duchy of Carniola and Istria together with the Windic March; Fig. 16.3), is the first known independent representation of the Duchy of Carniola. However, this visually attractive map

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D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_16

has many spatial deficiencies (Slovenci … 1986; Longyka 2003).

Atlases played a special role in familiarizing people with foreign lands. In 1570, the Flemish cartographer Abraham Ortelius included a map of *Schlavoniae, Croatiae, Carniae, Istriae, Bosniae, finitimarumque regionum nova descriptio* (A New Description of Slavonia, Croatia, Carniola, Istria, Bosnia, and Neighboring Regions) in the first edition of his atlas *Theatrum Orbis Terrarum* (Theater of the World). It was a reworked map of the Kingdom of Hungary, issued by the German cartographer Augustin Hirschvogel probably in the mid-sixteenth century (Kratochwill 1986).

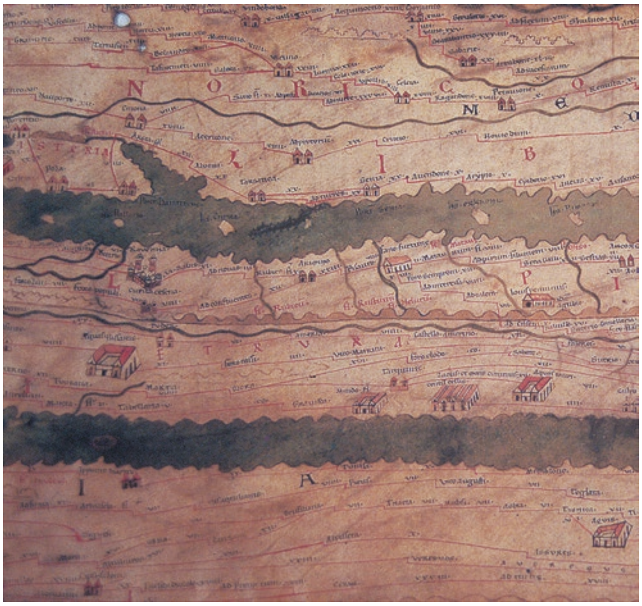

Fig. 16.1 A section of *Tabula Peutingeriana* with the Roman city of Emona (precursor to Ljubljana) in the center. (Mihevc 1998)

The Flemish cartographer Gerardus Mercator, who was the first to call a collection of maps an "atlas" (Perko 2005), produced the map *Forum Iulium, Karstia, Carniola, Histria et Windorum Marchia* (Friuli, Karst, Carniola, Istria, and the Windic March). He issued it in 1589, and this map formed the basis for many subsequent depictions of Slovenian territory. Because information was copied over from one map to another, certain inaccuracies and errors were repeated for many decades (Shaw and Čuk 2015).

The development of cartography in Europe was furthered in the seventeenth century by the Dutch publishing family Blaeu, which issued the atlases *Theatrum Orbis Terrarum, sive Atlas Novus* (Theater of the World or New Atlas) from 1635 onward. At first, these works continued and completed Ortelius' and Mercator's works, but later the atlas grew into an independent work. Like the other regions, Slovenian territory was thus depicted on numerous maps, most of which were based on the works by these two cartographers.

Fig. 16.2 Map of Istria by Pietro Coppo. (Lago and Rossit 1984)

Fig. 16.3 Map of the Duchy of Carniola by Wolfgang Lazius from 1561. (Lazius 1561) (National and University Library in Zagreb Archive)

The royal geographer to Louis XIII and Louis XIV and the most important French cartographer of the seventeenth century, Nicolas Sanson, produced the map *Hertzogthūber Steyer, Karnten, Krain, & c. Duchés de Stirie, Carinthie, Carniole* (The Duchies of Styria, Carinthia, and Carniola; Fig. 16.4) in 1657. Despite some inaccuracy, the map clearly depicts Slovenian territory and served as the basis for numerous later cartographic representations of this part of Europe.

One of the most important depictions of Slovenian territory during this period was the map *Styriae Ducatus Fertilissimi Nova Geographica Descriptio* (New Geographical Description of the Most Fertile Duchy of Styria) by the Austrian cartographer Georg Matthäus Vischer. It depicts Styrian territory in great detail and includes a few illustrations. One of them portrays the battle of Archangel Michael with the dragon, which represents the victory of the Austrian army over the Ottomans at the 1664 Battle of Saint Gotthard (Stopar 2006; Fig. 16.5).

16.2 The First Maps by Local Cartographers in the Seventeenth and Eighteenth Centuries

Due to political and military interests, the end of the seventeenth century notably stepped up development of navigation aids and land-surveying instruments, and the invention of more accurate surveying methods, such as triangulation. In addition to foreign cartographers, there were now also local ones, who established European cartographic trends on Slovenian territory. This was also the period that Slovenian historiography received its best description of the country. Janez Vajkard Valvasor (Johann Weikhard von Valvasor 1689) published a work on the culture, history, and topography of the Carniolan lands, *Die Ehre deß Hertzogthums Crain* (The Glory of the Duchy of Carniola). In the second of 15 volumes, he published the map *Carniolia, Karstia, Histria et Windorum Marchia* (Carniola, Karst, Istria, and the Windic

Fig. 16.4 Nicolas Sanson's map of 1657. (Sanson 1657) (GIAM ZRC SAZU Archive)

Fig. 16.5 Representation from the 1678 map of Styria by Georg Matthäus Vischer. (Vischer 1678) (National and University Library in Ljubljana Archive)

March; Fig. 16.6). It was modeled on older cartographic works, but it used field surveying to improve the accuracy of depictions of the river network, lakes, and settlements. His map of Istria was a step backward, however, because he did not make use of Coppo's map (Fridl and Šolar 2011). Valvasor had to sell almost all his property in order to cover his printing costs for *The Glory of the Duchy of Carniola*, and so up to his untimely death, he was never able to achieve his greatest dream, which was to produce a map of Carniola on a larger scale, for which he had already surveyed most of the country.

Valvasor's cartographic work continued to be used into the first half of the eighteenth century, as is evident in the map *Tabula Ducatus Carnioliae, Vindorum Marchiae et Histriae* (Map of the Duchy of Carniola, Karst, the Windic March, and Istria) by the German cartographer Johann Baptist Homann (Lago 1996). Due to its detailed depiction of the territory from Dalmatia to Carinthia and the added city view of Ljubljana and a precise drawing of intermittent Lake Cerknica, the map was reprinted many times (Gašperič and Zorn 2011).

Valvasor's plans were finally realized more than half a century later in 1744 by the priest Janez Dizma Florjančič (Joannes Disma Floriantschitsch de Grienfeld), with his wall map *Ducatus Carnioliae tabula chorographica* (Chorographic Map of the Duchy of Carniola; Fig. 16.7). This was the result of more than a decade of work, during which the mapmaker traveled around Carniola, taking

Fig. 16.6 Valvasor's map *Carniolia, Karstia, Histria et Windorum Marchia*. (Valvasor 1689) (National and University Library in Ljubljana Archive)

Fig. 16.7 A section of the map of Carniola by Janez Dizma Florjančič. (Florjančič 1744) (GIAM ZRC SAZU Archive)

geodesic measurements from nearly 300 high-elevation points. This was the highest-quality and most complete map of Carniola up to the first half of the nineteenth century (Zorn and Gašperič 2016). It is exceptional for its scale of about 1:100,000 and its detailed, stylized depiction of relief. The map consists of 12 sheets and is roughly 180 cm high and 188 cm wide (Fridl and Šolar 2011). This map was the first to feature certain toponyms in Slovenian dialect form, such as *Terglou* for the highest Slovenian mountain, Triglav. Other special features of this wall map include an added city view and street plan of Ljubljana in the upper right corner.

16.3 Military Map and Land Cadaster from the Second Half of the Eighteenth Century

The Habsburg Monarchy did not start using the new triangulation method until 1762 (Gašperič 2013). The survey of the western part of the monarchy, which included Slovenia, was completed around 1830. Between 1763 and 1787, the Habsburg Monarchy carried out the first military topographic survey of the entire country, but it was still using the old method of drawing individual sheets using a plane table directly in the field. The Josephine military map was a strictly guarded military document that was not available to the general public. Special attention was paid to more precise depiction of relief using hatching (Rajšp and Ficko 1994). Despite its projection inaccuracies and inaccessibility, the map is one of the best cartographic works of the second half of the eighteenth century, due to its detailed scale of around 1:28,800 and extensive information (Gašperič 2010; Gašperič et al. 2018). Facsimiles of individual sheets of the military map covering Slovenian territory were issued in seven volumes (Rajšp and Ficko 1995, 1996; Rajšp and Trpin 1997; Rajšp and Serše 1998; Rajšp and Grabnar 1999; Rajšp and Kološa 2000; Rajšp and Serše 2001).

The only maps to surpass the military survey in detail were the later Franciscan Cadaster and the subsequently revised version of it. As early as the eighteenth century, during Empress Maria Theresa's reign, property tax reform was implemented—for which the land was not surveyed, however, but only assessed by yield. A systematic survey of the land in all provinces of the Habsburg Monarchy except for Prekmurje, with a unified system of coordinates, was carried out between 1818 and 1828 under the reign of Emperor Francis I, which is why it is called the Franciscan Cadaster. Individual sections of the cadaster are in color, and most are drawn at a scale of 1:2800, with difficult-to-access regions at 1:5760 and some large settlements at 1:1440 or 1:720 (Golec 2010). The cadaster does not show the relief, but it is very precise in depicting parcels of land, which are given various colors according to their category of land use. Following the tax reform of 1869, an extensive revision of the cadaster was carried out between 1869 and 1887, and so it is now called the revised cadaster (Petek and Urbanc 2004).

16.4 Reflection of Slovenian Identity in Maps

The use and hierarchy of languages in Slovenia did not change much for several centuries, which is also evident from the titles of the maps described above. That is, in religious and educated society, Latin was required. The language of the high society, offices, and courts was German, or Italian in the southwest and Hungarian in the northeast. The majority of lower-class city residents, farmers, and serfs spoke only one language, however, and that was Slovenian. With the publication of grammars, hymnals, schoolbooks, and agricultural handbooks in Slovenian for farmers in the second half of the eighteenth century came the early stirrings of national awakening (Štih et al. 2016). The results of this were first visible on maps primarily through the use of Slovenian toponyms, such as those on the bilingual wall map by the botanist Heinrich Freyer. Between 1844 and 1846, he produced a 16-sheet thematic map called *Special-Karte des Herzogthums Krain* (Special Map of the Duchy of Carniola; Fig. 16.8). The map is exceptionally rich in Slovenian toponyms, and about half of these are also accompanied by the German version of the toponym. Locations of quarries, mines, and mine buildings are also marked (Gašperič 2007).

Difficult social, economic, and political conditions led to several revolutionary movements in Europe. Their demands to abolish absolutism and the remnants of feudalism reached their peak in 1848. The transformation of the Austrian Empire into a bourgeois parliamentary monarchy awakened hope among Slovenians that a larger administrative unit bringing together all Slovenian ethnic territory would be created. This was also one of the demands of the political program United Slovenia (*Zedinjena Slovenija*), which was supported by various Slovenian societies (Granda 2001).

One of the Slovenian students that came to Ljubljana from Vienna in order to encourage Slovenian leaders to sign the petition in favor of United Slovenia was Peter Kozler (Peter Kosler). As a lawyer, politician, and businessman, he also studied the borders of Slovenian territory in Istria, Gorizia, Carinthia, and Hungary. Using extensive documentation, he prepared his *Zemljovid Slovenske dežele in pokrajin* (Map of the Slovenian Land and Regions) at a scale of 1:576,000 (Fig. 16.9). In 1853, the Austrian military authorities confiscated the plates from the printer, sealing all 422 maps already printed and a thousand sheets of coats of arms of the Slovenian lands. They justified this by claiming that the map depicted a nonexistent political entity and undermined the lawful union of the Austrian crownlands, accusing Kozler of high treason. After a few months, Kozler was acquitted of all charges, but his confiscated property was not returned to him until 1856 at his own special request. With permission from the authorities, the map was reprinted twice in 1864, and once again in 1871 (Kordiš 2016). The 1864 reprint was accompanied by the supplement *Imenik mest, tergov in krajev* (Index of Cities, Towns, and Villages).

Blaž Kocen (Blasius Kozenn) also did not renounce his Slovenian ethnic origin and pride. He became famous for his outstanding school atlases and wall maps. His *Geographischer Schul-Atlas für die Gymnasien, Real- und Handels-Schulen der österreichischen Monarchie von B. Kozenn* (Kocen's Geographical School Atlas for High Schools and Secondary Schools in the Austrian Monarchy), published in 1861 in German, Hungarian, Czech, and Polish, has been published in more than 180 editions, reprints, or adaptations. Even though the atlas was not published in Slovenian and some fervent Slovenian nationalists criticized Kocen for his lack of Slovenian ethnic spirit, this was not true. In the school atlas' map of Alpine lands, he drew ethnic borders that he most likely adapted from Kozler, adding a German–Slovenian list of names of major settlements in the area inhabited by Slovenians. His use of Slovenian names of places cannot be taken for granted, considering that his textbooks and atlases were primarily intended for schools that used German as

Fig. 16.8 Section of the map of Carniola by Heinrich Freyer. (Freyer 1846) (GIAM ZRC SAZU Archive)

their language of instruction and that German was also used in schools in areas inhabited by Slovenians (Bratec Mrvar et al. 2011).

The publishing society "Slovenska matica" was established in 1864 with the aim of enhancing Slovenian national identity, or, in its own words, "doing what is in its power to promote the education of the Slovenian people and thus support Slovenian literature" (Melik 1997). To obtain as many members as possible, it announced in the newspaper *Kmetijske in rokodelske novice* (Farmers' and Craftsmen's News) that a copy of Kozler's *Zemljovid Slovenske dežele in pokrajin* would be enclosed with the society's almanac. The Slovenian Society unanimously supported the idea that intellectuals, students, and the general public should also obtain a Slovenian-language world atlas as soon as possible. Despite the invention of lithography, which significantly reduced the cost of printing multiple colors and accelerated the relevant printing procedures, publishing an atlas in book form was too expensive for the society. Hence from 1869 to 1877, 18 maps were published in 6 fascicles of 3 sheets each, presenting the world as a whole or its individual parts. The "Slovenska matica" entrusted the linguist and lawyer Matej Cigale with editing the first Slovenian world atlas, called *Atlant* (Fig. 16.10; Urbanc 2005). Cigale's work on *Atlant* was exceptional because he systematically translated or adapted numerous foreign names into Slovenian for the first time ever. Of a total of 28,075 geographical names and names of individual general concepts provided in the atlas, Cigale Slovenianized 5907 of them, or 21%. He Slovenized all major toponyms and hence can be rightfully referred to as the founder of Slovenian toponym use (Kladnik 2005).

16.5 Modern Maps of the Twentieth and Twenty-First Centuries

After the Second World War, when Slovenia became a Yugoslav republic, the responsibility for national topographic maps was assumed by the Slovenian Surveying and Mapping Authority. Through systematic field measurements, revised surveys, and cyclical aerial photography of Slovenia carried out by the Slovenian Land Survey Institute, Slovenia established a hierarchical system of topographic maps and plans. In terms of scale, they can be divided into base topographic plans at a scale of 1:5000 for flatland and 1:10,000 for hilly regions, national topographic maps at a scale of 1:25,000 and 1:50,000, and general maps at scales of 1:250,000, 1:400,000, 1:500,000, 1:750,000, 1:1,000,000, 1:1,500,000, and 1:2,000,000 (Lipej 2001).

Fig. 16.9 Peter Kozler's map of Slovenian ethnic territory. (Kozler 1853) (GIAM ZRC SAZU Archive)

Due to security interests of the former Yugoslavia, the base topographic plans and national topographic maps were only accessible to specialist services until Slovenia's independence in 1991, and so Slovenians closed the gap in the publication of large-scale topographic maps for the general public through the 1985 publication of *Atlas Slovenije* (Atlas of Slovenia; Kos 1985). The large-scale representations of Slovenian territory on 109 double-sided sheets of a 1:50,000 topographic map were published in as many as four revised editions of the atlas by 2012.

In the second half of the twentieth century, the leading role in thematic cartography for educational, tourism, recreational, and informative purposes was assumed by the Geodetic Institute of Slovenia, which produced the first

Fig. 16.10 A section from the Austria sheet (from 1869) of *Atlant*, the first Slovenian atlas of the world. (Fridl et al. 2005)

roadmap of Yugoslavia and set the standards for producing hiking maps and city maps. It designed 1:75,000–1:170,000 maps for many municipalities, and 1:2500–1:20,000 maps for individual settlements (Lipej 2001).

The ZRC SAZU Anton Melik Geographical Institute has the longest tradition in thematic cartography in Slovenia. It has produced maps for a series of popular and scientific volumes and atlases, including *Krajevni leksikon Slovenije* (Slovenian Gazetteer; Orožen Adamič et al. 1995), published in 1995, and the volume *Slovenija: Pokrajine in ljudje* (Slovenia: Regions and People; Perko and Orožen Adamič 1998) published 3 years later. In parallel with this, the institute's researchers also designed the first national atlas, directing special attention to emerging digital cartography. An expanded version of the national atlas was published in 1998 under the title *Geografski atlas Slovenije* (Geographical Atlas of Slovenia (Fridl et al. 1998); Fig. 16.11), and a compact version better-suited for non-Slovenian readers was published 3 years later under the title *National Atlas of Slovenia* (Fridl et al. 2001). For its sixtieth anniversary in 2006, the institute published a facsimile edition of *Atlant*, the first Slovenian world atlas (Fridl et al. 2005), and for the sixtieth anniversary of its thematic cartography department in 2012, it published a facsimile of Gaetan Palma's map of the Illyrian Provinces of 1812 with an accompanying research volume (Gašperič et al. 2012), continuing the publication of historically important cartographic works.

The Geographical Institute was entrusted with another important cartographic representation of Slovenia: *Popisni atlas Slovenije 2002* (2002 Census Atlas of Slovenia, Fig. 16.12). This atlas contains 106 thematic maps presenting the statistical data of the population, household, and housing census carried out by the Statistical Office of the Republic of Slovenia in April 2002. That was the fifteenth census carried out in Slovenia, the seventh after the Second World War, and the first one in independent Slovenia (Dolenc et al. 2007). In addition, the institute produced the English atlas *Slovenia in Focus*, which was published on January 1, 2008 at the start of Slovenia's EU presidency (Fridl et al. 2007).

As already mentioned above, aerial photography is the most important current source of data for cartography. The first aerial photos of Slovenian territory were already taken before the First World War for military reconnaissance purposes (Breg Valjavec and Ribeiro 2014). However, aerial

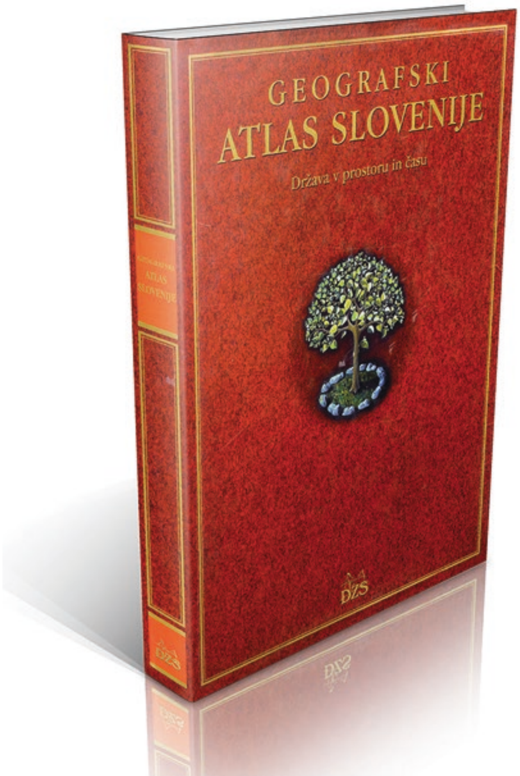

Fig. 16.11 The first national atlas of Slovenia. (Fridl et al. 1998)

photography for land-surveying purposes only began to be used as late as 1971. Systematic cyclical aerial photography began to be carried out in 1975 (Oštir 2006), and in 1980 aerial photos of all of Slovenia were produced at a scale of 1:30,000. At the same time, in addition to taking photos in the visible spectrum, photos were also taken in the near-infrared spectrum, which made it possible to interpret a new type of data on agriculture, forestry, hydrology, and geology. From 1985 onward, photos were taken at 3-year intervals at a scale of 1:10,000 for settlement areas and 1:17,500 for mountainous areas. In 1992, the scale was unified at 1:17,500. Because of technological advances, the quality of aerial photos has been changing, especially since 2006, when digital cameras began to be used (Logar 2008).

An important step in the spatial recognition of Slovenia's terrain was made with laser scanning of its entire territory using the Light Detection and Ranging (LiDAR) method (Fig. 16.13). This project was funded by the Slovenian Ministry of the Environment and Spatial Planning in 2011, 2014, and 2015. A major part of Slovenia was scanned with a density of at least five points per m^2, and high mountains and extensive wooded areas were scanned with a density of at least two points per m^2 (Triglav Čekada and Bric 2015). Thus, in addition to land-surveying vector data, raster representations such as digital orthophotos (DOF), digital terrain models (DTM), and laser images (LiDAR) are important in modern cartography.

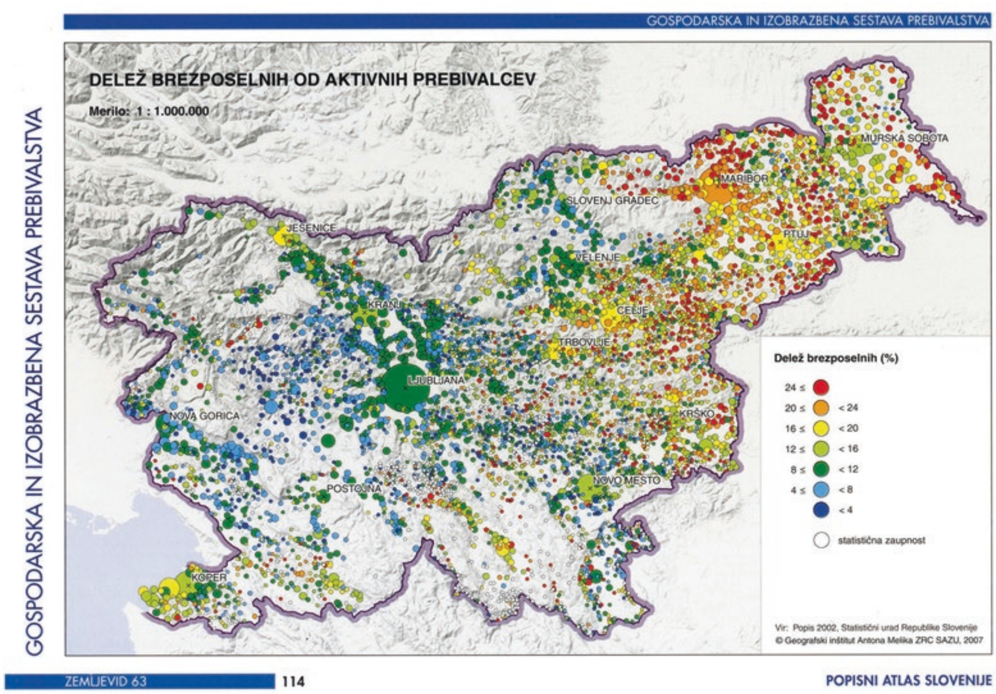

Fig. 16.12 Representation of the share of unemployed in the total working population in *Popisni atlas Slovenije*. (Dolenc et al. 2007)

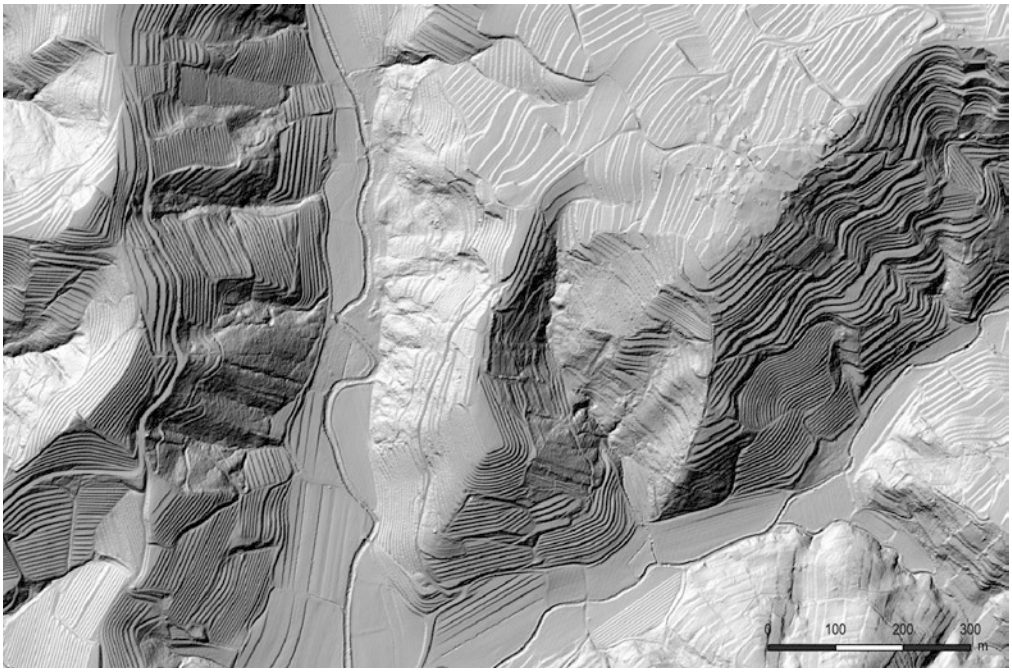

Fig. 16.13 Laser image of the winegrowing terraces in the Goriška Brda. (Slovenian … 2012)

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Part IV

Human Impact on Environment

17 Natural Hazards in Slovenia

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Abstract

Almost all types of natural hazards that are typical for Europe also occur in Slovenia, with the exception of some major events such as volcanic eruptions or ocean-related natural hazards such as large tsunamis. The greatest economic damage is caused by natural hazards affecting agriculture, such as drought, hail, rainstorms, and frosts. Great damage is caused by floods in settlements and by landslides and avalanches in mountain areas. Periodically earthquakes occur, and heat waves are increasingly frequent. Large differences exist among Slovenian regions with respect to the types and intensity of natural hazards. In the Alpine mountains in the west and north of the country, there are frequent rockfalls, landslides, debris flows, and avalanches. Landslides and torrential floods are characteristic for the Alpine hills in central Slovenia. The Dinaric regions in the south of the country are characterized by flooding of poljes. Fires characterize the Mediterranean landscapes in southwestern Slovenia. The Pannonian lowlands in the southeast are subject to flooding, whereas the drier and agriculturally more intensive Pannonian region in the northeast of the country is most often affected by drought. Seismic hazard is high in the western as well as central and southeastern parts of the country.

Keywords

Geography of natural hazards · Flood · Drought · Landslide · Avalanche · Earthquake · Economic damage

17.1 Introduction

Slovenia is susceptible to various types of natural hazards (Fig. 17.1; Perko 1992; Komac and Zorn 2007) due to its diverse lithological composition, varied relief (Hrvatin and Perko 2009), different climate types, and high landscape diversity (Ciglič and Perko 2013; Perko et al. 2017). Most common are drought, hail, floods, rainstorms, and landslides, and there are also numerous forest fires, frosts, avalanches, and, in the last two decades, heat waves. Glaze and earthquakes are rarer occurrences (Fig. 17.2).

Natural disasters in Slovenia result in few casualties but considerable damage. Since the second half of the nineteenth century up until the Second World War, natural disasters caused on average 4.7 deaths per year; in the second half of the twentieth century, this number fell to 2.4 deaths per year. Avalanches are responsible for the greatest number of victims, followed by lightning, floods, and rainstorms. Avalanches took over a thousand lives during the First World War alone, and several hundred more in the remaining period. Between the second half of the eighteenth century and the end of the twentieth century, avalanches accounted for more than half of all victims of natural disasters, on average one to two per year (Orožen Adamič 1998a; Pavšek 2002; Malešič 2005).

Between 1991 and 2008, the greatest direct economic damage was caused by drought (27%), followed by hail (18%), floods (16%), rainstorms (14%), and landslides and avalanches (9%). In the same period, the direct damage caused by natural disasters amounted to an average of 0.48% of annual GDP or an average of €45 per capita annually. The greatest amount of direct and indirect damage was caused by the two earthquakes of 1976 (about one tenth of annual GDP) and the floods in 1990 (about one fifth of annual GDP; Table 17.1; Zorn and Komac 2011). In 2017, major natural disasters caused €168.8 million in damage (around 0.12% of annual GDP), of which the most was caused by drought (€65.3 million), floods (€56.3 million) and frost (€46.8

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D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_17

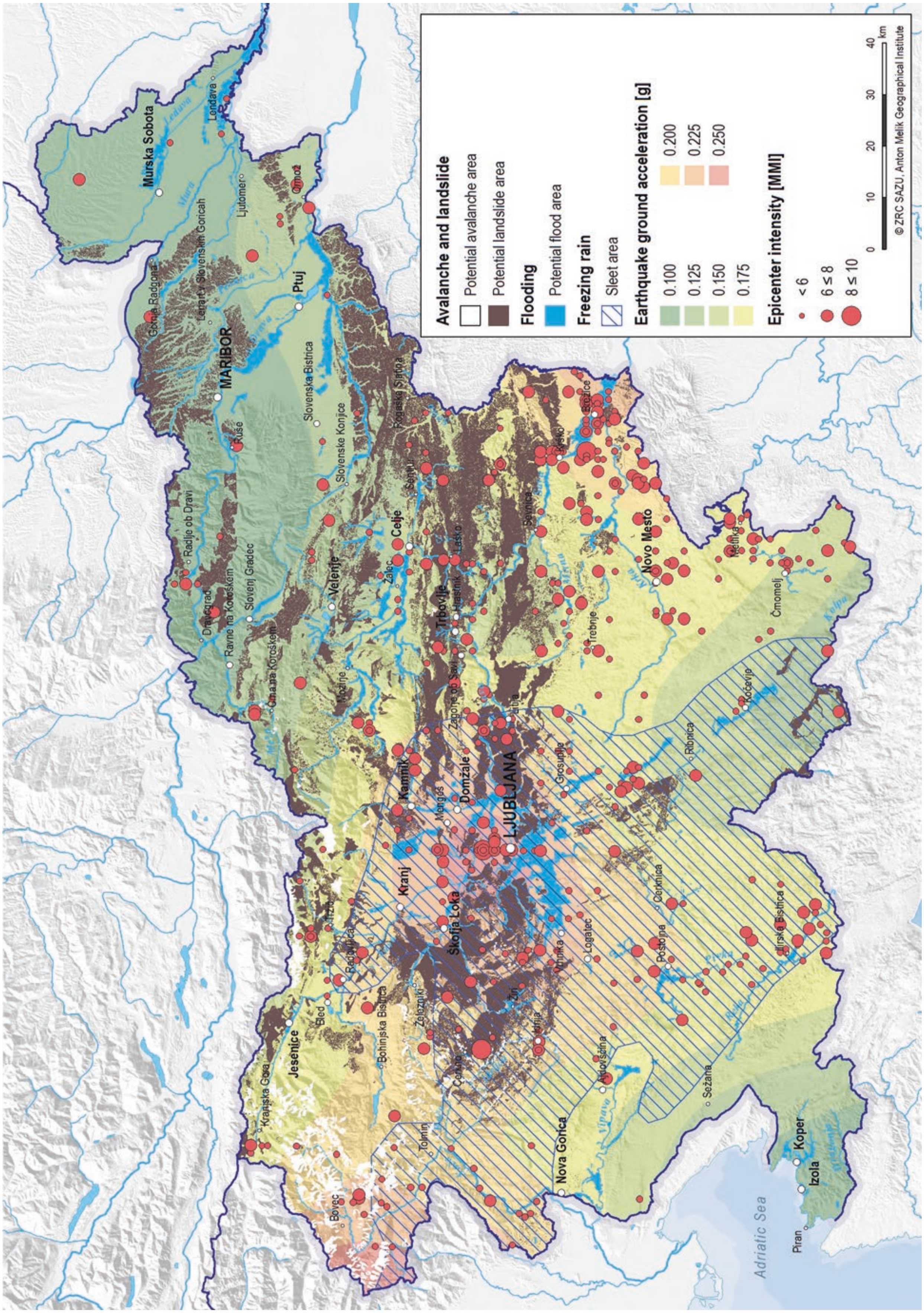

Fig. 17.1 Most frequent natural hazards in Slovenia. (Orožen Adamič 1998b)

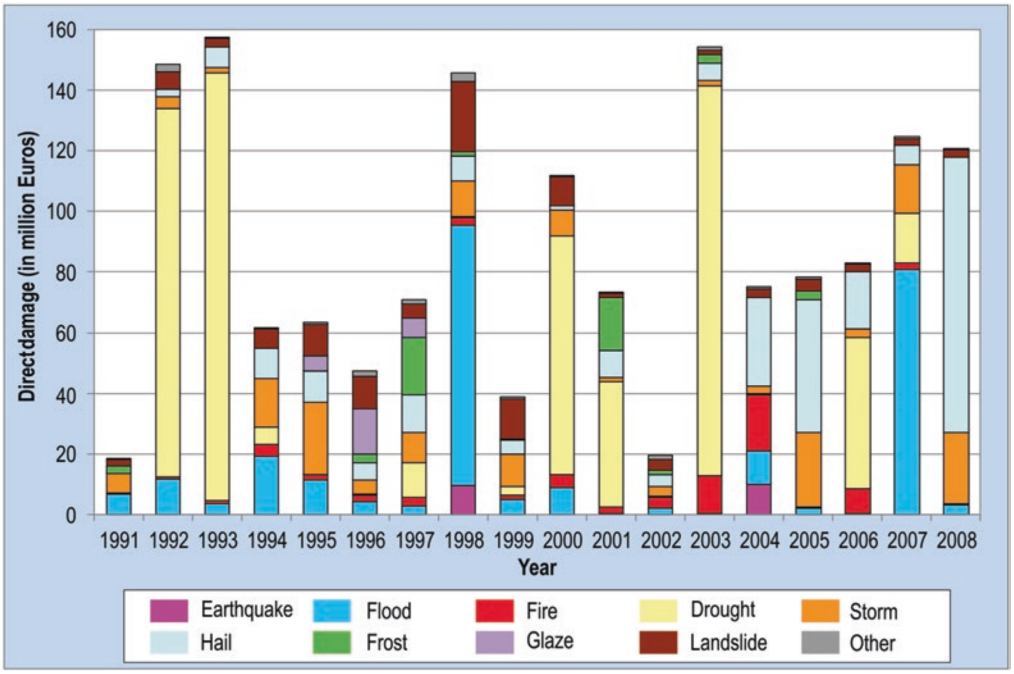

Fig. 17.2 Economic damage due to natural disasters between 1991 and 2008. (Zorn and Komac 2011; Zorn and Hrvatin 2015)

Table 17.1 Natural disasters in Slovenia causing the most direct damage between 1990 and 2014

Natural disaster (year of occurrence)	Direct damage, € million
Flood (1990)	552
Glaze and flood (2014)	430
Flood (2012)	311
Flood (2010)	207
Flood (2007)	187
Flood (1998)	173
Drought (1993)	141
Drought (2003)	128
Drought (1992)	122
Hail (2008)	91
Drought (2000)	79
Drought (2017)	65
Flood (2017)	65
Drought (2006)	50
Frost (2017)	47
Hail (2005)	44
Drought (2001)	42
Flood (1994)	30
Hail (2004)	29

million). That same year, the national government invested about €30 million and municipalities an additional €40 million in preventive measures (But 2018).

There are large differences among Slovenian regions with respect to the type and intensity of natural hazards. The intensity of geomorphological hazards declines from the Alpine west and north toward the Pannonian east and the Mediterranean and Dinaric south. Rockfalls (Zorn 2002), landslides, debris flows (Zorn and Komac 2002), and avalanches (Pavšek 2002) are common in the Alpine ranges in the west and north of the country. Landslides (Zorn and Komac 2008) and torrential floods (Komac et al. 2008) are typical of the Alpine hills of central Slovenia. Lowland floods predominate in the Pannonian plains in the east. Intermittent karst floods characterize the Dinaric landscapes in the south of the country (Komac et al. 2008). Drought most frequently affects the drier and agriculturally more intensive Pannonian regions in the northeast, and fires are a problem in the karst and Mediterranean areas in the southwest of the country. The seismic hazard is high in the west and in central and southeastern Slovenia (Perko 1992).

17.2 Geological and Geomorphological Natural Hazards

Predominant geological and geomorphological disasters in Slovenia are landslides, rockfalls, and debris flows (Komac and Zorn 2007). Between 1991 and 2008, *landslides* annually caused more than €100 million in damage (Zorn and Komac 2011). A maximum daily rainfall exceeding 130 mm can be critical for landslide occurrence, especially in looser soils and less resistant rocks (Komac 2005; Rosi et al. 2016). In areas of high and low hills, more than 7000 landslides have been recorded in the national database of landslides, which occur over an area of roughly 1200 km^2 (Fig. 17.3; Komac and Hribernik 2015); one-fourth of them pose a threat to infrastructure and buildings. They are characteristic

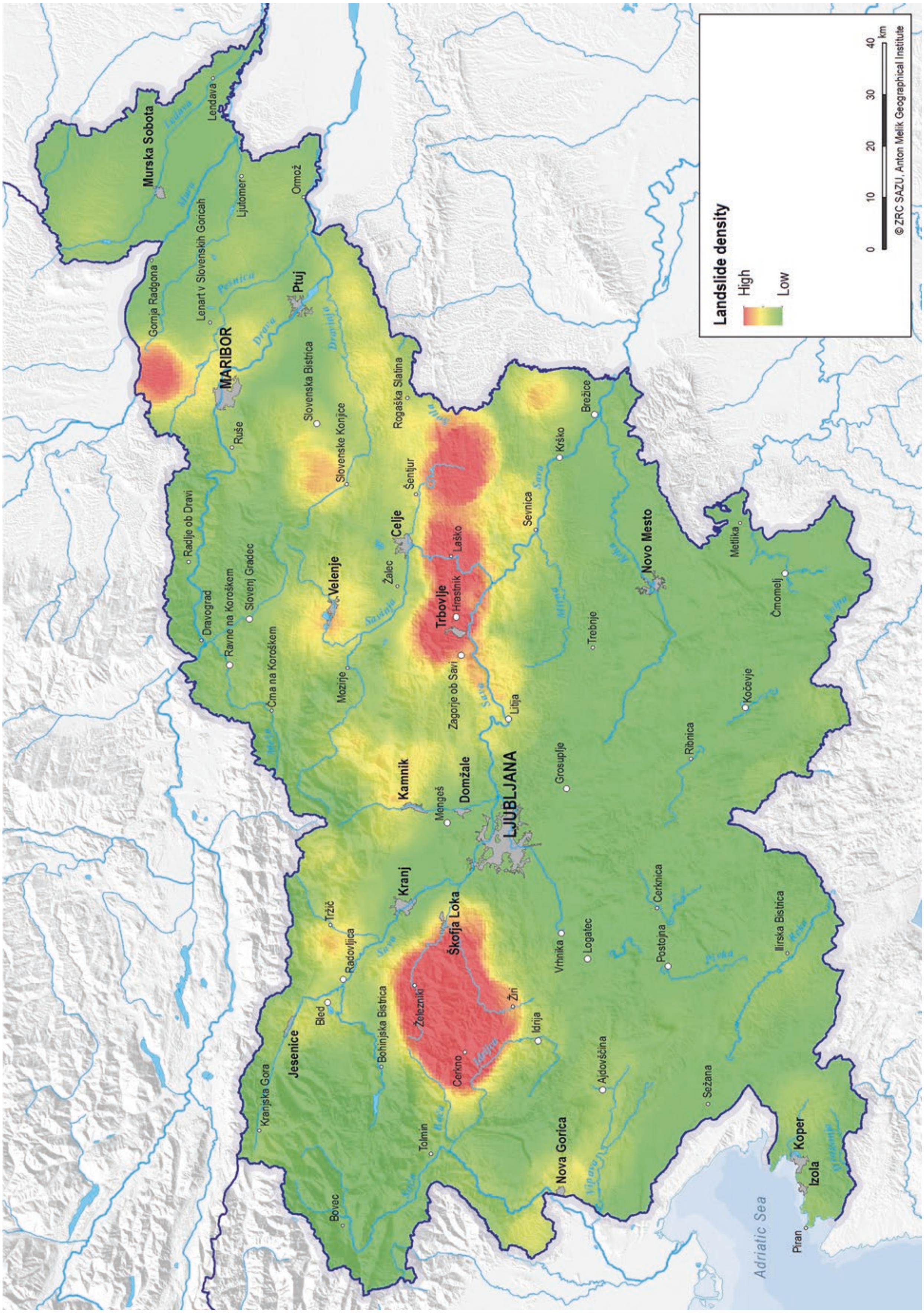

Fig. 17.3 Density of landslides in Slovenia based on the national landslide database. (Zorn and Komac 2008)

Fig. 17.4 In July 1989, when 150 to 200 mm of rain fell a 24-h period, more than 5000 slumps, or 47/km^2, were triggered in the predominantly marlstone area of Haloze low hills in northeastern Slovenia. (Zorn and Komac 2008) (Photo by Milan Orožen Adamič, GIAM ZRC SAZU Archive)

mainly of Alpine hills (e.g., the Škofja Loka, Idrija, Cerkno, Polhov Gradec, and Sava hills) and Alpine mountain ranges, especially the Karawanks, where shale clays and quartz sandstone predominate. Landslides also reshape the relief in the flysch Mediterranean hills of southwestern Slovenia and the marlstone Pannonian low hills of northeastern Slovenia, composed of tertiary rocks, where slumps are common during heavy rainfall (Fig. 17.4). The Dinaric regions of southern Slovenia are less susceptible to landslides due to the presence of limestone and dolomite (Zorn and Komac 2008).

Among major landslides are the Pleistocene landslide near Selo in the Vipava Valley in southwestern Slovenia, with a volume of about 150 million m^3, and a landslide in the region of Ilirska Bistrica (also in southwestern Slovenia), both of which occurred at the thrust contact of carbonate rocks above flysch, and the landslide near Vransko in the Celje Basin in central Slovenia (Zorn 2002; Placer and Jamšek 2011).

Among major landslides in contemporary times, caused for the most part by the contact of an upper layer of carbonate rocks on impermeable ones and triggered by heavy precipitation, are several landslides in the Vipava Valley: the Slano blato Slide in 2000 (700,000 m^3), the Rebernice Slide (400,000 m^3) triggered by construction of the freeway in 2001, and the Stogovce Slide (80,000 m^3) in 2010, which carried off a kilometer of state road (Fifer Bizjak and Zupančič 2009), and the 1990 Macesnik Slide (2,000,000 m^3) in the Upper Savinja Valley (northern Slovenia) with a bridge being built over it. The most destructive of all was the landslide triggered above Log pod Mangartom in the Upper Soča Valley (northwestern Slovenia) in 2000 (1,500,000 m^3), which turned into a debris flow (Fig. 17.7; Zorn and Komac 2002). There was a significant landslide in the Upper Soča Valley above the village of Koseč near Kobarid in 2001 (180,000 m^3), which also led to some small debris flows (Mikoš et al. 2006a).

Instances of landslides in degraded areas are also well known. In 1987 a slide of mine tailings was triggered in Zagorje in central Slovenia (Komac and Zorn 2007).

Rockfalls are common in the mountains of the Alpine and Dinaric regions of western Slovenia (Vidrih et al. 2001; Mikoš et al. 2006b; Komac 2015). The greatest number is in the limestone high-mountain areas of the Julian Alps, the Karawanks, and the Kamnik–Savinja Alps. They are also characteristic of the up to 80-meter-high flysch cliffs along the Adriatic coast (Fig. 17.5; Šegina et al. 2012).

The biggest known example, the Kuntri rockfall, was triggered in the Pleistocene on the southern slope of Mount Polovnik in the Julian Alps and blocked the flow of the Soča River with 200 million m^3 of material for an extended period of time. Other prehistoric rockfalls in the Upper Soča Valley occurred between Kal–Koritnica and the Soča village, near Kobarid and at the confluence of the Soča and Tolminka rivers. In the Upper Sava Valley, rockfalls occurred below Mount Planinski Vrh in the Jesenice area, where there are also a number of erosional hotspots in the dolomite rocks of the Karawanks (Sodnik and Mikoš 2006). Among historical rockfalls, noteworthy is the 100 million m^3 earthquake-induced rockfall on Mount Veliki Vrh in the Karawanks from 1348. Major recent rockfalls are to be found in the Soča Valley on Mount Javoršček and Mount Mangart and in Trenta Valley, and particularly notable are the approximately 100 earthquake-induced rockfalls in the Upper Soča Valley in 1998 (Fig. 17.6; Zorn 2002). Some rockfalls can reach the valley floor and block watercourses, as happened in the Idrijca Valley during the 1511 earthquake, when a rockfall dam caused floods in the town of Idrija (Cecić 2011), in Luče in the Savinja Valley in 1990, and in the headwaters of the Tolminka River above Tolmin in 2004 (Komac and Zorn 2009). Coseismic slope processes are especially characteristic of northwestern Slovenia (Komac 2015). Rarely, rockfalls

Fig. 17.5 The Slovenian coast and swimmers are threatened by frequent slope failures from flysch coastal cliffs; here at cape Debeli rtič in 2013. (Photo by Matija Zorn, GIAM ZRC SAZU Archive)

Fig. 17.6 The earthquake in the Upper Soča Valley on April 4, 1998 (M: 6), triggered a major rockfall (about 1 million m^3) from Mount Krn (2244 m; photo by Matija Zorn, GIAM ZRC SAZU Archive)

threaten buildings and infrastructure; below the rockfall at Trenta in the Soča Valley, a gallery was built to protect the road.

Debris flows were common in western Slovenia at the end of the Pleistocene, in recorded history there is evidence of their occurrence in the settlements of Log pod Mangartom

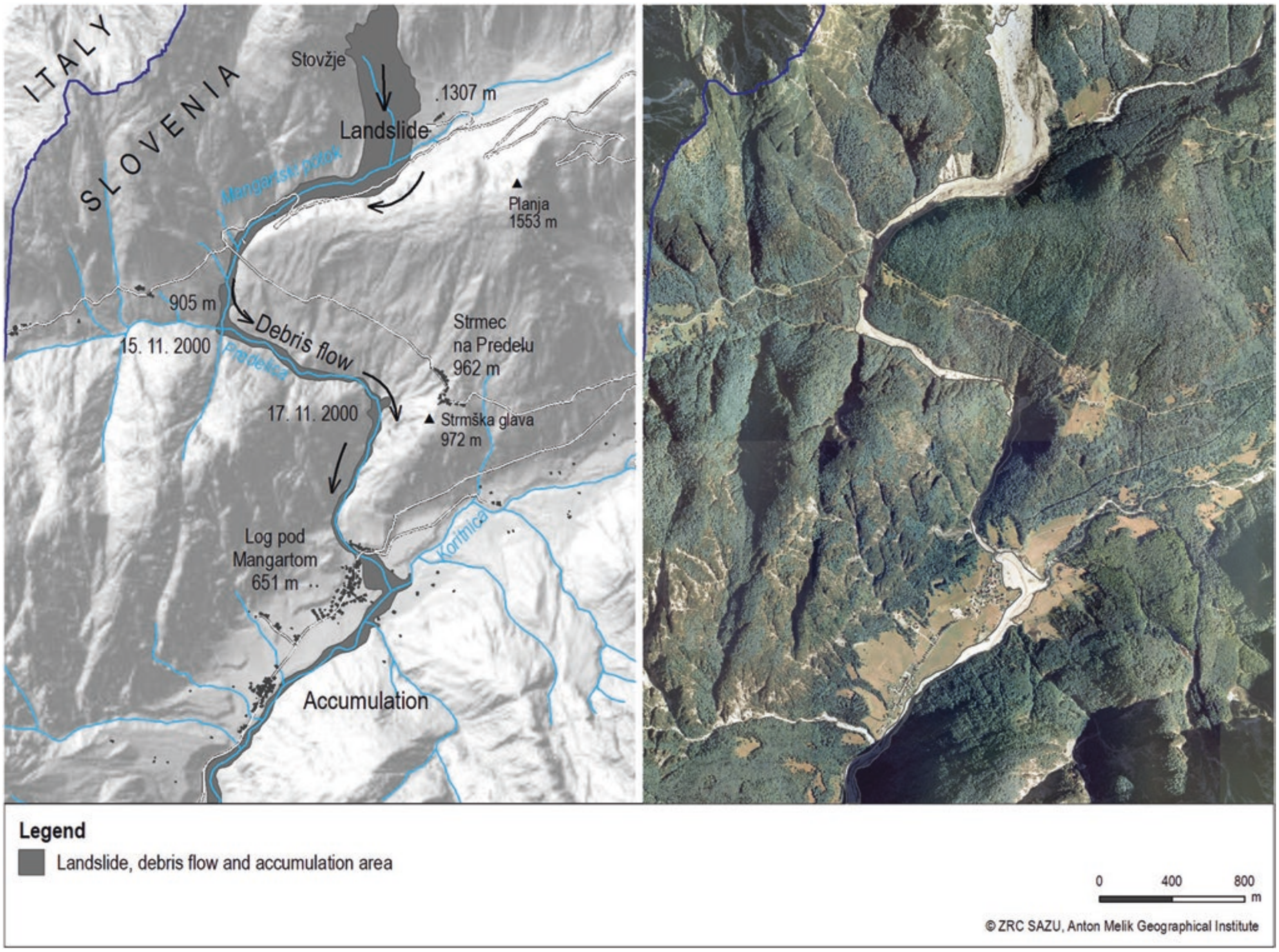

Fig. 17.7 The figure shows an orthophoto (Source: Surveying and Mapping Authority of the Republic of Slovenia 2005) of a debris flow triggered west of Mount Mangart (2679 m) in the Upper Soča region in November 2000 due to heavy rainfall. In November 2000, 1234 mm of precipitation fell in the area, which is roughly half of the average annual precipitation. A debris flow was created from the landslide mass (top: 1,500,000 m^3) that had been triggered at an elevation between 1340 and 1580 m, and the debris flow reached the village of Log pod Mangartom (bottom) at an elevation of 650 m, where it claimed 7 lives, demolished or damaged 18 houses and 8 other buildings, and deposited 700,000 m^3 of material over an area of 15 hectares. It caused €14 million in damage, and the survivors had to be relocated for 3 months. Over the next decade, the village was rebuilt, and with the help of government funding, 15 homes, a debris flow breaker, and 2 bridges were constructed (Zorn and Komac 2002). In the same period, a 50,000 to 80,000 m^3 landslide was triggered from the western slope of Mount Ciprnik (1745 m) in the Planica Valley, which partially turned into a debris flow. It decimated forest and part of the road near the world-famous ski-jumping area in Planica (Mikoš et al. 2007). Several smaller debris flows, up to 1000 m^3 in volume, were also created by the landslide above Koseč. Because they threatened the settlement, a larger bridge was erected in the middle of it (Mikoš et al. 2006a)

and Koroška Bela, and from recent decades three significant cases are known: major events in Log pod Mangartom (Fig. 17.7) and the Planica Valley in November 2000 and a series of small debris flows in Koseč, near Kobarid in the Soča Valley, in 2001. The settlement of Koroška Bela in the Upper Sava Valley is threatened by several landslides in the Karawanks that could turn into debris flows (Jež et al. 2008; Peternel et al. 2017).

Slovenia experiences a mild *earthquake* nearly every day, and the country is frequently affected by stronger ones because it is located at the seismically active southern edge of the Eurasian Plate and at the northwestern edge of the Mediterranean–Himalayan seismic belt. Most earthquakes occur at a depth of 5–15 km. The earthquake hazard is highest in western, central, and southeastern Slovenia, where the projected peak ground acceleration can reach 0.25 *g* (Lapajne et al. 2001). Based on known data, there have been about 60 destructive earthquakes in Slovenian territory up until the present.

An earthquake with an epicenter in Friuli (Italy) in 1348 and a magnitude of 6.5 achieved the strongest effects, with an intensity of X on the EMS-98, in the area of Villach, Austria, not far from the Slovenian border. It damaged many castles, fortresses, and settlements in what is today northern and northwestern Slovenia (Vidrih 2008).

Fig. 17.8 The damaged city center of Ljubljana after the 1895 earthquake. (GIAM ZRC SAZU Archive)

The Idrija earthquake of 1511 with an epicenter in Friuli (Italy) and a magnitude of 6.8 achieved an intensity of X. Due to numerous descriptions of injuries from Idrija with its world-known mercury mine, its epicenter was at first placed in the area of Idrija, and so it was called the Idrija earthquake (Ribarič 1979; Camassi et al. 2011).

The Ljubljana earthquake of 1895 with a magnitude of 6.1 and intensity of VIII to IX claimed ten lives. A tenth of the city's buildings had to be razed due to damage (Fig. 17.8). One positive effect of the earthquake was the urban renewal of Ljubljana and the establishment of a seismological service in the Austro-Hungarian Monarchy, as part of which the first earthquake observatory in Austria-Hungary was set up in Ljubljana in 1897 (Vidrih 2008).

There followed earthquakes in Brežice (1917; M: 5.7), Ilirska Bistrica (1956; M: 5.1), and Litija (1963, M: 4.9). An earthquake in the Kozje region (in eastern Slovenia) in 1974 with a magnitude of 5.1 and intensity of VII to VIII damaged 5300 buildings and affected 15 thousand people (Vidrih 2008).

The two 1976 Friuli earthquakes, the first with a magnitude of 6.5 and intensity of IX to X and the second with a magnitude of 6.1 and intensity of VIII to IX, with their epicenter in the Venzone area in Italy, claimed 990 lives in Italy and 157,000 people lost their homes. In Slovenia the toll was 1 dead and 31 injured. A total of 10,552 buildings were damaged (Cecić 2016) and 13,000 people lost their homes (Orožen Adamič and Hrvatin 2001). The same area of northwestern Slovenia was hit again by an earthquake in 1998 with a magnitude of 5.7 and intensity of VII to VIII (Fig. 17.6) and one in 2004 with a magnitude of 4.9 and intensity of VI to VII (Kastelic et al. 2008; Vidrih 2008). These last two earthquakes caused 18% (in 1998) and 13% (in 2004) of the total damage caused by natural disasters in Slovenia as a whole (Zorn and Komac 2011).

The Slovenian construction profession applied the experience gained from earthquakes in Skopje, Macedonia, in 1963; Banja Luka, Bosnia and Herzegovina, in 1969; the Kozje region in 1974; Friuli in 1976; and the Upper Soča Valley in 1998 and 2004 to the post-earthquake reconstruction of stone buildings (Benedetti and Tomaževič 1984; Tomaževič and Lutman 2007).

17.3 Hydrological Natural Hazards

The flooding of major rivers in Slovenia threatens an area of about 500 km^2, which is roughly 2.5% of the country's territory. Torrential flooding and lowland flooding occur as well as flooding of poljes, and Slovenia also experiences coastal, urban, and artificial floods (Natek 2005).

About 7.3% of the population of Slovenia lives in flood-prone areas, with the greatest proportions living in the Savinja River drainage basin (12.9% of the population of that area), in Carinthia (11.6%), in the Central Sava Valley (10.3%), and in central Slovenia (9.3%; Komac et al. 2008).

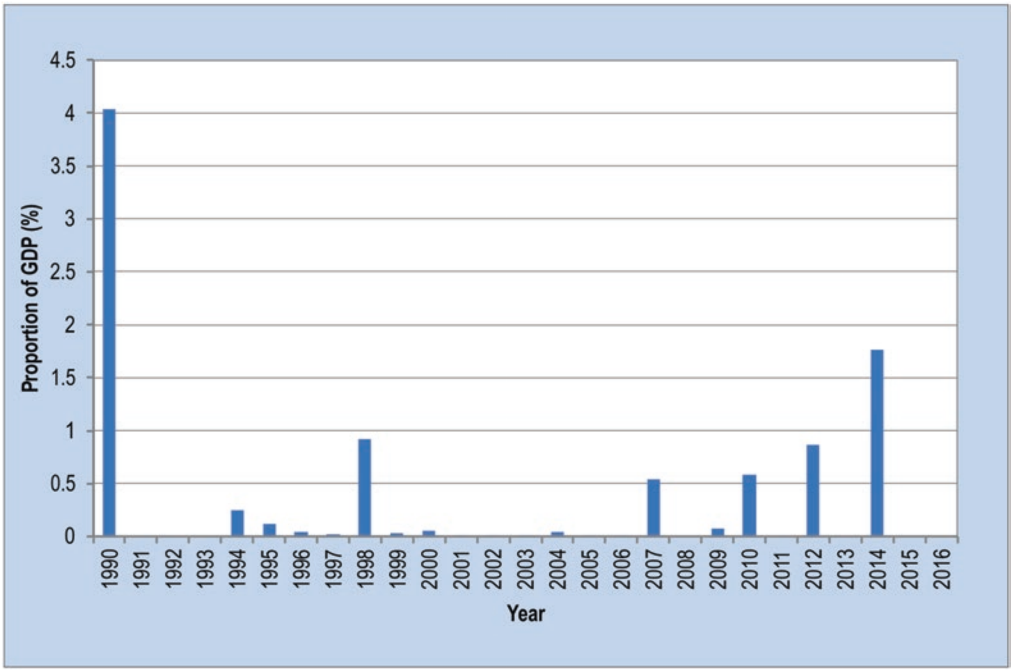

Fig. 17.9 Direct damage due to floods from 1990 to 2015 as a proportion of GDP (%). (Ocena … 2015)

On average, about €14 million in damage per year was caused by floods from 1991 to 2008 or 16% of the total damage caused by natural disasters in this period (Zorn and Komac 2011). The greatest damage was caused in the drainage basin of the Savinja in 1990 (more than €500 million in direct damage), and in the last decade direct economic damage exceeded €200 million on three occasions (2010, 2012, and 2014; Table 17.1, Fig. 17.9).

Overbank floods occur during high river discharges resulting from heavy precipitation in autumn or melting of snow in spring (Hrvatin 1998). At present they only rarely extend over large areas of flood plains because they were artificially reduced by extensive regulation and melioration of the majority of rivers in the twentieth century (Komac et al. 2008). In the past, flood plains were uninhabited rich ecosystems of wetlands, but they later became farming and urbanized areas (Fig. 17.10) that need suitable flood protection measures (Natek 1992). In order to mitigate overbank floods, levees were often artificially raised.

Overbank floods affect a large part of the country and typically occur in plains in the lower reaches of major rivers such as the Ljubljanica, Savinja, Krka, Drava, Mura, and Sava, as well as along smaller rivers such as the Gradaščica, Pšata, and Kamniška Bistrica near Ljubljana, the Pesnica and Ledava in eastern Slovenia, and the Vipava in the southwest (Komac et al. 2008).

The largest flood-prone areas are the Ljubljana Marsh (80 km^2), along the Dravinja (66.5 km^2) and the Krka (62 km^2) and along the lower reaches of the Savinja, Sava, Sotla, and Kolpa rivers and in the Cerknica Polje. Since the beginning of the twentieth century, there have been major lowland floods in 1901 (all of Slovenia), 1910 (Drava River), 1923 (Soča, Sava, and Savinja rivers), 1925 (Mura River), 1926 (Ljubljanica and Savinja rivers), 1933 (Sava and Savinja rivers), 1954 (Savinja River), 1972 (Mura River), 1990 (Savinja River), 1998 (Sava River), 2000 (Savinja River; Polajnar 2002), 2004 (Bač Rivera), 2005 (Sava River), 2007 (Sora River), 2010 (Ljubljanica River), 2012 (Drava River), and 2014 (Ljubljanica and Mura rivers).

Torrential floods are characteristic of mountainous and hilly areas (Fig. 17.11) and upland areas with a preponderance of narrow valleys. Of 27,000 km of watercourses in Slovenia, a third are torrential ones that appear occasionally. They are important because they threaten 237,000 hectares of land, or about 12% of the country's territory. Along the Dragonja and Drnica rivers in the Mediterranean hills in the southwest, the valley floors are sparsely settled and torrential floods do not cause a considerable damage (Zorn 2008). In the Julian Alps, torrential floods are limited to the steepest mountain slopes (Kolbezen 1996). In the Karawanks, torrential floods are typically frequent along torrential streams such as the Belca, causing damage in the newer parts of settlements and to infrastructure (Komac et al. 2008). In hilly central Slovenia, with the Sora and Savinja rivers, traditional settlement retreated to higher fluvial terraces and inactive alluvial fans in order to avoid torrential floods, but today these valley floors are densely settled (Meze 1991; Natek 1992; Trontelj 1997; Komac et al. 2008). In the northeast, torrential floods are common in the Slovenian Hills and Haloze Hills, and in the north they are limited to the Pohorje

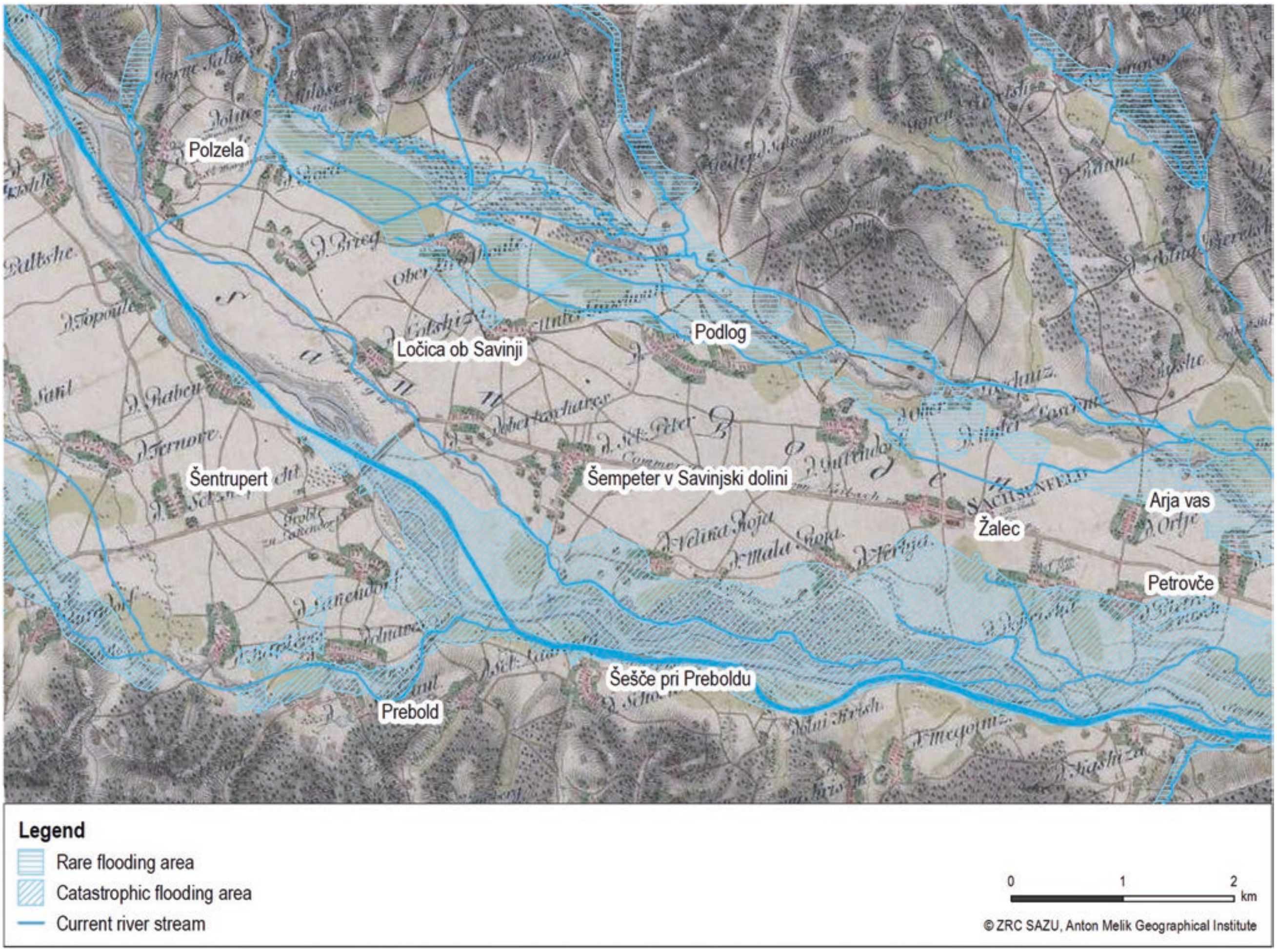

Fig. 17.10 The Lower Savinja Valley between Prebold and Žalec (central Slovenia) on a Habsburg military map from the second half of the eighteenth century. A number of former side channels of the Savinja can be seen on the old map, with the present channelized riverbed of the Savinja added. Former side channels coincide with the former flood area and show that settlement has come too close to the river. (Zorn 2017)

and Kozjak Hills, where the greatest torrential river is the Mislinja (Gams 1991). In the southeast, torrential floods occure in the Gorjanci Hills (Tičar et al. 2018).

Coastal floods are fairly common in the autumn months, when storm waves develop due to the combined influence of winds, low air pressure, and tidal bores, and bring flooding to the lower-lying parts of coastal towns. Annual floods affect about 1% of the territory of coastal municipalities and extreme events about 4%. Extreme floods in the Municipality of Piran affect about a sixth of the territory. Between 1963 and 2003, the sea caused limited flooding on 256 occasions, and in 1967, 1970, 1980, 1981, 1983, 1987, and 1994, floods were quite extensive (Robič and Vrhovec 2002; Kolega 2006). Despite the seismic hazard, major tsunamis caused by earthquakes are unlikely in the Adriatic Sea; however, in narrow bays there sometimes occur meteotsunamis, which are created at times of rapidly changing air pressure, and these cause damage.

Karst floods are a distinctive phenomenon on poljes in the Dinaric karst region in southern Slovenia. They occur where the karst aquifer groundwater level rises above the elevation of the polje floor and percolates slowly through hundreds of cracks and voids in the floor and rim of the poljes. A unique trait of karst floods is the clarity of water due to the low sediment load, creating transparent intermittent lakes that last for several weeks or even months (Komac et al. 2008; Ferk 2016). In their normal extent karst floods are not categorized as natural disasters because they do not threat settled areas (Fig. 17.12), but during the highest water levels, they may reach to the edges of some settlements (Stepišnik et al. 2012). The most typical periodically flooded poljes are the Planina (Fig. 17.12), Cerknica, Lož, Račna (*Radensko*), Ribnica, and Kočevje poljes (Komac et al. 2008). Since 2000 there have been major flood events in 2000/2001, 2008/2009, and 2014 (Frantar and Ulaga 2015).

Fig. 17.11 Impact of a torrential flood in the Davča Valley (Škofja Loka Hills) in 2007. (Photo by Matija Zorn, GIAM ZRC SAZU Archive)

Fig. 17.12 Normal annual flooding in poljes does not threaten settlements. A normal annual flood in the Planina Polje. (Photo by Miha Pavšek, GIAM ZRC SAZU Archive)

Avalanches are in first place in Slovenia with respect to the number of victims claimed by natural hazards. They occasionally cause damage to forests, roads, and buildings. There are about 1000 areas in Slovenia that are identified as having a high avalanche hazard (Pavšek 2002; Volk Bahun 2016).

The worst avalanche disaster took place in 1916, during the construction of the military road across the Vršič Pass (Julian Alps, 1611 m) during the First World War, claiming about 250 victims (Pavšek 2002). The first extensive study of avalanches in Slovenia (Gams 1955) took place following two extremely snowy winters that took the lives of a number of victims and caused enormous damage at the beginning of the 1950s, and a comprehensive study of the problem was produced half a century later (Pavšek 2002). The most recent extensive avalanches occurred in 2006, when a number of them also caused damage in the floors of major valleys such as the Logar Valley (*Logarska dolina*) and Makek Cirque (*Makekova kočna*) in the Jezersko area.

17.4 Meteorological Natural Hazards

The greatest damage from natural disasters is caused by *drought*. It occurs most frequently in Pannonian, Mediterranean, and Dinaric regions, with the first two also being regions with intensive agricultural production (Pavlič 2013; Sušnik et al. 2014). From 1991 to 2008, it caused direct damage totaling €600 million, or more than a third of all damage caused by natural disasters in the country. Extreme droughts occurred in 1961, 1968, 1971, 1978, 1980, 1983, 1992, 1993, 2000, 2001, 2003, 2006, and 2007 (Matajc 2002; Zorn and Komac 2011).

Drought is often accompanied by *heat waves*. Average temperatures in Slovenia have been rising over the last half century (Tosić et al. 2016), and the number of hot days is also increasing. Severe temperature extremes were recorded in 2003 and 2013. There were three heat waves in Slovenia in 2013, with a corresponding increase in mortality (Hojs et al. 2015), and there were also more deaths than expected during the 2003 heat wave (Šelb Šemerl and Tomšič 2008). The phenomenon is especially pronounced in cities (Zalar et al. 2017) due to urban heat islands (Komac and Ciglič 2014; Komac et al. 2017).

Rainstorms are particularly common in Slovenia along the Alpine–Dinaric mountain barrier. The region of the Ljubljana Basin and the Kamnik–Savinja Alps is among the stormiest areas of Europe, with about 100 rainstorms per year, a consequence of the extreme heating of the air on the plain of the Ljubljana Basin in summer. Extreme and stormy winds with abundant precipitation, hail, and rainstorms with blasts of wind cause downing of trees and property damage in the amount of €10 million annually. Between 1991 and 2008, rainstorms associated mainly with the passage of cold fronts and storm clusters caused €173 million in damage, with the annual damage exceeding €20 million in 1995, 2005, and 2008. Especially noteworthy are the tornado near Vrhnika in 1986 (Trontelj and Zupančič 1987), the downing of trees due to wind on the Jelovica Plateau in 2006 (Klopčič et al. 2010), and the gusting winds that hit the eastern part of the Ljubljana Basin in 2008. Rainstorms are accompanied by *strong winds* such as the sirocco and bora in the southwest of the country, by *lightning strikes*, which are common along the Alpine–Dinaric mountain barrier, and by *hail*, which is very unevenly distributed. There are between 30 and 50 days per year in Slovenia with hail (Sušnik 2002). Hail caused €270 million in damage between 1991 and 2008. In 2004 the level reached €29 million, in 2005 €44 million, in 2006 €19 million, and in 2008 as much as €91 million in damage.

Frost causes damage in the agricultural southwestern and southeastern parts of Slovenia, particularly to fruit production and viticulture. Frosts are typical for the period between October and May and were especially severe in 1977, 1988, 1985, 1994, 1997, and 2001. Between 1991 and 2008, they caused a total of €50 million in damage, with the greatest amounts in 1997 (€19 million) and 2001 (€17 million).

Glaze causes damage primarily to forests and infrastructure in the Dinaric Alps in southwestern Slovenia (Vrhovec and Kastelec 2002). Particularly noteworthy are the years 1995, 1996, and 1997 (Zorn and Komac 2011) and above all 2014, when 51% of Slovenia's forests were affected and, along with accompanying floods, suffered €430 million in damage. About 250,000 people were left without electricity; in the town of Postojna (population 9000), the outage lasted over a week, rail traffic between Ljubljana and Koper was halted for an extended period, and 21 people lost their lives in forestry accidents in the aftermath (Beguš 2015).

Fires in Slovenia most threaten the karst Mediterranean areas in the southwestern part of the country. These areas experience frequent droughts and strong winds (the bora). The cause for roughly half of fires is unknown, and for the other half, human carelessness is generally at fault (Jakša 1997).

Fires are most frequent in February and March and in July and August. People have increased the threat of fires by planting Austrian pine (*Pinus nigra*) and Scots pine (*Pinus sylvestris*; Jakša 2002; Šturm 2017). A great deal of damage was caused by fires in 2003 and 2004, and altogether fires caused €68 million in damage (€4 million annually) between 1991 and 2008 (Zorn and Komac 2011).

17.5 Conclusion

Based on the variation coefficient of the cost of damage by natural disaster between 1991 and 2008 (Zorn and Hrvatin 2015), it was determined that most predictable damage was caused by windstorms, landslides, and avalanches because they occurred every year, but such damage was never extremely high. Somewhat less predictable was the damage caused by fires, hail, and drought. In general, these disasters occur every year, but their intensity can vary greatly. They can cause tens of millions of euros of damage in individual years. Even less predictable are floods and frost, which can be less significant and cause little damage for several years in a row, but strike extensive areas severely in a specific year. Ice storms and earthquakes vary the most. Glaze and strong earthquakes occur fairly rarely, but when they do their impact

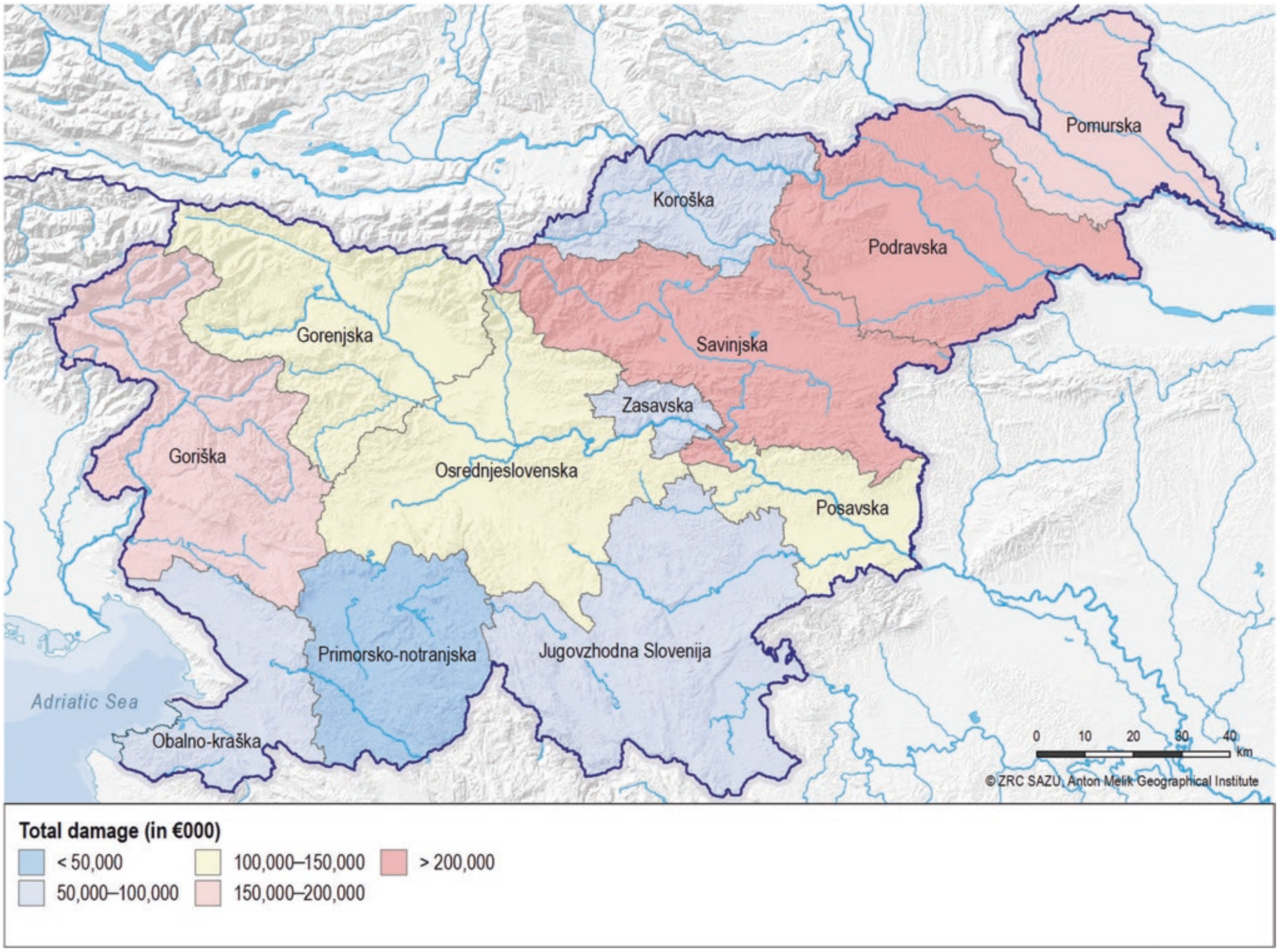

Fig. 17.13 Total damage caused by natural disasters by statistical region (EU NUTS-3 regions) from 1992 to 2008. It is evident that the statistical regions in northeast Slovenia (the Savinja (*Savinjska*), Drava (*Podravska*), and Mura (*Pomurska*) statistical regions) recorded the greatest damage. In western Slovenia, only the Gorizia (*Goriška*) Statistical Region is included in the top class. Considering that drought was the most frequent natural disaster, this kind of distribution across the most important agricultural statistical regions was expected. Moderate damage was recorded in central Slovenia (the Ljubljana Basin, Central Slovenia (*Osrednjeslovenska*), and Central Sava (*Zasavska*) statistical regions), and the least damage was recorded in the Dinaric and certain Alpine areas, where arable farming is only a secondary activity. (Zorn and Hrvatin 2015)

is great and extended recovery is required. Moreover, the damage varies significantly between individual Slovenian regions (Figs. 17.13, 17.14 and 17.15).

Especially meteorological disasters as well as landslides are often ascribed to climate change, but in Slovenia there are other often social reasons that are more important in reducing society's resilience to natural hazards (Kuhlicke et al. 2011; Komac and Lapuh 2014; Zorn and Komac 2015; Komac 2017):

- Inadequate spatial planning; for example, urbanization of hazardous areas (Figs. 17.16 and 17.17). Only a few municipalities have susceptibility maps for various natural hazards.
- Lack of supervision; for example, low quality of post-earthquake reconstruction revealed in a subsequent earthquake.
- Insufficient insurance policies; for example, insurance against natural hazards is not obligatory.
- A mix of politics and capital influences because, despite laws prohibiting the practice (e.g., the 2002 Waters Act (Zakon o vodah 2002) and the 2007 Spatial Planning Act (Zakon o prostorskem … 2007)), one finds hundreds of instances of legally built new buildings in hazardous areas.

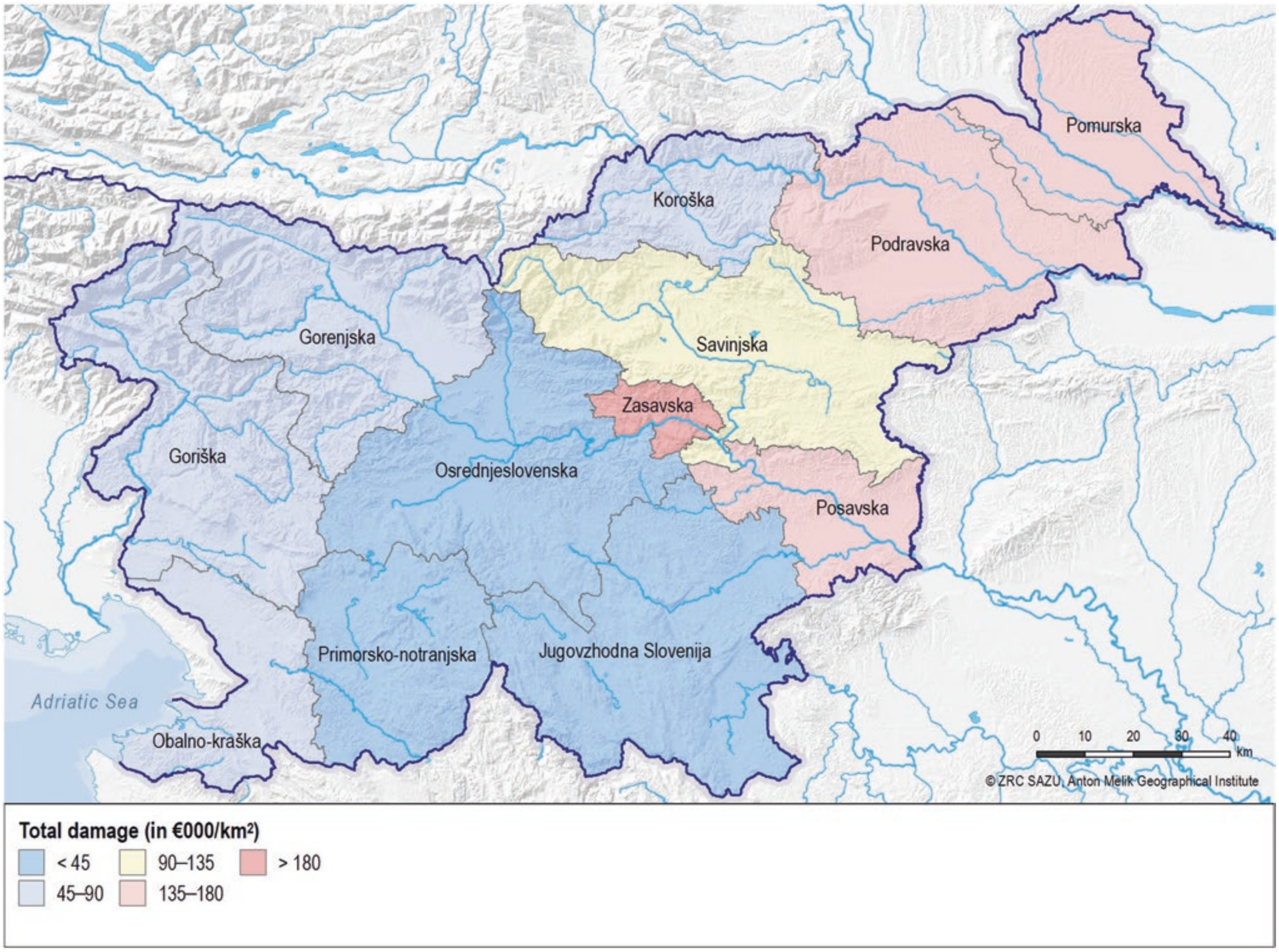

Fig. 17.14 Total damage caused by natural disasters per km^2 of statistical region, 1992–2008. This map, too (perhaps even more than Fig. 17.13), highlights the damage caused by drought in the most important arable farming areas in Slovenia. In every statistical region of eastern Slovenia, this damage exceeded €130,000/km^2, and a large part of western and central Slovenia recorded damage below €60,000/km^2. The least damage, barely €16,000/km^2, was recorded in the predominantly wooded and sparsely populated Dinaric region. (Zorn and Hrvatin 2015)

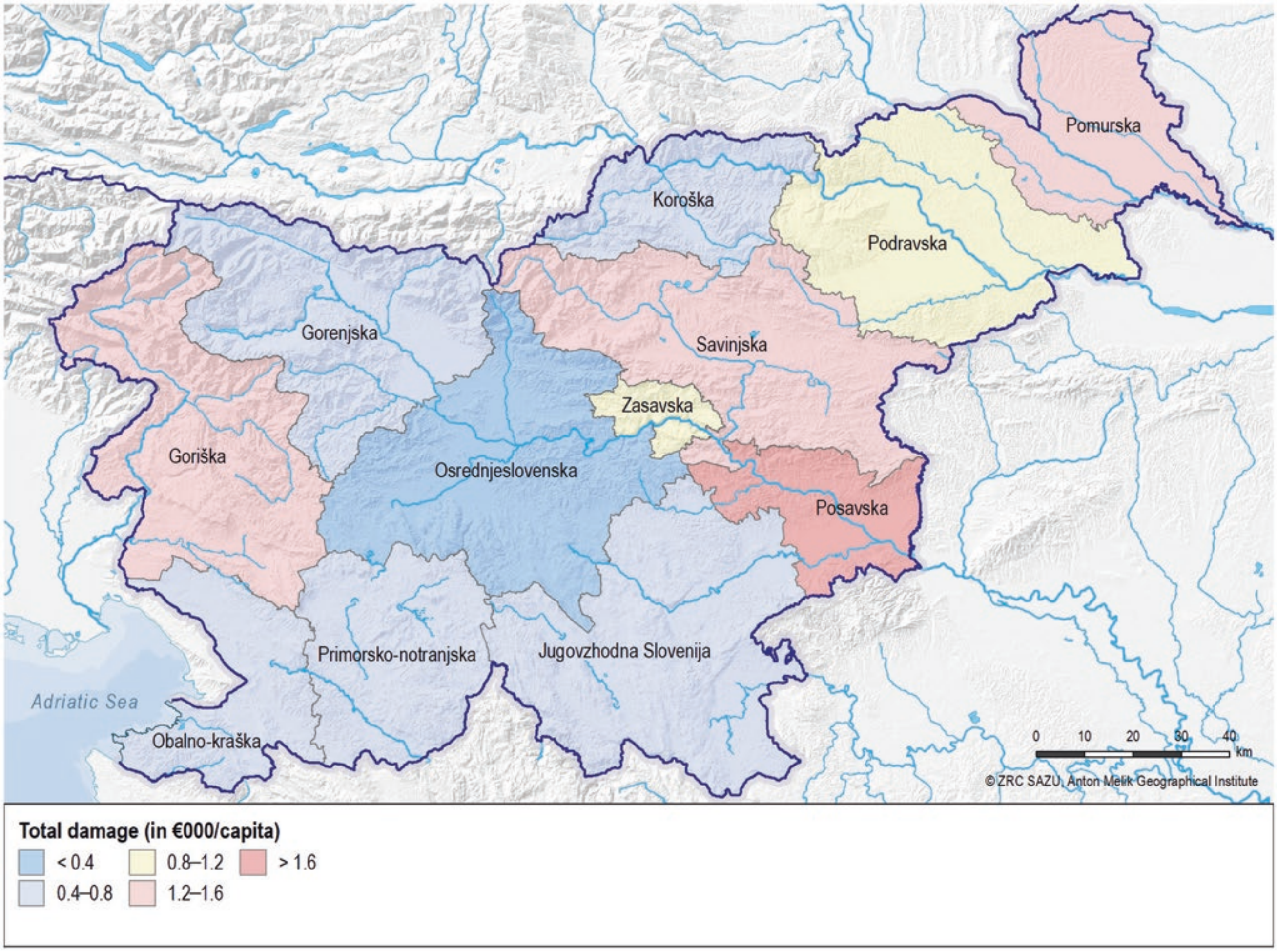

Fig. 17.15 Total damage caused by natural disasters per capita by statistical region, 1992–2008. Also in this case, the highest classes with damage exceeding €1000 per capita include the statistical regions in northeast and eastern Slovenia (the Mura (*Pomurska*), Drava (*Podravska*), Savinja (*Savinjska*), Central Sava (*Zasavska*), and Lower Sava (*Posavska*) statistical regions). Another statistical region highlighted on the map is the sparsely populated Gorizia (*Goriška*) Statistical Region, which was affected the most by multiple earthquakes, and not drought. Due to the moderate damage suffered and fairly high population density, the Central Slovenia (*Osrednjeslovenska*) Statistical Region is in the lowest class, with damage of €224 per capita. (Zorn and Hrvatin 2015)

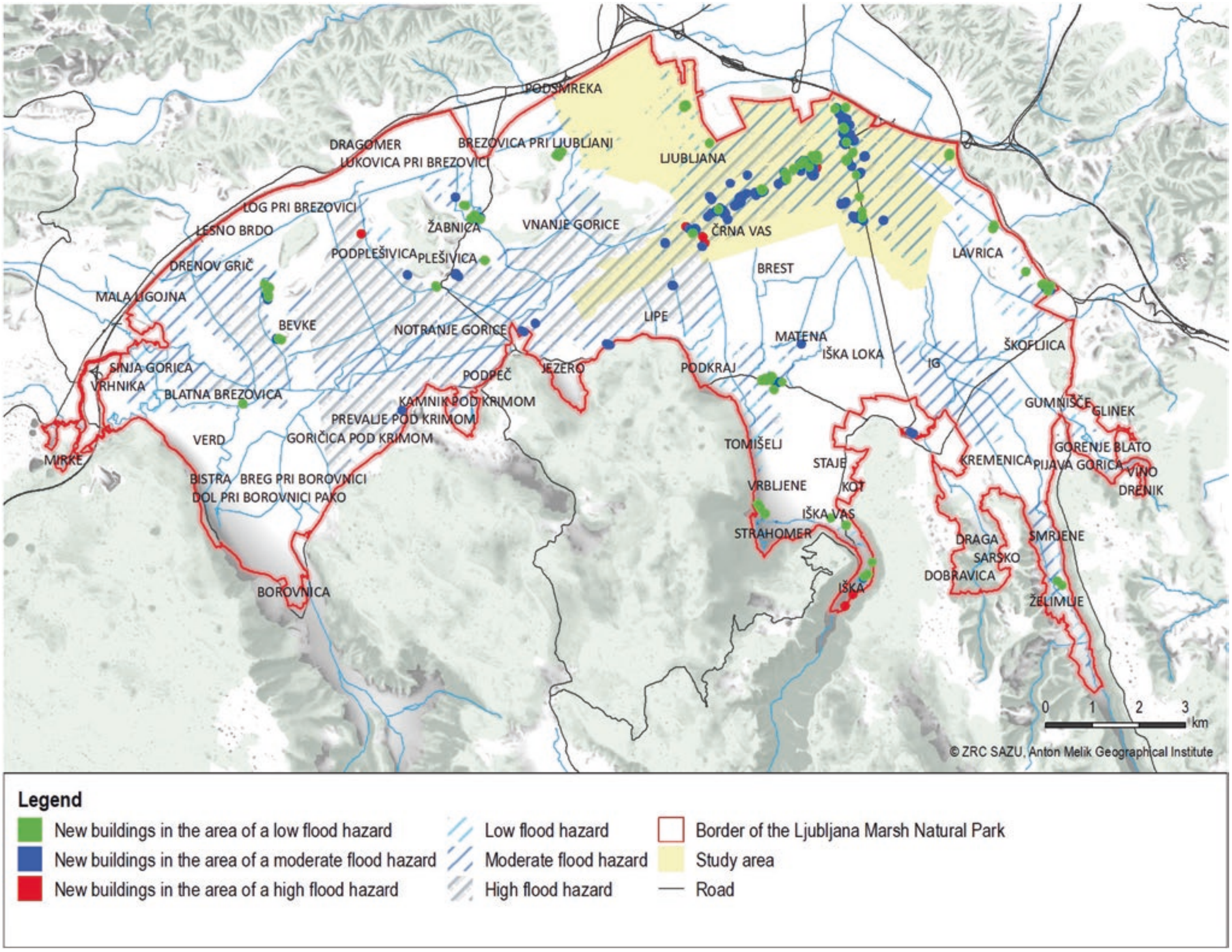

Fig. 17.16 New construction between 2003 and 2015 in flood-prone areas of the Ljubljana Marsh. Due to its proximity to Ljubljana, good transport connections, and natural environment, the Ljubljana Marsh is an attractive place of residence. New construction is rare in areas with a high flood hazard, but for this reason all the more common in areas with a moderate or low flood hazard. The value of new construction in flood-prone study area is estimated at €22 million, occupying an area of nearly 20,000 m^2. Unfortunately, the case of the Ljubljana Marsh is not an exception because one can find similar cases in numerous flood-prone areas around Slovenia. (Goluža and Zorn 2017)

Fig. 17.17 Flooding in September 2010 affected new construction in the Ljubljana Marsh. (Photo by Miha Pavšek, GIAM ZRC SAZU Archive)

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18 Land Use in Slovenia

Matej Gabrovec, Peter Kumer, Daniela Ribeiro, and Mateja Šmid Hribar

Abstract

Landscape diversity results in significant land-use differences between Slovenia's landscapes. A high-quality set of land-use data covering the period from the early nineteenth century to the present is available for Slovenia, which makes it possible to study the impact of various factors on land-use changes. In the early nineteenth century, when subsistence farming predominated, farmers on each farm or in each village had to have enough arable land to produce food, enough meadows to feed the animals, and enough forest for firewood. Therefore, the variability in land use was much greater at the local level than today but smaller between regions. Afforestation prevails in the Alpine mountains, hills, and Dinaric landscapes of western Slovenia, grass overgrowth dominates in the hills of eastern Slovenia, farming intensification characterizes the Pannonian plains, and urbanization predominates on the coast and the Alpine plains. Compared to neighboring central European countries, the sociogeographical factors of land-use change in Slovenia diverged the most between 1945 and 1990, resulting in more fragmented land and dispersed settlement.

Keywords

Regional geography · Land-use changes · Landscape diversity · Franciscean Cadaster

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18.1 Land Use as a Landscape Diversity Indicator

Land use is the result of many physical-geographical, historical, demographic, and economic factors (Gabrovec and Kladnik 1997). Because of the country's great landscape diversity, natural-geographical factors are at the forefront in Slovenia. The shares of individual land-use types differ significantly by natural-geographical landscapes (Perko 2007; Perko et al. 2015). To show this landscape diversity, the shares of individual land-use categories by Slovenian landscape type have been calculated (Table 18.1).

In Slovenia (Table 18.1), fields cover just under a tenth of the territory; they are largely concentrated in the Pannonian plains, where they cover more than half of the area, whereas they account for only 0.5% in the Alpine mountains. The overall share of vineyards is 1%, but in the Mediterranean low hills, they account for 6% of the territory; there are none in the Alpine mountains and plains. The largest share of orchards can also be found in the Mediterranean low hills: they account for 5% of the territory, which is three times the Slovenian average of 1.7%. The fewest orchards can be found on Mediterranean and Dinaric plateaus and in the high mountains. Orchards are the category with the smallest variability among landscape types because traditionally all landscapes had extensive orchards next to farms. The largest share of meadows can be found in Dinaric lowlands and the smallest in the Pannonian plains. Slovenia stands out in Europe with its above-average share of forest (i.e., 61.8%). An above-average share (i.e., 82.8%) characterizes the Dinaric plateaus, where the karst relief and high elevations limit farming opportunities (Ciglič et al. 2012), and the smallest share can be found in the Pannonian plains, where forest covers only 5% of the terrain. Built-up areas cover 5% of Slovenia's territory. The majority (close to one-fifth) can be found in the Alpine plains, where the capital of Ljubljana is also located and the fewest on Dinaric plateaus. Individual landscape types also differ in terms of the processes of

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D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_18

Table 18.1 Shares (in %) of individual land-use types by Slovenian landscape type in 2017

Landscape type	Arable land	Vineyards	Orchards	Meadows	Forest	Built-up	Other
Alpine mountains	0.5	0.0	0.5	13.0	74.5	1.4	10.2
Alpine hills	3.0	0.2	2.2	22.3	68.2	3.6	0.6
Alpine plains	24.5	0.0	1.4	21.6	31.6	19.5	1.4
Pannonian low hills	21.5	3.0	3.6	23.4	42.9	5.1	0.6
Pannonian plains	52.8	0.2	1.1	9.9	21.8	11.5	2.6
Dinaric plateaus	1.1	0.2	0.6	13.8	82.8	1.2	0.3
Dinaric lowlands	9.1	0.4	1.2	28.9	52.9	6.8	0.7
Mediterranean low hills	5.7	6.4	5.0	16.8	57.8	7.4	0.9
Mediterranean plateaus	1.0	1.3	0.4	25.3	68.6	3.2	0.2
Slovenia	**9.7**	**1.0**	**1.7**	**19.0**	**61.8**	**4.7**	**2.2**

Source: Land Use Data Base, Ministry of Agriculture, Forestry and Food
The largest shares are marked red, and the smallest are marked blue

land-use change (Gabrovec and Kumer 2019), and the variability of land use is increasing between them.

18.2 The Franciscean Cadaster as a Source of Data on Traditional Land Use

A high-quality set of land-use data spanning two centuries is available for the territory of the former Habsburg Monarchy in central Europe. The Franciscean Cadaster from the first half of the nineteenth century is unique in the world because, in addition to written records, it also includes 1:2880 cadastral maps showing land use (Bičík et al. 2001, 2015). The majority of Slovenian territory was covered in the cadaster as early as the 1820s, with the exception of Prekmurje (in northeast Slovenia), which belonged to the Hungarian part of the monarchy and was included in the cadaster around 1860 (Petek and Urbanc 2004). Land use in the Franciscean Cadaster was elaborately inventoried for the needs of tax administration. The nineteenth-century cadaster has been used (with certain modifications) until the present regardless of political changes, which makes it possible to compile a high-quality land-use database, incorporate it into a geographic information system, and determine the factors influencing land-use changes (Gabrovec and Kumer 2019).

Based on the written part of the cadaster, nineteenth-century land-use maps have been prepared (Figs. 18.1 and 18.3). The written part of the land cadaster is presented in a table (a land-use statement) for each cadastral municipality separately, featuring the areas of individual land-use types. The spatial measures are provided in the *Joch* (0.58 ha) and *Klafter* (3.6 m^2). The forms for Carniola, Carinthia, Styria, and part of the Littoral are provided in German and envisage the entry of 29 land-use categories. The surveyors also added new categories to the majority of cadastral municipalities, whereby they struck out the categories that did not appear in a given cadastral municipality and added new ones on the printed form. The most frequent categories added included meadows or pastures with trees or shrubs. The forms used for some cadastral municipalities in the Littoral region were adapted to a more detailed classification of Mediterranean crops. In Prekmurje, in the Hungarian part of the monarchy, the form used includes 46 land-use categories. The data for Carinthia, Carniola, Styria, and Prekmurje are kept by the Slovenian Archives, and the data for Gorizia and Istria are kept by the Trieste State Archives. The graphic part was often used because its large scale (1:2880) allows detailed analyses of factors influencing local land-use changes (Gabrovec 1995; Petek and Urbanc 2004; Paušič and Čarni 2012; Ažman Momirski and Gabrovec 2014; Šmid Hribar 2016). These cadastral maps have been used to present nineteenth-century land use (Fig. 18.7). The Franciscean Cadaster was revised several times in the two centuries following its creation; new land surveys were conducted, and the land-use categories were partly altered, but the basic concept has remained the same until today. The first major revision of the cadaster was performed during the 1870s (Seručnik 2009). A significant change in terms of land-use data occurred in 2011 with the enforcement of a provision from the 2006 Real Estate Recording Act requiring that the land-use data entered in the land cadaster be taken from the Land Use Data Base (Gabrovec and Kumer 2019). The Land Use Data Base is based on visual interpretation of orthophotos.

18.3 Factors Influencing Land-Use Change in the Nineteenth and Twentieth Centuries

The Franciscean Cadaster shows land use typical of preindustrial agriculture. During that period, agriculture was solely based on local resources; no mineral fertilizers were used, and no machines powered by fossil fuels were available. The agriculture of that time can be referred to as “low input–low output” farming, which employed local resources through manual and animal labor. The “traditional” farming of that time was inevitably mixed, with farms engaging in both animal husbandry and arable farming. Therefore, “non-

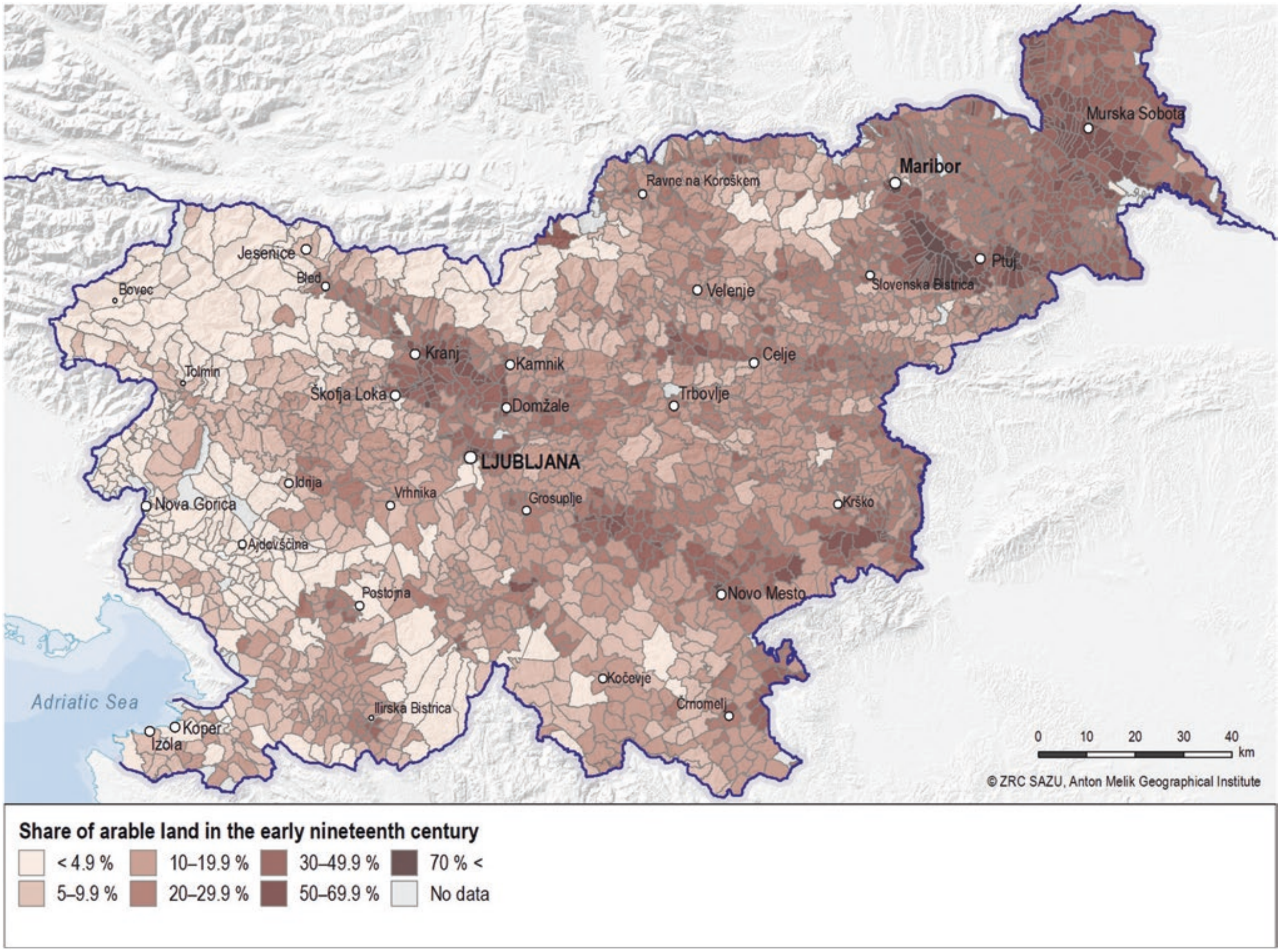

Fig. 18.1 Share of arable land in the early nineteenth century. (Source: Franciscean Cadaster)

uniform land use" was typical at the local level. Animal husbandry and arable farming complemented one another. The side products of arable farming and areas not suitable for arable land were used to produce fodder for livestock, and without the animals there was no manure for the cultivated fields. Forests were also a part of every farm; on the one hand, they were used as a source of energy and, on the other, for grazing and providing bedding for livestock (Krausmann 2006). Due to local land-use optimization, in the nineteenth century, land-use variability between landscape types was smaller than today, but the diversity of use in individual villages was greater. This difference is evident when comparing the shares of arable land in the early nineteenth century and today (Figs. 18.1 and 18.2).

In contrast to the predominantly subsistence farming, winegrowing was an exception during the nineteenth century and was already market-oriented. Vineyards were significantly larger than today (Figs. 18.3 and 18.4). The second half of the nineteenth century was affected by the deterioration of vineyards due to the *Viteus vitifoliae*, or phylloxera, plague. In France, this deterioration already began in 1868, and within a decade or a few years longer, most of the French vineyards were destroyed. Hence, the demand for wines from other European regions increased. Olive trees were cut down in Istrian areas, and reeds were introduced as supports for grapevines. In 1880, phylloxera emerged in Slovenia and in a short time destroyed most of the vineyards, which had reached their greatest extent only a few years earlier. The Austrian authorities alleviated taxes for vineyards and thus intensely stimulated their restoration; restored vineyards were exempt from taxes for 10 years. Despite their later renovation, the vineyards never again covered an area as large as they did in the mid-nineteenth century (Titl 1965; Ažman Momirski and Gabrovec 2014).

Over the past two centuries, the territory of what is now Slovenia belonged to various states with various sociopolitical systems, which, in addition to technological development, had a significant impact on land-use changes. Due to agrarian overpopulation, the second half of the nineteenth century was characterized by farming intensification and an increase in the share of fields (albeit not that significant). Despite industrialization and the development of transport, land use did not change significantly during the second half of the nineteenth century (Petek 2005). The most intense

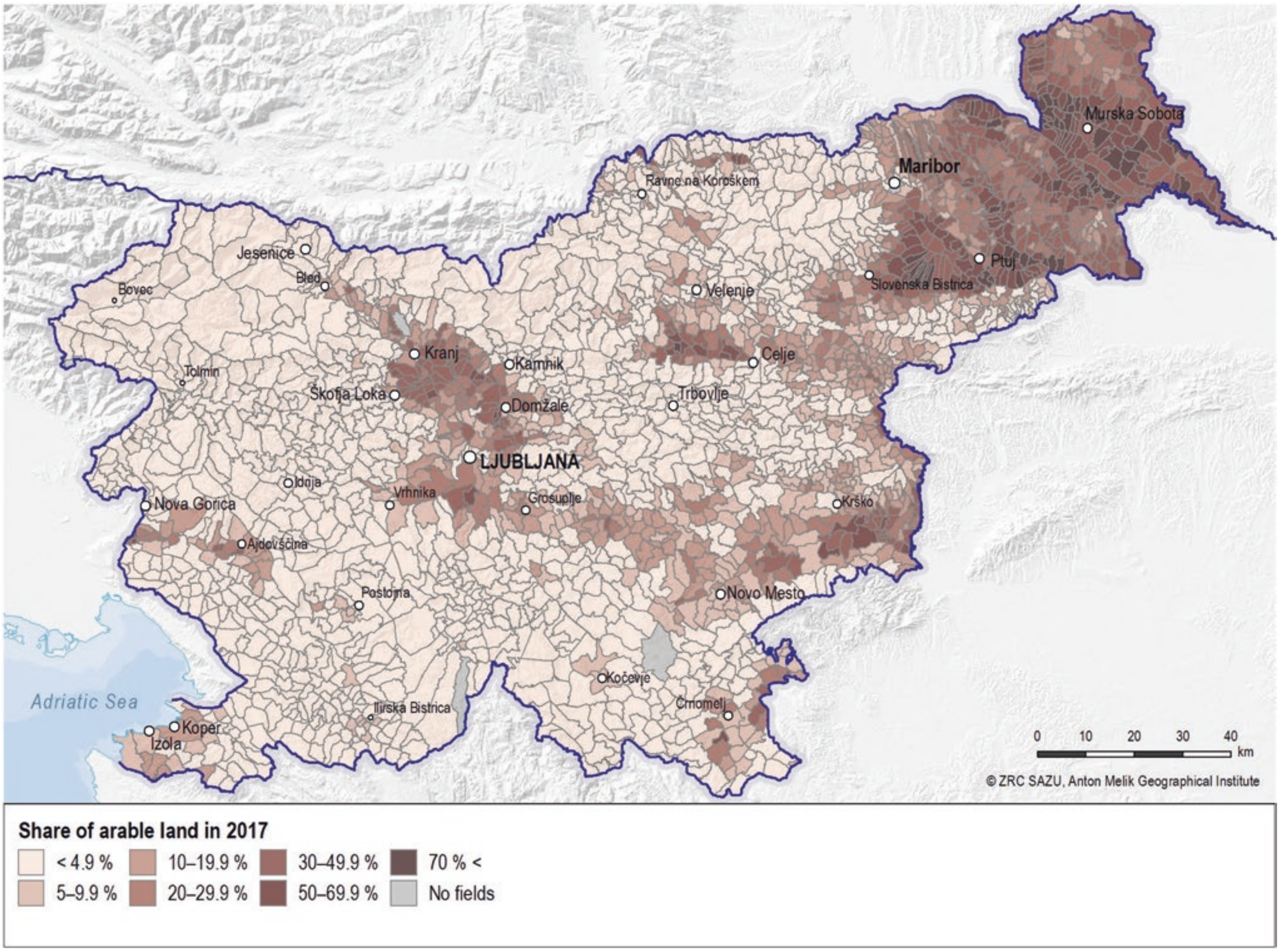

Fig. 18.2 Share of arable land in 2017. (Source: Land Use Data Base, Ministry of Agriculture, Forestry and Food of the Republic of Slovenia)

land-use changes occurred in the second half of the twentieth century. From 1945 to 1990, when Slovenia was part of the former Yugoslavia, the development of agriculture differed significantly from other central European countries. In contrast to most other communist countries, only a small share of Slovenian farmland was subjected to nationalization, and the share of private land remained above 85%. However, because a maximum of 10 ha of cultivated land (20 ha in hilly regions) and 15 ha of forest was imposed, land fragmentation continued to be a problem, preventing economical farming. Therefore, most members of rural households also worked in industry (Jepsen et al. 2015). With Slovenia's entry into the European Union and a uniform European agricultural policy, during the twenty-first century, the factors influencing land-use change are again comparable to those in other Central European countries. Nonetheless, Slovenia stands out with its land fragmentation, dispersed settlement, and small share of urban population.

In individual cadastral municipalities, changes in specific land-use types occur in different shares of their total area. The predominant process is presented on the map of typology of land-use changes (Fig. 18.5), which was produced based on Medved's methodology (1970). He distinguished between the following four main processes: afforestation, grass overgrowth, urbanization, and intensification. Considering the increase in the area covered by forests during the period studied, it is obvious that afforestation is the predominant process. Pannonian landscapes in Eastern Slovenia are more diverse. Grass overgrowth predominates in the lower hills, and intensification dominates in the plains. Strong urbanization is typical primarily along the Adriatic coast, in Ljubljana Basin, in the Lower Savinja Valley, and in Maribor and its surroundings (Gabrovec and Kumer 2019).

18.4 "Forest Transition"

Forests cover more than 60% of Slovenia's territory. The theory of forest transition, proposed by Mather (1992), is characterized by the change from shrinkage to expansion of forest. This process has occurred in most of the developed world (Mather and Needle 1998) including the territory of

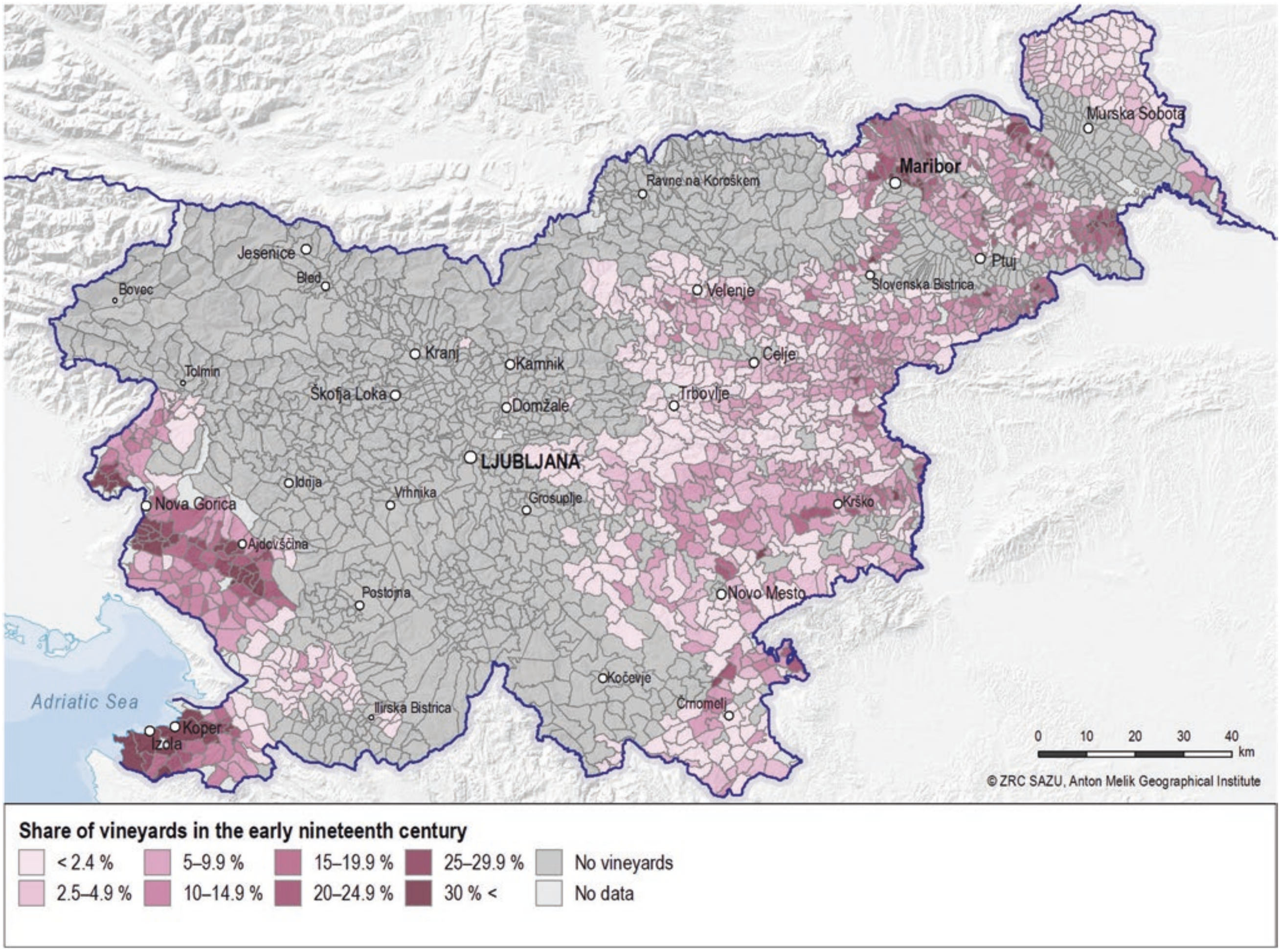

Fig. 18.3 Share of vineyards in the early nineteenth century. (Source: Franciscean Cadaster)

present-day Slovenia. Andrič (2004) found that after the last ice age, the vegetation in what is now Slovenia went through three major changes. The first change took place when a warm period occurred after the ice age some 11,000 years ago. The second change occurred some 9000 years ago after the climate changed (presumably due to an increase in precipitation), and the first anthropogenic effects were identified. Beech and fir became the prevailing species. This change led to differences between regions in forest types. The third change in forest type occurred in the second half of the Holocene due to growing human influence on land use as well as change in the paleoclimate. The share of oak increased and the share of beech and fir decreased.

In prehistory, forest use was limited to hunting and gathering. One can speak of a genuine cultural region only at the end of the Bronze Age and the transition into the Iron Age (Ciglenečki et al. 1998). At that time, forests were felled to build settlements and produce metal, especially iron. The Romans built roads, along which they cleared forests, and they developed timber transport on these roads as well as on the rivers and sea. With the emergence of more productive farming, the forests were used for extensive livestock grazing, or they were burned to create arable land in clearings (Mihelič 2008).

People began extensively clearing forests during the tenth-century colonization of the lowlands, when the increase in population resulted in a lack of arable land. During the thirteenth century, colonists began clearing forests at higher elevations. Compared to fields, forests were considered of lower value, and so they shrank to half of their original size (Müllner 1902; Blaznik et al. 1970; Mihelič 2008). Forests were initially cleared to create agricultural land because clearings generated more income than wooded land. With the development of mining and ironworking, wood became an important energy resource.

According to some sources, forests covered the smallest area in the eighteenth and nineteenth centuries (Petek 2005). Since then, areas covered by forest have grown continuously (Fig. 18.6): from 39% in the first half of the nineteenth century to a full 61% in 2015. The increased share of forests in the hills and mountains of the Alpine macro-region is connected with the abandonment of farmland and old-field

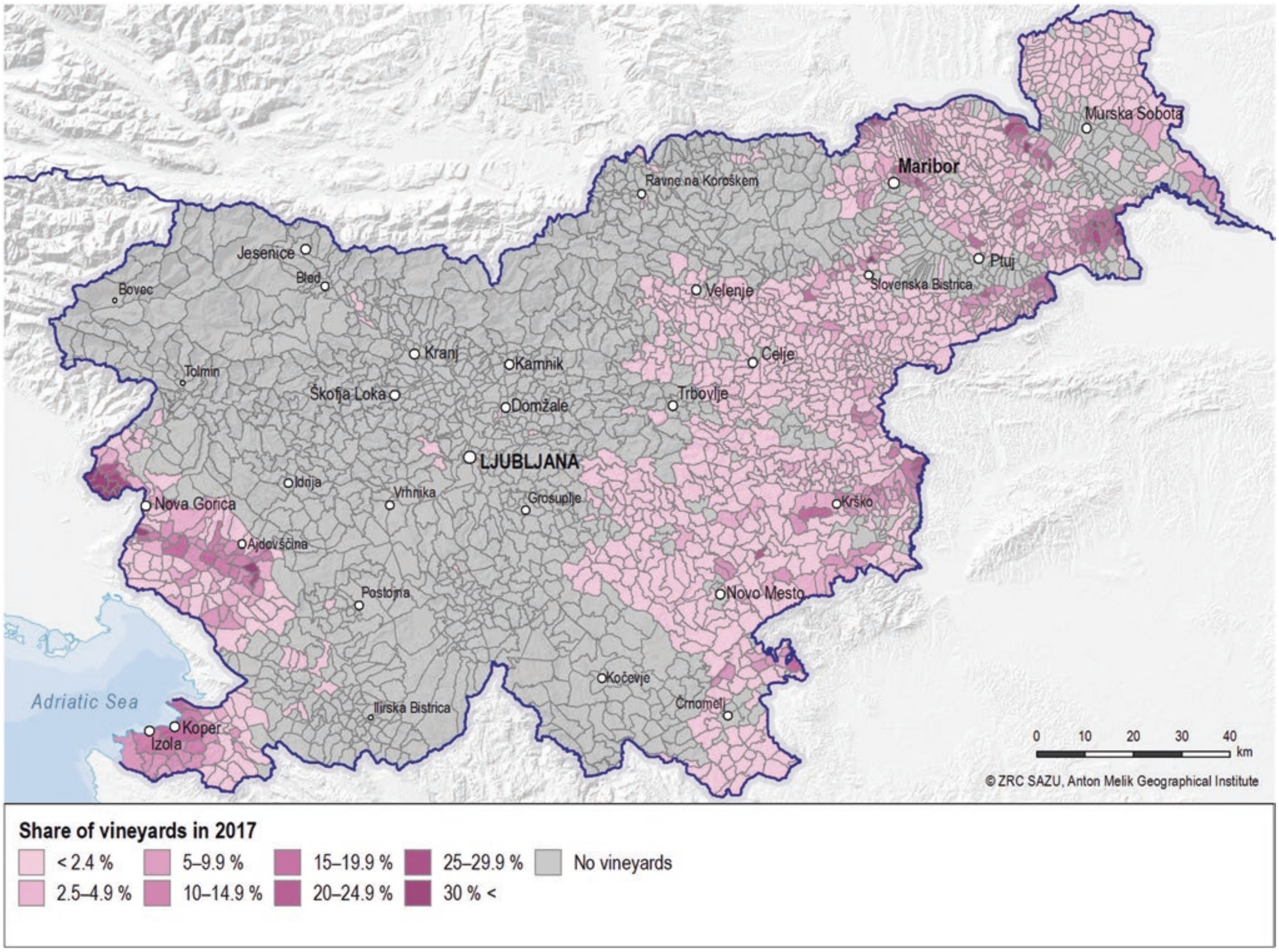

Fig. 18.4 Share of vineyards in 2017. (Source: Land Use Data Base, Ministry of Agriculture, Forestry and Food of the Republic of Slovenia)

succession (Gabrovec and Kumer 2019). The Franciscean Cadaster shows that among all Slovenian regions, natural forest vegetation was cleared the most on the Kras Plateau in southwest Slovenia (Fig. 18.6). Today forest covers more than half of the Kras Plateau, which is the result of planned reforestation at the end of the nineteenth century (Kladnik et al. 2008; Zorn et al. 2015) and abandonment of farmland in the twentieth century.

18.5 Bela krajina (White Carniola)

The European Union has defined types of landscapes with natural limitations for agriculture. With its karst relief (part of the Dinaric karst), Bela krajina, a region in southeast Slovenia, is a typical example of such a landscape. Generally, agriculture in these landscapes does not provide a sufficient income, there is a lack of jobs in nonagricultural industries, and these areas have poor connections to administrative centers and service activities cease (Cunder 2001). Due to these unfavorable economic and social conditions, people move away from the region. Consequently these areas are being abandoned, overgrown with grass, and later afforested. Karst conditions are a very important limiting factor for agriculture in Slovenia, where more than 44% of the country has a karst character. Ciglič et al. (2012) have identified the limiting factors due to karst terrain as fine terrain dissection, primarily with dolines; a lack of surface water due to rapid drainage through karst rock; discontinuous, rocky, shallow, and loamy soil of uneven depth and with frequent protruding rocky outcrops; and dispersion of small plots of agricultural land, hampering mechanical cultivation and use of modern agricultural methods. As a result of the karst landscape features, cultivation in Bela krajina is connected to great investments in land improvement, commonly by clearing loose stone. The natural conditions do not permit the development of intensive agriculture in the region, and the most favorable natural conditions for agriculture are limited to a narrow belt along the Kolpa River (Plut et al. 1984). In addition to this area, cultivated fields are commonly located at the bottom of dolines. The spatial processes and patterns across temporal and spatial scales to reveal the landscape

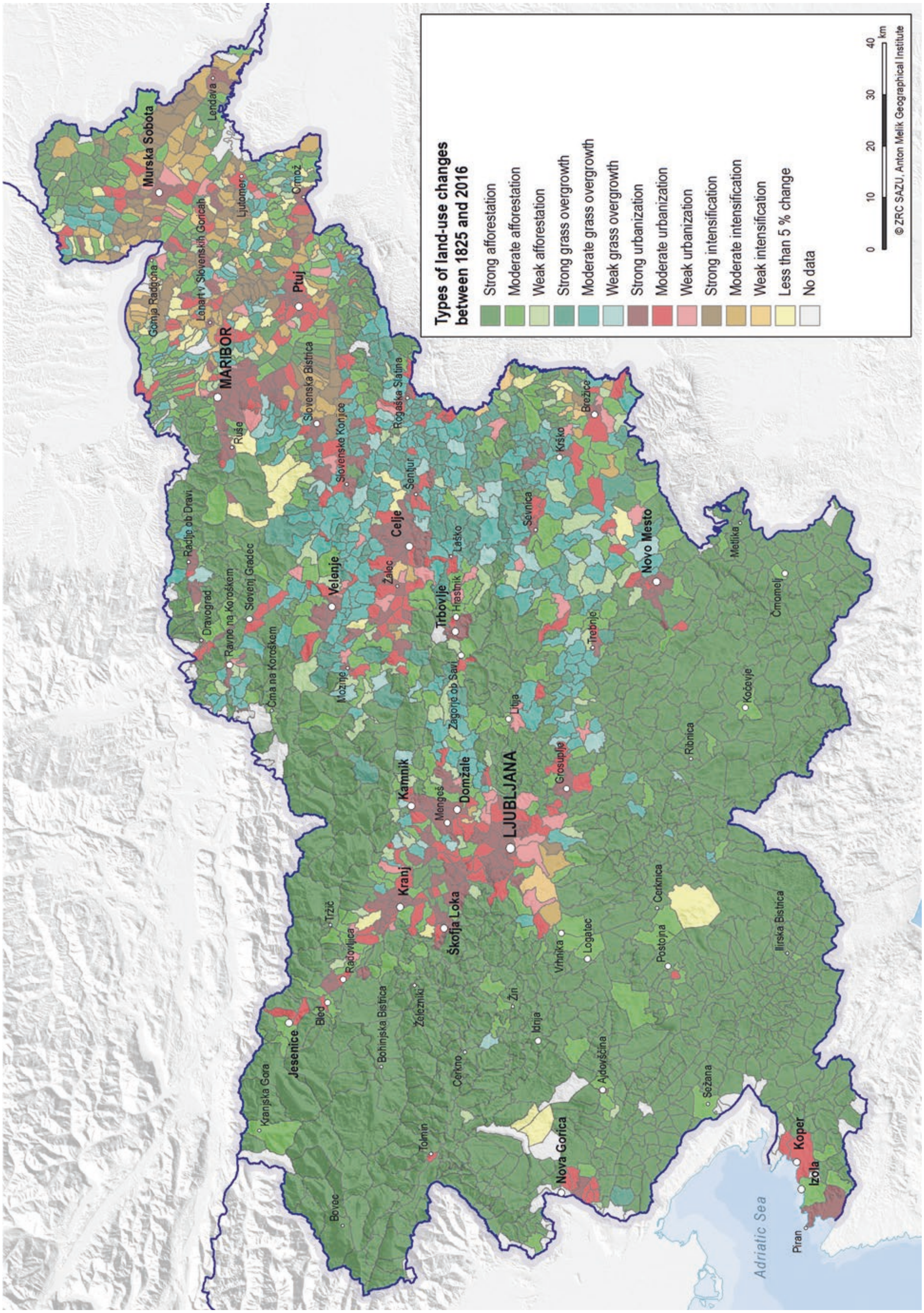

Fig. 18.5 Types of land-use changes between 1825 and 2016

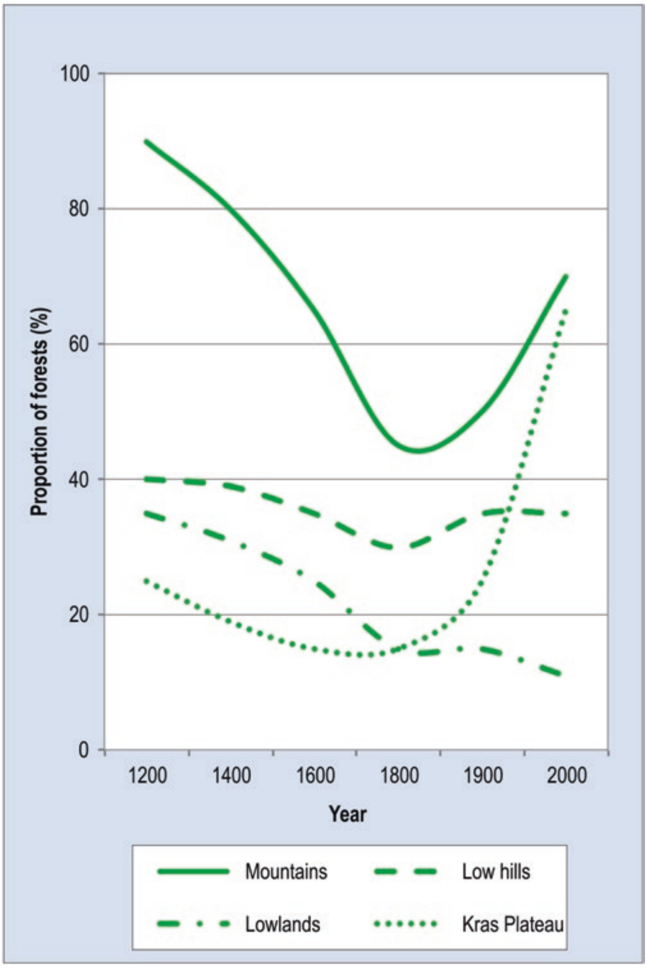

Fig. 18.6 Estimated changes in the share of forests on some types of relief and on the Kras Plateau, shown by trend lines. (Gabrovec et al. 2012)

changes are shown in a case study of the village of Bojanci (Fig. 18.7). For a variety of reasons, emigration from this area was common. As a result of out-migration, the population continuously declined (Dražumerič 1987), with a consequent increase in land abandonment. Today the region is grappling with significant social challenges, resulting in the loss of cultural traditions and practices that influence the landscape structure (Ribeiro 2017).

Studying land-use changes shows that the spread of forests is a general phenomenon (Fig. 18.7). The major landscape changes took place between 1860 and 1987 (Ribeiro 2017).

Because the peak of out-migration from Bela Krajina was between 1912 and 1927, it was expected that the scale of land abandonment also peaked in this period. In 1830, grasslands dominated in Bojanci; this land use significantly increased until 1860. After this, the share of grassland decreased due to the increase in forests. Cultivated fields showed a dramatic decrease from 1830 to 2012, although this change is more evident from 1860 to 1987; during this period gardens also decreased. The changes in cultivated fields are closely related to demographic changes. The slight increase in these areas between 1830 and 1860 was accompanied by a population increase in Bojanci for the same period. The pronounced decline in cultivated fields between 1860 and 1987 is parallel to a pronounced decline in population due to emigration, continuing to 2012. From 1987 to 2012, forests and overgrown areas continued to increase, whereas grasslands and cultivated fields continued to decrease. These data show how population decline influences land-use changes (Ribeiro 2017).

18.6 Ljubljana Marsh

Ljubljana Marsh in Central Slovenia was once the southernmost raised bog in Europe. In contrast to Bela krajina, mentioned above, the marsh is characterized by farming intensification and urbanization. As part of efforts to make Ljubljana Marsh the granary of the Habsburg Monarchy, in the early nineteenth century, drainage projects were begun. After almost 200 years of drainage, an area of approximately 160 km^2 became the largest complex of wetland meadows in Slovenia. Due to its exceptional biotic diversity, in 2008 a major part of the area was proclaimed a protected landscape area. The village of Črna vas was one of the last settlements colonized in the marsh and in Slovenia as a whole. The area of what was previously wet pastures began to be settled in 1830. The settlement was planned along the road with drainage canals to the left and right, and behind them houses, farms, fields, and meadows (Melik 1927). Frequent floods—a problem that has never been entirely solved in this region—forced the residents to switch to animal husbandry. Building dwellings on wooden foundation piles was a way of adapting to frequent floods. Because the marsh-dwellers mostly did not own any forest, they made the support piles from alders obtained from hedges that the original settlers had planted along the canals (Melik 1927). Together with the trenches and land parcellation, the hedges created a mosaic landscape (Fig. 18.8).

By 1870, the area was already dominated by cultivated fields, meadows, and canals, although there were still some lower-quality forests and peatland left. The following decades saw intensive peat extraction, which lowered the land's surface and radically changed the landscape. The once extensive areas of wet pastures were broken up into fragments and significantly reduced in size, and new houses, fields, canals, and roads were built on them. With technological development, farming in Črna vas increasingly intensified (Šmid Hribar 2016).

Around 1900, the area was dominated by medium-intensive meadows, with considerably fewer cultivated fields and rare

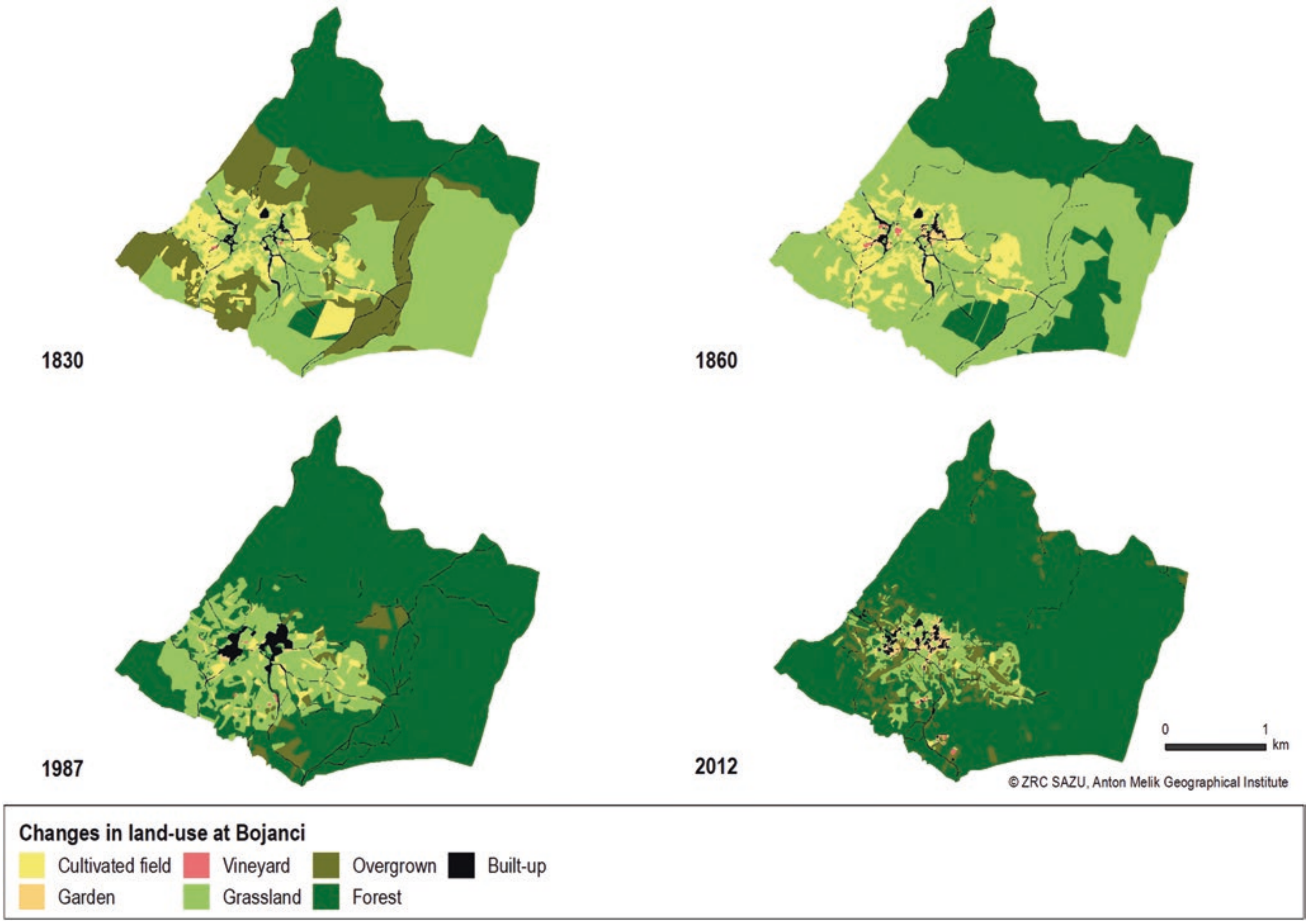

Fig. 18.7 Changes in land-use categories at Bojanci from 1830 to 2012. (Ribeiro 2017)

woods. The region continues to be characterized by modest arable farming (e.g., corn) and animal husbandry (e.g., horses and donkeys), and there are hardly any proper farmers left. The locals, who largely commute to Ljubljana for work, engage in plot gardening and some also in market gardening, different services, and transportation. Despite land-use intensification, in 2013 the area also included abandoned land, which is quickly becoming overgrown and difficult to traverse. In turn, the share of urbanized areas has increased significantly because, being only a few kilometers away from Ljubljana, Črna vas has become attractive for new residents. Construction of a second row of houses was approved, although this deviated from the originally planned layout mentioned above. Rather than renovating old houses, the newcomers have built new ones on the meadows and green areas within the settlement. Some of them are cutting down the hedges, and new ones are usually no longer planted. All of this is changing the character of the settlement and increasing the risk of floods (Zorn and Šmid Hribar 2012; Šmid Hribar 2016).

18.7 Land Use in Slovenia Today

Slovenia's present land use is the result of the factors and processes described above (Fig. 18.9). Concentrations of individual land-use types are clearly visible. Fields predominate in the Pannonian plains, whereas in the Alpine plains, their share is smaller. The largest concentration of vineyards is typical of the Gorica Hills in Mediterranean Slovenia, followed by individual locations in the Pannonian low hills. Orchards and olive groves only rarely cover large contiguous areas. The largest shares of meadows can be found in the Alpine valleys, Dinaric lowlands, and hills of eastern Slovenia. A high share of forests is typical of the Dinaric plateaus and Alpine mountains. The largest concentration of built-up land can, understandably, be found in Ljubljana and the surrounding area, on the coast, and in regional centers.

Fig. 18.8 The landscape of the Ljubljana Marsh is largely composed of various meadows, fields, pastures, canals, hedges, tall herb communities, shrubs, and thickets. The Ljubljanica River gives the marsh its key character. (Photo by Viktor Šmid)

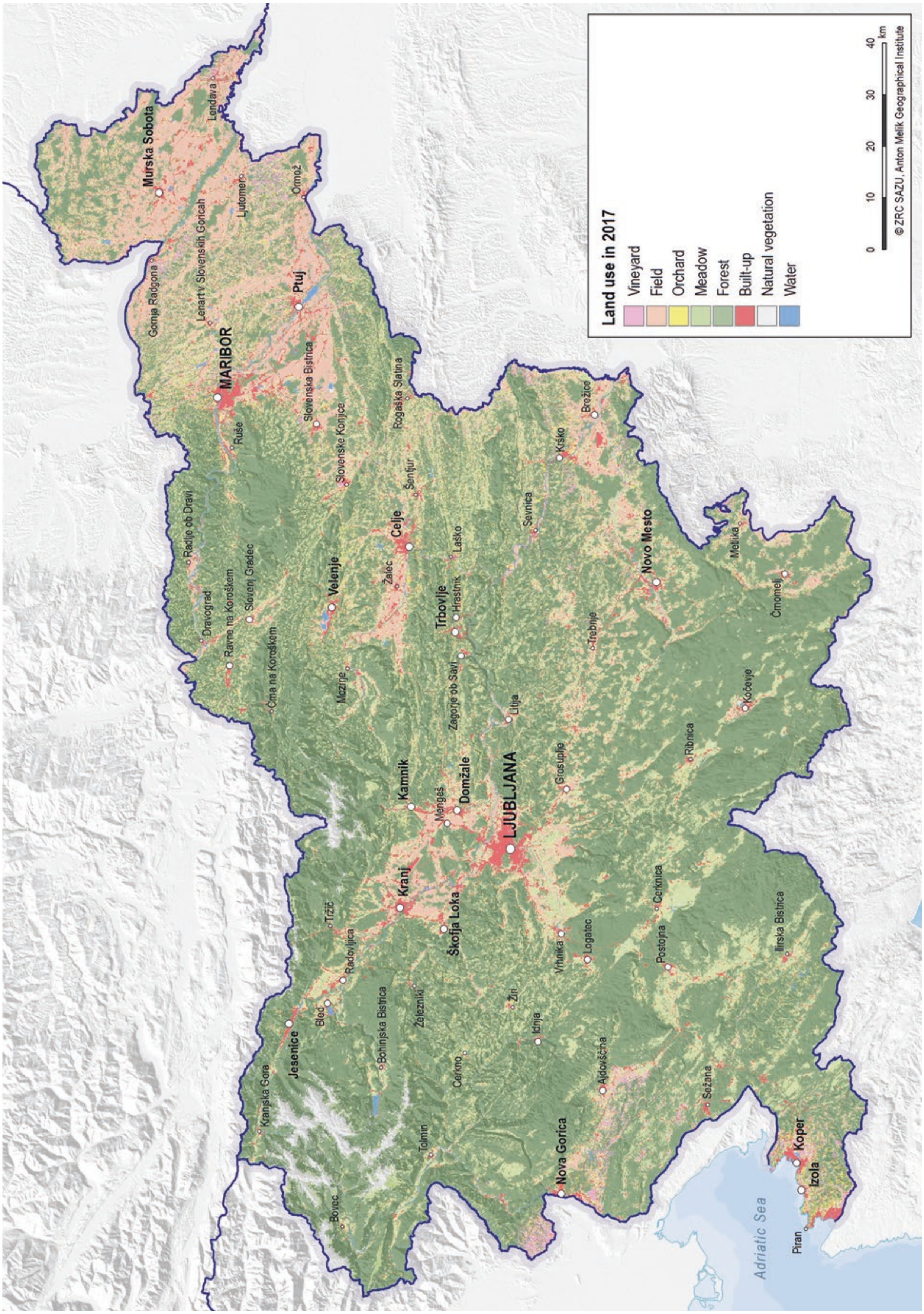

Fig. 18.9 Land use in 2017. (Source: Land Use Data Base, Ministry of Agriculture, Forestry and Food of the Republic of Slovenia)

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19 Regional Development in Slovenia

Janez Nared

Abstract

This chapter describes the current status of Slovenia's regional development, focusing on both regional and municipal development. The data show large regional differences, with less-developed regions in Eastern Slovenia and more developed ones in Western Slovenia. The chapter also presents the history of Slovenian regional policy, which has gone through three stages since 1971: a period of promoting the development of less-developed areas until 1990, a period of promoting the development of demographically threatened areas until 1999, and a period of endogenous regional policy after 1999. Despite the regional differences identified and its relatively early introduction, regional policy has had limited success due to limited funds, which is manifested in the fact that the status of less-developed areas is largely held by one and the same areas. An important factor rendering regional policy less effective is also the absence of administrative regions, with individual municipalities tailoring the regional policy to their own needs. On the one hand, this has reduced the value of regional policy, but on the other it has also contributed to better infrastructure in individual municipalities.

Keywords

Regional planning · Regional policy · Local development · Intermunicipal cooperation

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19.1 Territorial Division

Territorially and institutionally, the Slovenian administrative system has two levels of administration: national and local. National institutions, such as the cabinet, ministries, government offices, agencies, and public institutes, are mostly located in Ljubljana, and individual regional units operate at the lower levels (e.g., branch offices of the Institute for the Protection of Cultural Heritage, the surveying and mapping authorities, and tax offices). National administration also offers its services through 58 administrative units, providing better access to services related to internal affairs (e.g., personal IDs, residence permits, matters related to public order, foreign nationals, and vital records), transport (e.g., vehicle registration and driver's licenses), construction and other spatial development (e.g., building and operating permits), agriculture (e.g., sales of farmland, registration as farmers, and protected farms), denationalization, and so on.

Matters of local importance are handled by 212 municipalities, which vary significantly in terms of size, population, and economic power. The smallest municipality has a population of less than 400, and the largest, the City of Ljubljana, has a population of approximately 290,000. Eleven of them are urban municipalities and have certain additional powers compared to other municipalities (e.g., to manage the urban transport system and prepare sustainable urban strategies).

The differences between municipalities and the absence of an intermediate regional level are causing problems in carrying out individual tasks of regional importance, such as public transport, spatial planning, waste management, and natural disasters. Some tasks are too small to be carried out at the national level but also too large for the municipalities to carry out by themselves. Effective implementation of more demanding tasks represents a problem for smaller municipalities in particular (Prebilič and Haček 2012) because they have to deal with insufficient staff and funds, and they are weak compared to the national level.

© Springer Nature Switzerland AG 2020
D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_19

There have been several attempts to introduce administrative regions since 1999, but they have all failed due to different ideas about their number, size, and powers.

Twelve development regions (at the NUTS3 level) have been established in Slovenia for implementing its regional policy, and another two (at the NUTS2 level) were established for implementing the EU cohesion policy (i.e., Vzhodna Slovenija (Eastern Slovenia) and Zahodna Slovenija (Western Slovenia)). The following bodies operate at the level of development regions: a regional council composed predominantly of the mayors of all of the municipalities in that region; a development regional council composed of representatives of the municipalities, the business world, and the non-government sector; a regional development network, which combines the key development institutions in the region on a contract basis; and a regional development agency, which performs general development tasks in the region and prepares a regional development program for every program period. A development council of the cohesion region operates at the level of cohesion regions.

Even though none of the Slovenian national governments succeeded in establishing a system of administrative regions and despite the problems identified in smaller municipalities (cf. Nared 2004), the number of municipalities continued to increase after 1991. When Slovenia gained independence in 1991, it had 62 municipalities. The number grew to 147 by 1994 and 192 by 1998. In 2002, 2005 and 2006, an additional 12 municipalities were created and another 2 in 2011. Hence, today Slovenia includes a total of 212 municipalities. Recently, this process of municipality fragmentation has slowed down somewhat, but the local level remains an important development factor because a fair share of powers has been transferred to it. Because small municipalities are relatively weak, this also stimulated strong centralization, reflected in the increasingly greater role of Ljubljana and the Osrednjeslovenska Statistical Region.

19.2 Regional Development and Regional Policy

The analysis of spatial differences according to selected factors of economic growth (Nared 2009) indicated the great development diversity of Slovenia's municipalities and regions, which for several decades has been visible in certain areas of concentration where the majority of the population, jobs, business, and industry is located, as well as in extensive areas marked by less development, sparse settlement, and weak development potential. These areas are predominantly located on the margins of the country, far from development cores, and they have little hope for a development breakthrough due to their poor demographic and economic structure and limited infrastructure.

The development of Slovenian municipalities and regions has been explored by many researchers (Kušar 2007, 2016, 2017; Nared 2002, 2007; Pečar 1999, 2008, 2017; Ravbar 1999, 2014), who used various analysis perspectives and methodologies. Regardless of whether the level of development is studied at the municipal or regional level, Slovenia is characterized by large developmental differences, whereby the differences within regions or between municipalities are greater than between regions (Pečar 1999; Bole 2011).

Regional development analysis relied on the development risk index, and it was complemented with other indicators and research findings. The development risk index of individual regions is calculated by the state and is used to define the level of co-funding regional projects. It is calculated as the arithmetic mean of the following development, threat, and development potential indices (Pravilnik … 2014): per capita GDP, gross value added per employee, gross fixed investment as percentage of GDP, registered unemployment rate for ages 15–29, employment-to-population ratio for ages 15–64, percentage of people with tertiary education for ages 25–64, gross domestic expenditure on R&D as percentage of GDP, percentage of at least secondary treated water in discharged wastewater, percentage of protected areas in the region, estimated damage due to natural disasters as percentage of GDP, registered unemployment rate, population aging index, disposable income per capita, and settlement.

The development risk index (Fig. 19.1) shows a lower level of development of the Pomurska and Zasavska regions and below-average development of the Primorsko-notranjska (Littoral–Inner Carniola), Podravska (Drava), Koroška (Carinthia), and Posavska (Lower Sava) regions. All of these regions belong to the Zahodna Slovenija cohesion region. Osrednjeslovenska (with the Slovenian capital of Ljubljana) is by far the most-developed region, followed by Jugovzhodna Slovenija (Southeast Slovenia) and Gorenjska (Upper Carniola).

Similar results are obtained if the level of development is determined based on GDP (SURS 2018a; Fig. 19.2). Osrednjeslovenska stands out, followed by the Obalno-kraška (Coastal–Karst), Jugovzhodna Slovenija, Goriška (Gorizia), Savinjska (Savinja), and Gorenjska statistical regions. The top six most-developed regions in 2016 remained the same and in the same order as in 2000, with only minor intermediate changes, but these changes were more frequent among the less-developed half of the regions. The main reason for this was the economic crisis that began in 2008 and was reflected in Slovenian regions in both a strong GDP decrease and high unemployment. Over the 8 years before the crisis, Slovenian GDP increased by 69% compared to 2000, and in the following 8 years, it only rose by 4.2% compared to 2008 after an initial decline.

According to Damijan (2018), during the first decade following the crisis, Slovenia lost a total of 60–133% of its

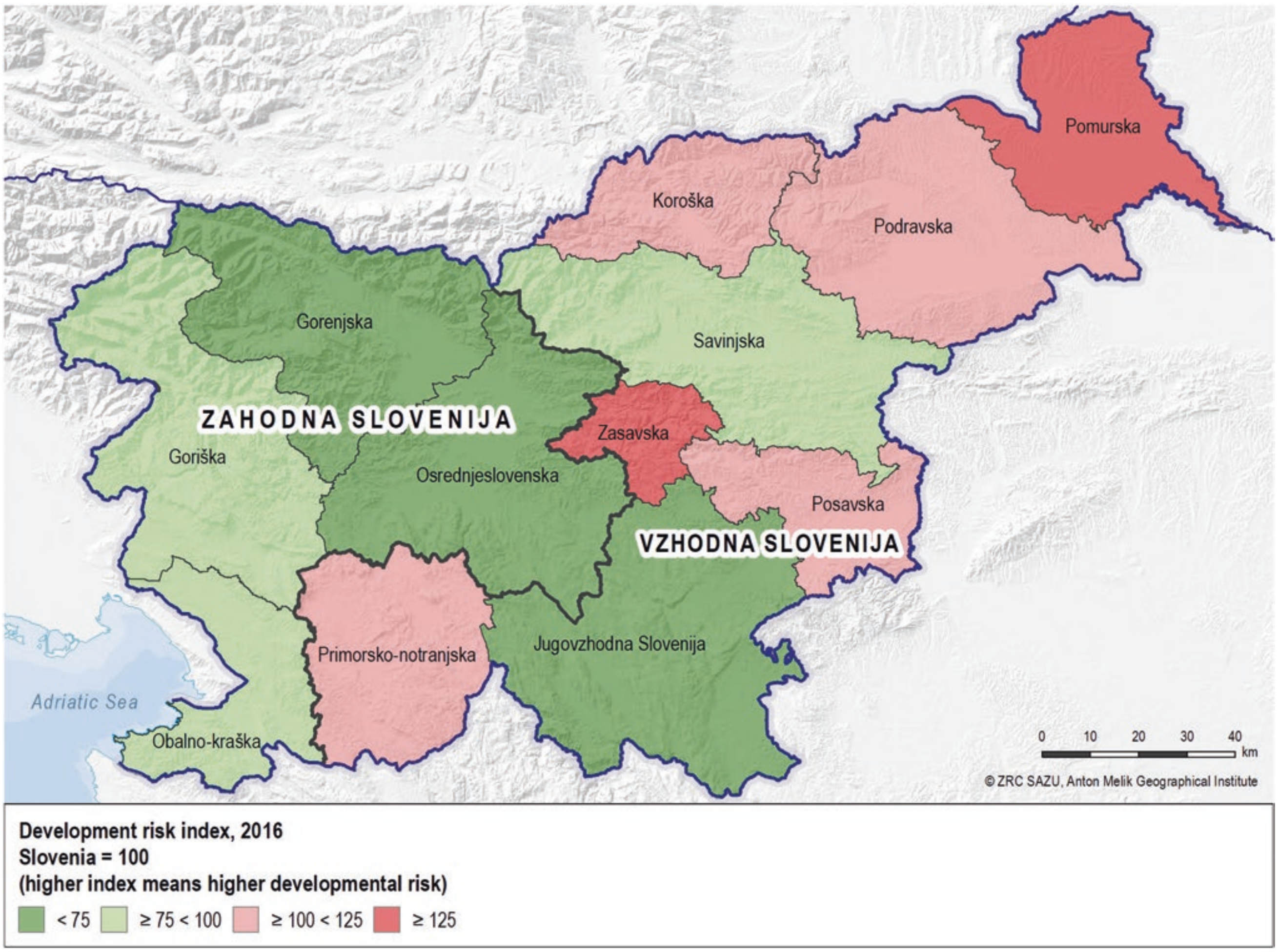

Fig. 19.1 Development risk index, 2016, Slovenia = 100. (Pečar 2017)

annual GDP (evaluated based on fixed prices from 2000, depending on the anticipated economic growth rate), which ranked it among the European countries most affected (Verbič et al. 2016). The consequences of the recession are also visible from the registered unemployment rate (SURS 2018b; Fig. 19.3).

The registered unemployment rate eased until 2008, after which it greatly worsened and then leveled off relatively late compared to other European countries. It first began easing in 2012, only to worsen again, before finally subsiding significantly in 2015. The differences in GDP and the number of unemployed are evident among the regions, but the majority follows a uniform trend. Brozzi et al. (2015) compared the resilience of Alpine regions and established that, in addition to special regional features, it is the responses at the level of national governments that greatly contribute to responses to a crisis, whereby Slovenian regions perform worse than regions in other Alpine countries. This could be compared to results of the ESPON group (Bristow et al. 2013), where huge differences among countries are also noticeable.

Good insight into regional differences is also provided by an analysis of the population's well-being (Pečar 2017; Fig. 19.4), which ranks Slovenian regions into four groups based on material well-being, quality of life, and subjective well-being indicators. The first group includes the Osrednjeslovenska (Central Slovenia), Gorenjska, and Goriška statistical regions, which are characterized by high indicator values in life satisfaction, income, civic engagement, access to services, and safety and are the weakest in terms of social capital, especially the Goriška Statistical Region.

The second group comprises the Obalno-kraška and Primorsko-notranjska statistical regions, which score high especially in terms of income, life satisfaction, access to services, and safety. Their status is also favorable in terms of jobs, whereas their subjective well-being indicators are less favorable (Pečar 2017).

The third group, which is also the largest and most heterogeneous among the four, includes the Podravska, Savinjska, Koroška, Jugovzhodna Slovenija, and Zasavska (Central Sava) statistical regions, and the fourth group includes the Posavska and the Pomurska statistical regions. The indicator

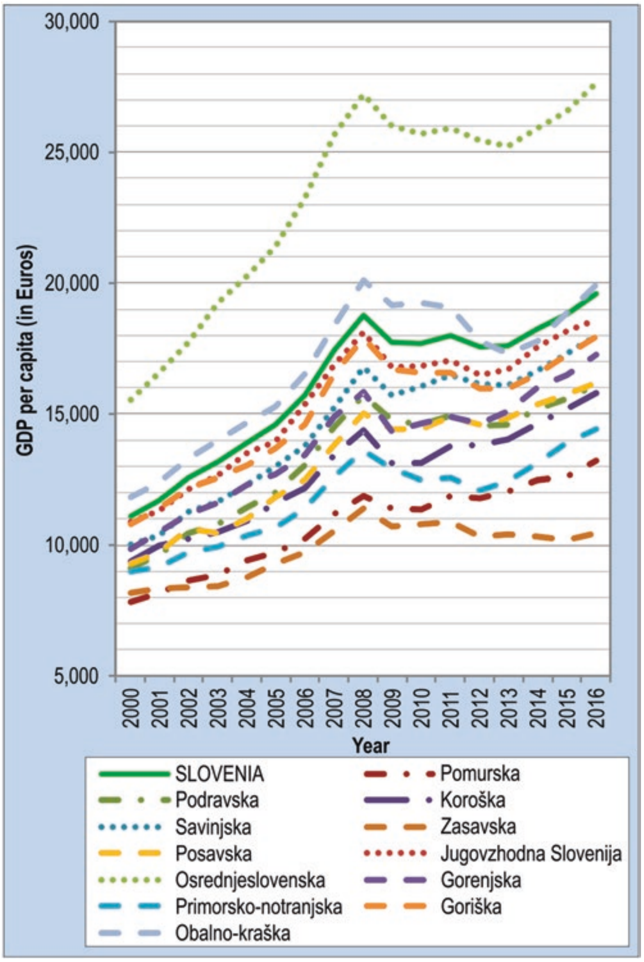

Fig. 19.2 GDP per capita between 2000 and 2016

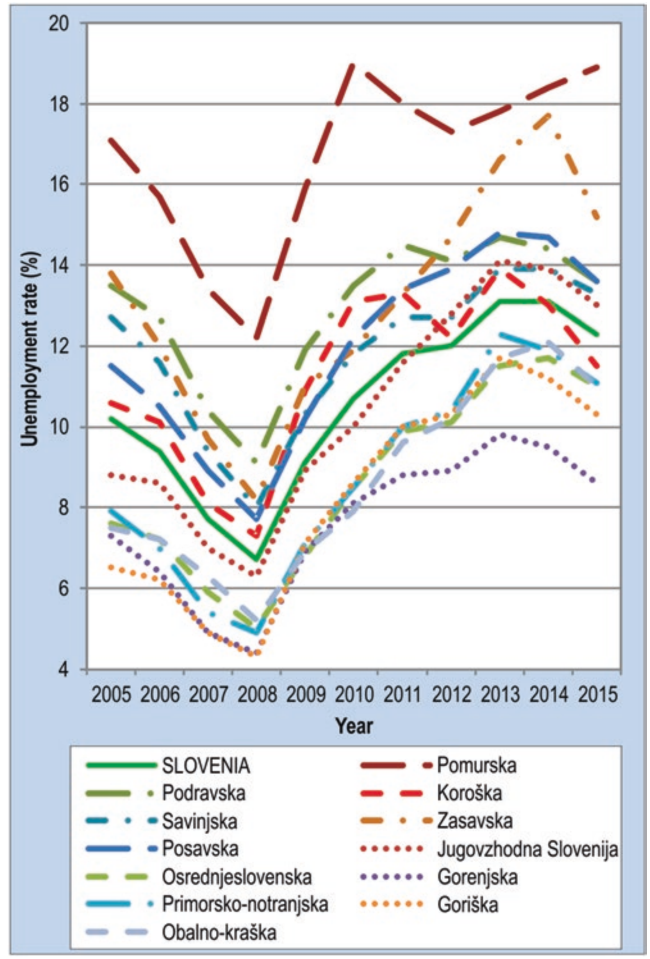

Fig. 19.3 Registered unemployment rate by region of permanent residence between 2005 and 2015

values in the Posavska Statistical Region are among the lowest, whereas the Pomurska (Mura) Statistical Region shows favorable results in certain areas (e.g., housing and access to services and social capital) and scores the lowest in others (e.g., income, jobs, employee education, and civic engagement; Pečar 2017).

As established further by Pečar (2017), the population well-being status is not entirely consistent with the regional development risk index. Major deviations are typical especially of the Jugovzhodna Slovenija Statistical Region, where the regional well-being indicator is lower than the development risk index. In turn, the Primorsko-notranjska Statistical Region ranks higher in terms of regional well-being than one would expect based on its development risk.

The repeatedly identified regional differences also present a great challenge for politicians, which has been highlighted by individual authors from the 1960s onward. Hence in 1971, the Promotion of Less-Developed Areas Act (Zakon o ukrepih … 1971) was adopted to define individual economically underdeveloped areas and to develop instruments that could level out the living and working conditions across all of Slovenia. Eleven municipalities were ascribed the status of an underdeveloped area and provided with financial aid to build infrastructure important for the economic and social development of the area. Tax relief and favorable borrowing conditions were used to encourage investment in developmentally important infrastructure. Expert and technical assistance was also available for drafting investment and developmental programs and for implementing measures to promote agriculture (Nared 2003, 2007). Investment resulted in an increased number of places with factories and a more diverse economic structure, which contributed to faster employment growth in areas that were receiving the aid. In addition, the economic and social infrastructure in these areas also improved (Drozg and Premzl 1999; Kukar 1995, 1997; Nared 2003, 2007; Ravbar 1999; Ravbar et al. 2000; Vrišer 1978, 1999).

In 1975, the law was amended, expanding the range of indicators used for defining underdeveloped areas. The indicators were defined based on economic development, demographic features, standard of living, and available

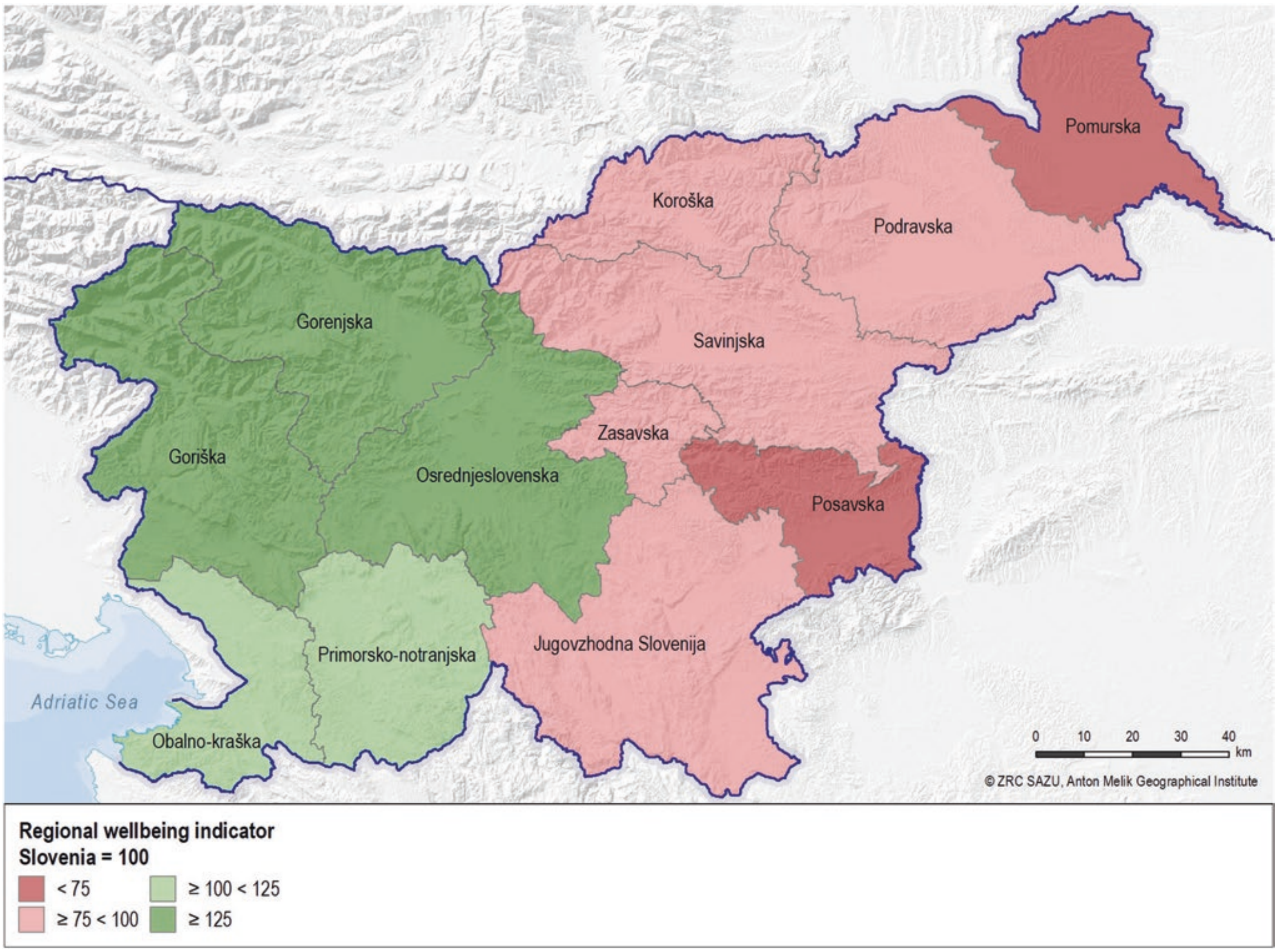

Fig. 19.4 Slovenian statistical regions in terms of the well-being indicator. (Pečar 2017)

infrastructure. In addition to individual municipalities, underdeveloped areas also included larger contiguous geographical areas that met the required criteria. The measures taken contributed to these areas no longer lagging so much behind the developed areas and to their faster GDP growth and employment. New jobs were opening up, and these areas were also catching up in some areas of economic and social infrastructure (Drozg and Premzl 1999; Kukar 1995, 1997; Nared 2003, 2007; Ravbar 1999; Ravbar et al. 2000; Vrišer 1978, 1999).

The 1980–1981 amendments to the law (Zakon o pospeševanju … 1980) reduced the criteria to the development of productive forces, the effects of these forces, and the development of standard of living. An important change was also the introduction of 3-year transition periods for the underdeveloped municipalities and areas that after the expiry of the medium-term planning period no longer met the required criteria. Moreover, by providing new jobs and improving the economic structure and the municipal, economic, and social infrastructure, the incentives contributed to faster employment growth in underdeveloped areas (Drozg and Premzl 1999; Kukar 1995, 1997; Nared 2003, 2007; Ravbar 1999; Ravbar et al. 2000; Vrišer 1978, 1999).

Despite the regional policy measures, regional differences remained and increased even further, especially when some regional centers fell into a structural crisis. Demographic changes also became a development factor, partly because of rural flight and partly because of increasing population aging. Therefore, the Act Promoting the Development of Demographically Threatened Areas in the Republic of Slovenia was adopted in 1990 (Zakon o spodbujanju … 1990), omitting economic criteria in defining the problem areas and instead relying fully on demographic indicators. Local communities were the basic spatial units used in defining demographically threatened areas, and, after their status changed through the Establishment of Municipalities and Municipal Boundaries Act (Zakon o ustanovitvi … 1994), they were replaced by individual settlements.

In addition to the already established ones, regional policy instruments were expanded to also include promotion of economic investment, social protection measures, and measures in primary education, employee training, scholarship policy, culture, physical culture, and primary healthcare. In some areas, co-funding was also provided for the construction of company housing. Important achievements of this law include improved infrastructure, more jobs in demographically threatened areas, improved economic structure, better service provision, improved living standards, and a partial halt of out-migration from demographically threatened areas; however, here too, due to the large extent of demographically threatened areas and dispersed investment, investment only mitigated the negative effects on development (Nared 2003). The law's weaknesses also showed during transition to the market economy, when the regional policy based on demographic indicators was unable to help areas that experienced a severe economic decline due to the loss of Yugoslav markets (Nared 2007).

Hence, at the end of the 1990s, a reform of the regional policy finally took place, when, in order to establish partnership and transfer powers to regions, a new institutional structure was put in place through the adoption of the Promotion of Balanced Regional Development Act (Zakon o spodbujanju … 1999). The National Agency for Regional Development was established at the national level, and regional development agencies were set up at the regional level. A regional development program was prepared for every region, defining its development needs, and a program based on the region's endogenous potentials. Funding was allocated for entrepreneurial investment, current company operations, economic restructuring, construction of entrepreneurial infrastructure, construction of local and regional infrastructure, drafting regional development programs, and staff training in implementing the regional structural policy. In addition, planning grew significantly stronger at the national level, which was reflected in the adoption of the Slovenian Regional Development Strategy (Strategija … 2001), the 2001–2006 National Development Program (Državni … 2002), and the Single Programming Document (Enotni … 2003).

The Slovenian Regional Development Strategy defined the regional development objectives and the instruments and policy for achieving them. Ensuring a high living standard and quality of health and the living environment for all Slovenian people in a manner that takes into account the sustainable use of resources, while using the regions' potentials to the best extent possible, became the starting point of regional development. This was expected to reduce regional differences and, at the same time, reduce Slovenia's development lag behind the EU average (Nared 2007).

As an implementing document of the Slovenian Economic Development Strategy (ZMAR 2000), an important role was also played by the National Development Program, whose goals included (similarly to the Slovenian Regional Development Strategy) reducing Slovenia's economic lag behind the EU average and stopping the increase in the differences between the Slovenian NUTS-2 regions. The same goals were also adopted by the Single Programming Document, which was intended for obtaining funds from EU structural funds.

Regional policy measures were implemented across all Slovenian territory, but economically weaker areas, areas with structural problems and high unemployment, developmentally limited border areas, and areas with limited factors were nonetheless given priority in allocating financial aid (Nared 2007).

Initial regional development programs were not based on real financial frameworks and usually exceeded the region's or state's financial capacity. With this law, too, certain problems began to show very early on arising from the ambiguous text formulation or certain solutions that were not necessarily the best and whereby the legislators wanted to substitute for the role of the nonexistent regional level (e.g., mandatory approval of regional development programs by all of the region's municipal councils). In October 2005, a new Promotion of Balanced Regional Development Act (Zakon o spodbujanju … 2005) was adopted, redefining the objectives, principles, and organization of balanced regional development promotion and ascribing the responsibility for development to the state and the self-governing local communities. It redefines a development region as a functional territorial unit that is used for implementing regional policy and comprises a homogenous settlement, economic, infrastructural, and natural contiguous whole. Based on the principle of partnership, this law seeks to include as many development actors as possible in the development efforts and to connect them; these actors include municipalities and associations of municipalities, business associations, trade unions, non-governmental organizations, and other partners at the level of development regions that fulfill their interests via the regional development councils (Nared 2007).

While drafting regional programs in the past, problems occurred in connection with approving programs at individual municipal councils, and so the new law envisages the formation of a regional council as the decision-making body at the regional level and a regional development council as a coordinating body for regional policy implementation at the regional level.

The law also reformed the organizational structure at the national level by dissolving the Slovenian Public Agency for Regional Development and delegated development tasks to the bodies in charge of regional development (either a government office of a sector within a specific ministry).

The Operational Program for Promoting Regional Development Potential was prepared for the 2007–2013 program period. Of a total of €1.7 billion in EU funds envisaged to be spent on the operational program, €586 million was allocated to implementing regional development programs for 12 development regions, whereby funds were allocated based on the development risk index. Funds were primarily invested in developing and increasing local and regional potentials (i.e., regional competitiveness factors), of which a full 88% of funds were invested in construction and equipment (Kavaš 2014).

The economic crisis was another major challenge for the regional policy. It manifested itself in all regions in the form of reduced economic activity and higher unemployment. Unemployment was especially high in the Pomurska Statistical Region, which was affected by the bankruptcy of the Mura textile company as a major employer for the entire region. The response to the difficult economic situation in the region was the adoption of the 2010–2019 Development Support for the Pomurje Region Act (Zakon o razvojni … 2009), but it turned out that adopting special development acts made no sense because other regions were facing similar problems and so a systemic solution had to be found. Hence 2011 saw the adoption of a new Promotion of Balanced Regional Development Act (Zakon o spodbujanju … 2011), which was later amended twice. Areas with more than 17% unemployment were defined as problem areas with high unemployment—that is, Maribor and the surrounding area, the Kolpa Valley, and the municipalities of Hrastnik, Radeče, and Trbovlje.

Regional development councils, whose main task is to coordinate development initiatives and interests in the region, were reestablished. They are composed of the representatives of municipalities, the business sector, and non-governmental organizations and adopt regional development programs, reach agreements connected with regional development, monitor the implementation of program documents, and cooperate with other regions. Because there is no administrative instance at the regional level, the amendments to the act again ascribed the role of approval to the regional council composed of the mayors of all the municipalities included. In addition, the legislators wanted all of the regional development agencies to remain under majority public ownership, which proved to be unrealistic over time.

The law also introduced a regional development network, which combines all key development institutions in the region on a contract basis.

The law retained regional development programs as strategic documents, whereby the plan was to expand them with a spatial perspective. A regional development agreement is concluded in order to implement them; in addition to regional projects, this agreement also includes national/sectoral projects in individual regions. Thereby regional policy has become strongly dependent on individual sectors, and it is implemented as a horizontal regional policy. Due to ambiguous project funding, this caused substantial delays in concluding regional development agreements and showed a need for reintroducing the regional development priority into the current operational program, which would provide new impetus for regional policy.

19.3 Local Development

An evident weakness in regional policy implementation was the absence of administrative regions, which is why there was no legal entity at the regional level that would have taken the responsibility for regional projects. Consequently, decision-making was left to the mayors, which resulted in the localization of regional policy (Nared 2018) or in predominantly local projects. On the one hand, this weakened regional policy, and, on the other, it provided important impetus to municipalities or the local level. Despite everything, the differences between municipalities are quite substantial and can be illustrated with the municipal development coefficient.

The municipal development coefficient (Določitev … 2018) is the arithmetic mean of the values of the following ten indicators: the income tax base per municipal resident, the number of jobs per working population, the gross value added per employee, the municipal population aging index, the registered unemployment rate in the municipality, the employment-to-population ratio in the municipality, the percentage of Natura 2000 sites in the municipality, the provision of goods and public utility services (percentage of residents with connections to the public sewage system), the population density of the municipality, and the cultural monuments and units of public cultural infrastructure per resident and per km^2 (average).

It is usually calculated for 2 years by taking into account the 3-year average of the indicators listed above (except for the indicators Natura 2000 sites and cultural monuments and units of public cultural infrastructure per resident and km^2).

Based on the calculation for 2018 (Fig. 19.5), the coefficient was 0.37 for the least-developed municipality (Hodoš) and 1.45 for the most-developed municipality (Trzin). In addition to the Municipality of Trzin, a coefficient of over 1.20 was calculated for the municipalities of Lukovica, Škofja Loka, Trebnje, Šempeter–Vrtojba, Šenčur, Cerklje na Gorenjskem, Grosuplje, Ljubljana, Mengeš, Žiri, Horjul, Ankaran, Novo Mesto, Komenda, and Domžale.

Half of the most-developed municipalities are located in the Osrednjeslovenska Statistical Region; four are located in Gorenjska, two in Jugovzhodna Slovenija, and one each in the Goriška and Obalno-kraška regions. More poorly developed municipalities are located in the border areas and the contiguous areas of southeast and southern Slovenia.

Over the past 10 years, the situation has become worse especially in the municipalities of the Pomurska Statistical Region; parts of the Jugovzhodna Slovenija, Obalno-kraška,

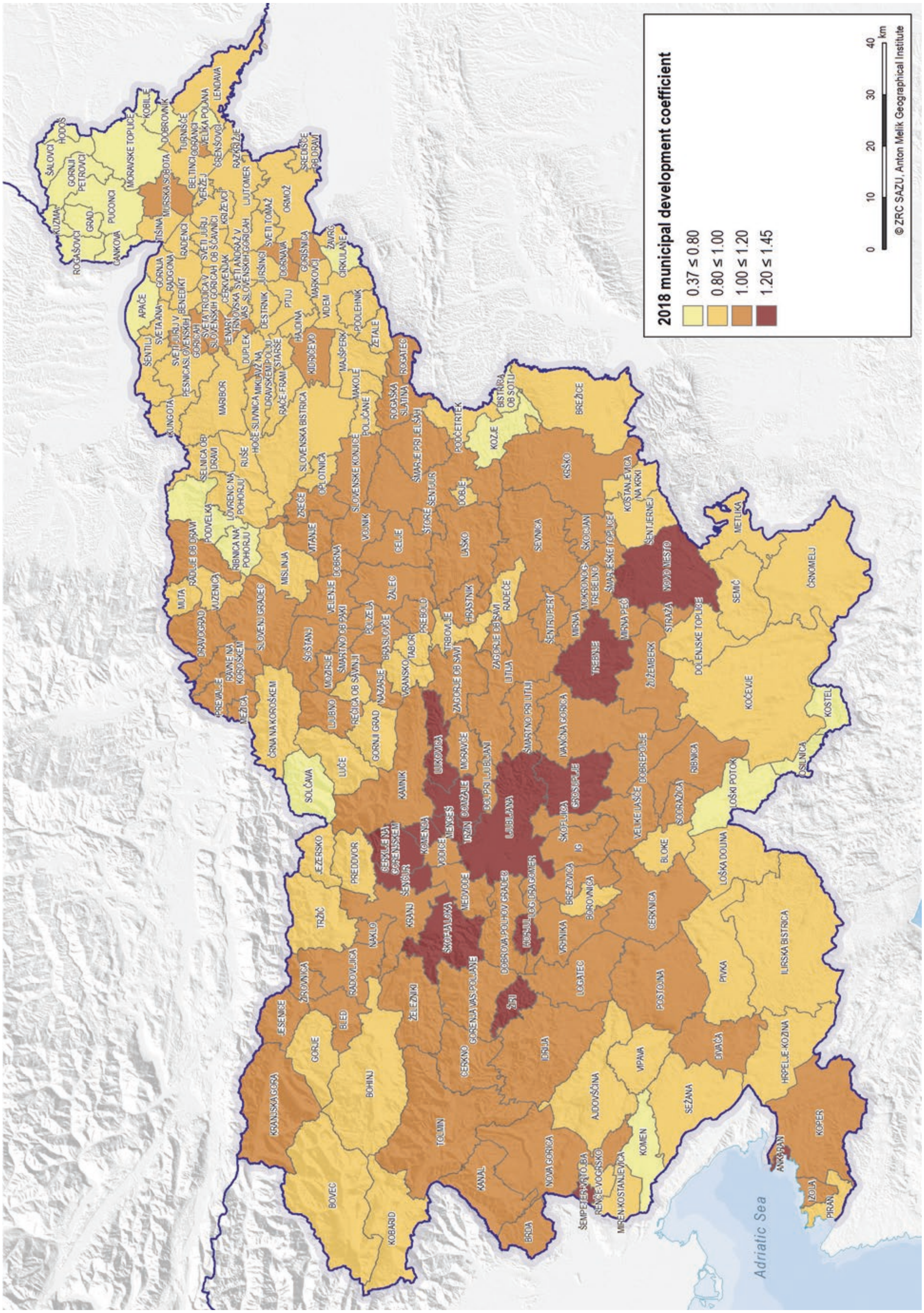

Fig. 19.5 2018 municipal development coefficient

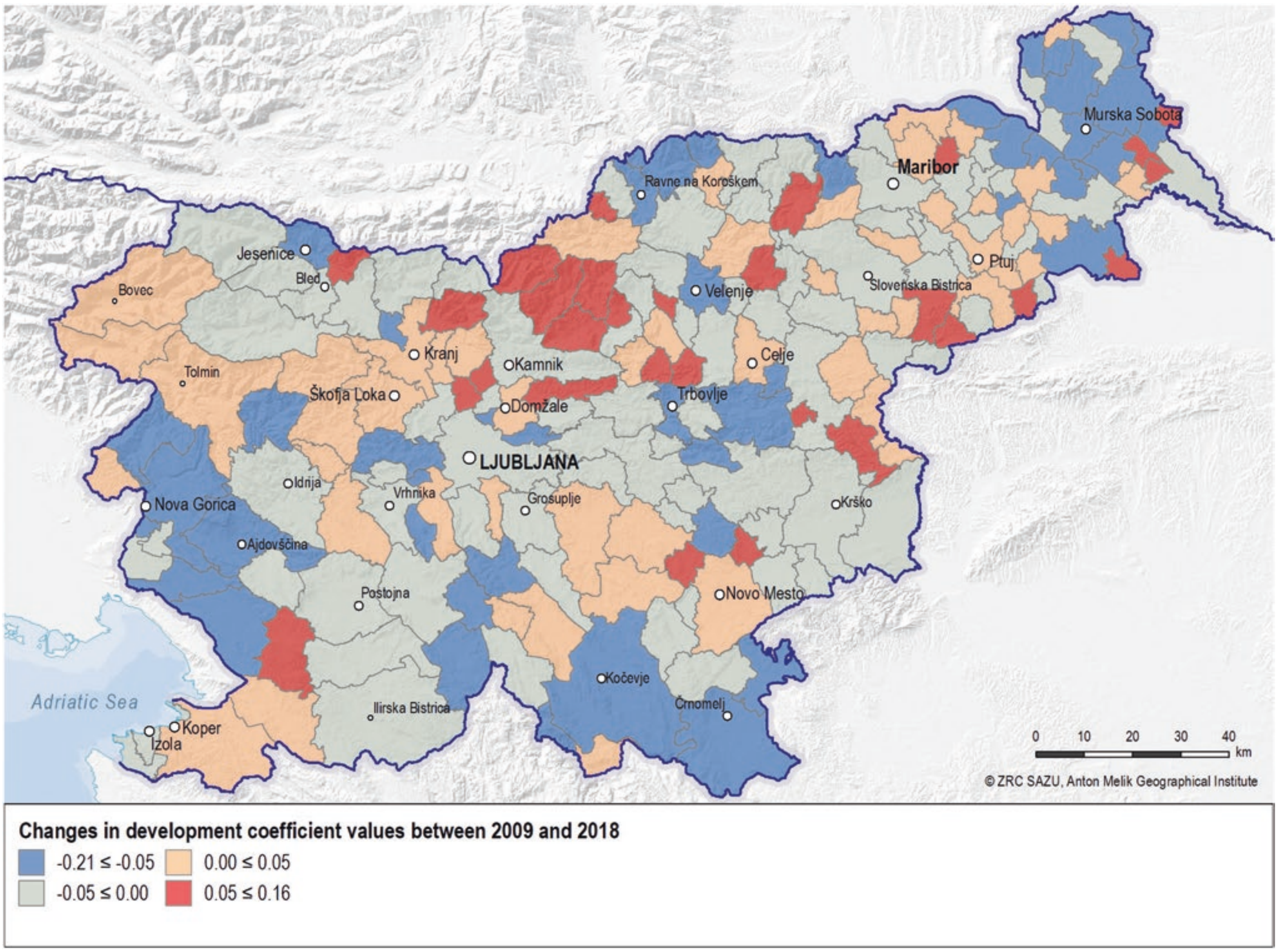

Fig. 19.6 Changes in development coefficient values between 2009 and 2018

and Goriška statistical regions; and some other municipalities. On the other hand, faster development or stronger improvements have been typical of the Upper Savinja Valley and individual municipalities, predominantly in Eastern Slovenia (Fig. 19.6).

As established by Ravbar (2014) in his analysis of the development potentials of Slovenian municipalities, these potentials are highest in Central Slovenia, parts of Gorenjska, the central part of the Savinja Valley with Celje, the central part of the Krka Valley with Novo Mesto, and the conurbation of coastal towns. In turn, below-average potentials are typical of all the border, hilly, and karst areas. According to Ravbar, this type of differentiation is primarily due to uneven demographic potentials, but he also ascribes great significance to economic factors, unemployment, educational structure, less entrepreneurial activity, and poorer accessibility.

In his analysis of municipalities, Kušar (2017) places an even greater focus on their economic potential, concluding that a more significant economic role is played by 78 municipalities, corresponding to approximately one-third of all Slovenian municipalities. The economy in the other two-thirds is not as significant. As highlighted by Kušar, less economic power should not be equated with a lower level of development because many municipalities are located in the immediate surroundings of important economic centers and serve as bedroom communities. He ranks the following municipalities under major Slovenian economic centers, ascribing them the features of development poles: Koper, Nova Gorica, Ljubljana, Kranj, Novo Mesto, Krško, Žalec, Celje, Maribor, Kidričevo, and Ptuj.

The problem of Slovenian municipalities is not only their smallness but also their relatively weak cooperation. According to Rus et al. (2018), they most often cooperate as part of shared municipal administrations, joint public corporations and institutes, and joint projects. Cooperation is more frequent between municipalities that were formerly part of the same larger municipality. Similar path-dependent development was also established by Nared et al. (2019) in their analysis of Slovenian municipalities, which also highlighted voluntary cooperation in the form of mayors' meetings and joint projects in addition to the types of cooperation already mentioned above. In a survey conducted

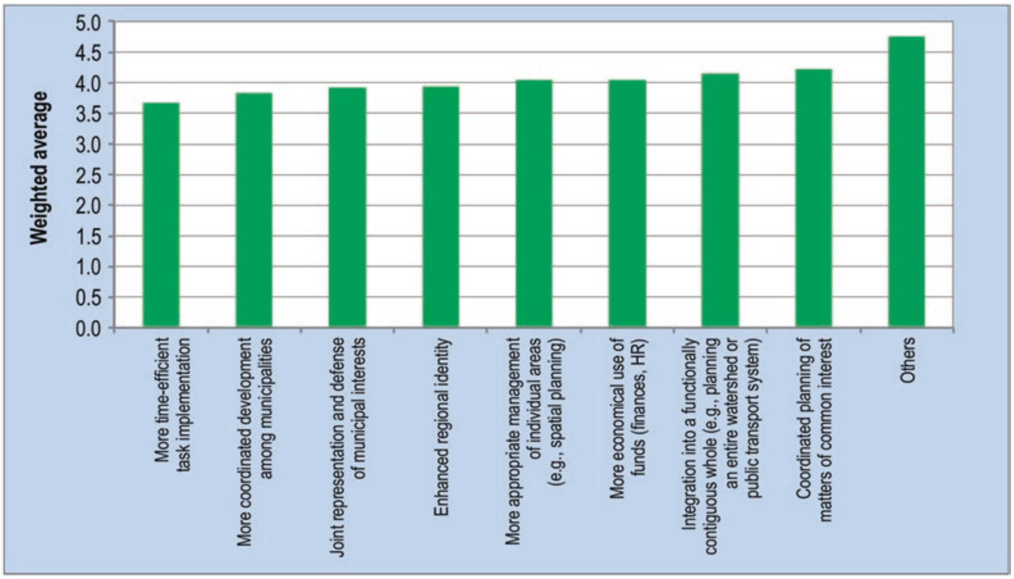

Fig. 19.7 Advantages of intermunicipal cooperation. (Nared et al. 2019)

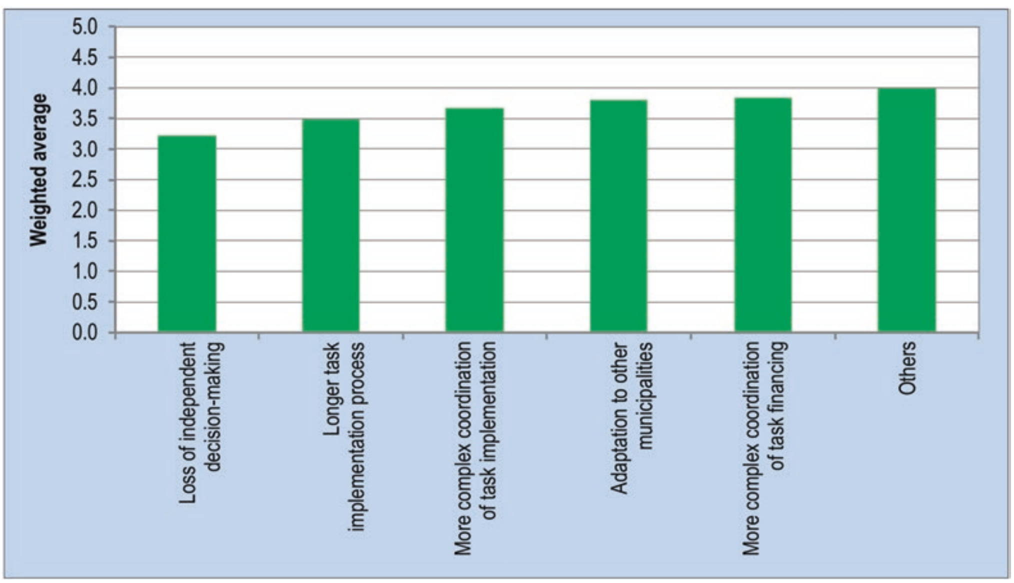

Fig. 19.8 Disadvantages of intermunicipal cooperation. (Nared et al. 2019)

with Slovenian municipalities, the municipalities listed the following among the advantages of intermunicipal cooperation: coordinated planning of matters of common interest, integration into a functionally contiguous whole, more economical use of funds, and more appropriate management of individual areas (Fig. 19.7).

Among the disadvantages of intermunicipal cooperation, the municipalities highlighted more complex coordination of task financing, adapting to other municipalities, and more complex coordination of task implementation (Fig. 19.8).

According to the municipalities, the reasons for the relatively weak intermunicipal cooperation include finances, insufficient guidelines from the state, and unclear legislation. The sources of financing mutual cooperation efforts, as listed by the municipalities, include government funding for financing shared municipal administrations, municipal funds, EU funds, and other government funding (Nared et al. 2019).

The emphasis that the municipalities place on financing intermunicipal cooperation and other municipal tasks shows that their funding is insufficient. The poll tax decreased due to the financial crisis, and at the same time, municipalities were charged with new tasks without any financial coverage. Nonetheless, municipalities played an important role in building new communal infrastructure and some even managed to carry out important development projects (Nared 2018).

19.4 Conclusion

In Slovenia, awareness of regional differences came to the fore during the rapid industrialization following the Second World War, when major industrial towns improved their positions compared to the disadvantaged countryside. Thus, in the late 1960s, it was acknowledged that underdeveloped areas needed help with their development, which led to the adoption of the first regional policy legislation in 1971. For the first 15 years, regional policy was based on providing aid to less-developed areas, followed by a decade of promoting demographically threatened areas. For the past two decades, it has been based on the premises of endogenous regional development. Even though regional policy aimed to reduce regional differences and stimulated the development of individual areas, investment was insufficient to cause any significant change. Hence, the status of underdeveloped areas was largely kept by one and the same area, especially individual parts of northeast and southern Slovenia.

A further problem in implementing effective regional policy is the absence of an intermediate level of self-governance or administrative regions. There have been several unsuccessful attempts to establish them, and, on top of everything, splitting off into increasingly smaller municipalities was characteristic. Because municipalities were the only decision-making instance in addition to the state, they also had a key influence on the implementation of regional policy, which led to its localization and the predominance of smaller municipal projects.

In some places, intermunicipal cooperation developed, but this has usually been territorially and conceptually limited. However, some municipalities have used this situation to improve their infrastructure and carry out certain projects, whereby some important projects extend beyond the municipal borders and thus also contribute to the development of the wider area.

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20 Human-Induced Degradation in Slovenia

Aleš Smrekar, Mateja Breg Valjavec, and Katarina Polajnar Horvat

Abstract

Environmental degradation in Slovenia is largely the result of past unsustainable use of natural resources (mineral raw materials, including coal) and the pollution of urban air, soil, and vegetation (forests) caused by the processing industry, which reduced the quality of life. Selected cases are used to present various types of degraded areas in Slovenia distinguished by the type of degraded environmental components, the extent and intensity of degradation, and the method and success of remediation. Jesenice is a restructured old industrial town in a narrow valley polluted with sulfur oxides and solid particles. Ljubljana, the Slovenian capital, is limiting road traffic emissions by closing the city center and promoting sustainable modes of transport. Other cases presented include the minor remediation of zinc-contaminated soil around the Celje zinc works, and the conversion of coalmine subsidence areas for recreational use and the development of secondary habitats in Velenje. Also presented is the positive response by Trbovlje residents gathered around an NGO to the negative environmental impact caused by the co-incineration of waste at the local cement works.

Keywords

Environmental protection · Environmental degradation · Air pollution · Mining degradation · Soil pollution · Public awareness

20.1 Introduction

Land degradation is a natural or human-induced process that impacts the land's ability to function effectively in an environmental system, and it can be defined as a process of degrading land from a former state (Zorn and Komac 2016). Environmental degradation is a negative modification of the environment that affects its individual components or entirety through biological, physical, or chemical changes. Human-induced environmental degradation refers to the devaluation of the environment through a rate of emissions that exceeds its self-cleansing capacity or represents a threat to the health, development, and survival of people and other living things (Smrekar 2013).

With growing population, changes affecting the environment in Slovenia also became increasingly greater, and at the same time, people began having increasingly greater material demands (Polajnar Horvat 2015). Aggressive activities, such as industry (Fig. 20.1) and transport, are the main drivers of development, but they also cause a series of negative environmental impacts manifested in various degrees of environmental pollution and leading to various landscape, health, economic, and other negative consequences (Špes et al. 2002). The Slovenian Spatial Development Strategy (Strategija … 2004) introduced sustainable spatial development to Slovenia. This means that such land use and spatial arrangements are being provided that can meet the needs of the current generation without threatening the needs of future generations while ensuring environmental protection, nature conservation, sustainable use of natural resources, and the conservation of cultural heritage and other qualities of the natural and living environment.

Slovenia is dealing with diverse problems connected with the ownership, reactivation, and restoration of degraded areas. There are heavily contaminated degraded areas resulting from the production of chemicals and the operation of galvanizing factories and zinc works, as well as degraded areas that have not been contaminated, but require political

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© Springer Nature Switzerland AG 2020
D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_20

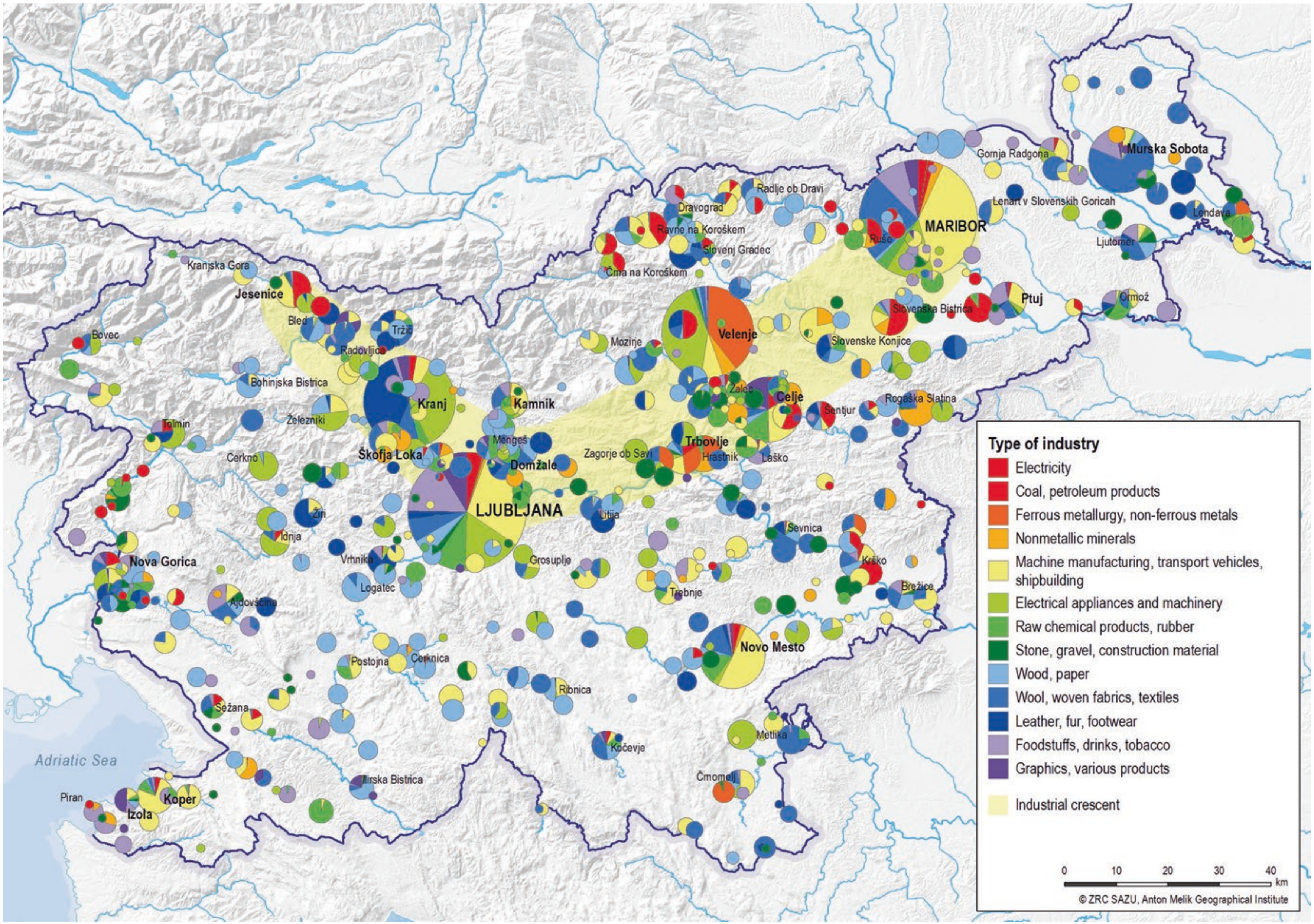

Fig. 20.1 Degradation in Slovenia is connected with previous mining and industry in the country's industrial crescent

will and an interested investor to be made useful again. An example of this is abandoned strip mines.

An important shift in environmental protection occurred after Slovenia's independence, when the economic, political, and legislative context of resolving environmental issues changed at the same time. The introduction of democracy also brought the opportunity to participate in making decisions about environmental issues (Smrekar 2006). The right to a healthy living environment is provided for in the Slovenian constitution (Ustava … 1991). People began to appreciate the environment as a value. The 1993 Environmental Protection Act (Zakon … 1993) laid the foundations for modern environmental protection in Slovenia. From the method of resolving increasing environmental issues that was common until that time and focused on technical solutions to reduce the impact on the environment arose the concept of solving issues from the viewpoint of sustainable development (Polajnar Horvat et al. 2017). The first Slovenian environmental protection legislation was adopted in 1993—that is, only a year after the environmental conference in Rio de Janeiro, which is why it already includes the findings and recommendations from the documents adopted at that conference. The act proceeded from the premise that environmental protection entailed not only or primarily cleaning up the polluted environment but that preventive action and prudence were required to make decisions about new changes to the environment and the use of natural resources.

Among the more important basic principles of this act, one should highlight the principle of integrity, arising from the realization that environmental protection cannot be successfully carried out only partially or without consensus and participation (Špes 2008). After the adoption of this legislation and especially after Slovenia's entry into the European Union, the number of legal acts on environmental protection increased rapidly (Plut 2004). Through adaptation to EU legal requirements, environmental protection has become an indispensable part of political, economic, and social decisions. Environmental issues have been placed at the forefront of public discussions, they have become the subject of public policies, and taking care of the environment has become a positive value, albeit often only as lip service (Polajnar Horvat 2015). The fact is that in principle, people tend to support environmental protection because that is socially desired, but, when they have to deal with limitations that encroach on their lifestyle, their enthusiasm quickly fades (Polajnar Horvat 2015). This kind of environmental protection support (i.e., support in principle only) often does not translate into behavior, which means that the shift to an environmentally conscious society is far from being achieved.

This chapter uses selected cases to present various types of degraded areas in Slovenia distinguished by the type of degraded environmental components, the extent and intensity of degradation, the method and success of restoration, and, ultimately, also the characteristics of public response to the negative changes to and impact on the environment.

20.2 Air Pollution

Air in Slovenia is excessively polluted primarily with PM_{10} particles and ground-level ozone. The PM_{10} limit values are mostly exceeded during winter due to small wood furnaces. Pollution is also caused by traffic, industry, and the release and flotation of particles in the atmosphere (Vintar Mally and Ogrin 2015). High concentrations of particles in the air are caused by frequent temperature inversions in poorly ventilated basins and valleys of continental Slovenia. From 1990 to 2014, emissions of sulfur dioxide (SO_2) and non-methane volatile organic compounds (NMVOC) decreased the most, and emissions of nitrogen oxides (NO_x), ammonia (NH_3), and $PM_{2,5}$ particles decreased the least. This led to a reduction in the emissions of matter that causes acidification (Poročilo … 2017).

Jesenice is an old industrial town in the narrow Alpine Upper Sava Valley (Fig. 20.2), which was considered one of the biggest industrial polluters in Slovenia in the second half of the twentieth century, before technological improvements to the ironworks and the environmental cleanup of their surroundings. The wider urban area is a typical Alpine mountainous landscape, in which the relief changes rapidly. The valley is the narrowest at Jesenice (Gams 1981). The town's emission area is well ventilated and usually prevents temperature inversions and concentration of emissions; between 1950 and 1970, there were only 10 foggy days per year on average (Pristov and Trontelj 1975).

Just like in other places in the town's immediate and wider surroundings, the first blast furnaces and foundries in what is now Jesenice were built from the mid-sixteenth century onward. During the nineteenth century, many Upper Carniolan foundries moved to Jesenice, thus avoiding bankruptcy. The 1869 establishment of the Carniolan Industrial Society, which joined all the foundries in Upper Carniola, was important for the further development of the iron industry and so was the railroad connection with Ljubljana and Tarvisio (Melik 1954). At the end of the nineteenth century, the first Siemens–Martin furnace for producing steel was put into operation, and six more furnaces were added by the early 1960s; until 1988, when the last one was shut down, these furnaces were the main source of sulfur dioxide and other ironworks emissions.

The Siemens–Martin furnaces were the main sources of dust emissions because they made collecting solid particles practically impossible. Sulfur dioxide and dust emissions were significantly reduced after 1979, when natural gas began to be used instead of fuel oil. Until then, the ironworks

Fig. 20.2 The iron industry was the main driver of economic and spatial development in Jesenice and first and foremost a symbol of environmental issues. (Photo by Miha Pavšek, GIAM ZRC SAZU Archive)

generated up to 20 tons of solid particles a day or approximately 2400 tons of sulfur dioxide a year. After 1980, the use of a dust collector reduced the quantity of solid particles by 40%. By abandoning both blast furnaces and shutting down the last Siemens–Martin furnace in 1988, all air emission values fell below the limit values (Špes 1998).

Ljubljana is the capital of Slovenia and has a population of approximately 287,000. It has many advantages in terms of good quality of life (Tiran 2016) and green infrastructure (Smrekar et al. 2016). Until the mid-1970s, the town was characterized by excessive air pollution with pronounced winter highs (Fig. 20.3; Špes et al. 2002). Because it lies in a basin and is poorly ventilated, Ljubljana has unfavorable conditions for naturally dispersing harmful substances in the air (Plut 2007).

After the Second World War, rapid demographic development and industrialization resulted in an increase in the number of home furnaces, which were the main source of air pollution at the end of the 1960s. Awareness and understanding of this issue led to pollution prevention measures, and so a heating plant was built in 1966. Later on, sulfur dioxide emissions and the quantity of ash were reduced by using Indonesian coal, which was of higher quality (Palatinus 2009). A new negative trend in energy-related emissions of sulfur dioxide and solid particles (Loose et al. 2010) has been present since 2008, when home furnaces using wood biomass began to be widely used again due to the financial crisis, high oil prices, and subsidies for biomass-fueled heating.

With the gradual reduction in energy-related and industrial emissions, the negative impacts of traffic pollution came to the forefront. The Ljubljana transport system has an impact on the wider region because it lies at the intersection of the fifth and tenth Pan-European corridors (Černe 2002). With denser and increased road traffic, traffic jams and congestion have increased the concentrations of pollutants produced by traffic (harmful gases, nitrogen dioxide, nitrogen oxide, and solid particles). Noise produced by road traffic has also increased (Ogrin 2008).

In 1996, the Environmental Measuring System was set up to measure the quantity of nitrogen dioxide and solid PM_{10} particles in the air. Major changes occurred after 2007, when the city center began to be closed to traffic, bicycle paths and bike rentals were introduced, the public transport system began to be modernized and optimized through new connections to neighboring municipalities, the "Park and Ride" program was put in place, and a separate bus lane was established. A great deal has also been achieved in informing, educating, and encouraging residents to switch to public transport, cycling, and walking (Mobilna Ljubljana 2012).

20.3 Soil Pollution

Most of the soil in Slovenia is not polluted. In some places, especially around mines, smelting plants, and metallurgic structures, it is contaminated with certain inorganic pollutants (e.g., cadmium, lead, arsenic, and copper) and organic pollutants (e.g., pesticides). Serious and even critical emission values of inorganic pollutants have been exceeded in certain areas. The pollution of soil with organic pollutants is less acute in Slovenia, with only minor exceedances of the limit emission values for pesticides or their decomposition products recorded. Soil is contaminated the most in the

Fig. 20.3 Air pollution is a major environmental issue in the most cities, but the situation in Krško has improved in recent years. The photo was taken before the installation of the newest cleaning devices. (Photo by Miha Pavšek, GIAM ZRC SAZU Archive)

Mežica Valley, Celje Basin, Jesenice, and Idrija. Cadmium and lead are the most problematic for people's health and the environment (Poročilo… 2017).

The beginnings of industrialization in Celje go back to the nineteenth century and coincide with the construction of the railroad from Vienna to Trieste, which made possible and simplified the transport of coal and raw materials from nearby mines (Trbovlje and Šoštanj) and ones far away (Serbia and Macedonia; Špes 1998; Žibert and Šajn 2008). That was also the time when air pollution and land degradation began in the Celje Basin; land degradation reached its peak in the second half of the twentieth century (Lobnik et al. 1989; Domitrovič-Uranjek 1990; Špes 1998; Šajn 2001, 2005; Žibret and Šajn 2008), especially due to more than a century of operation of the zinc works (built in 1873).

The first environmental issue in Celje was caused by gas emissions of sulfur oxides released during production. The effects were already visible on forest trees during the 1930s (Špes 1998), and 4000 ha of forest were damaged by the 1970s (Šolar 1974). Acidification also changed the geochemical characteristics of soil and the quality of habitats (Špes 1998). In 100 years, the zinc smelter at the Celje zinc works produced approximately 580,000 tons of raw zinc through the pyrometallurgical process. The plant was a source of silver, arsenic, copper, molybdenum, lead, sulfur, and antimony, and an especially strong source of zinc and cadmium in the region (Lobnik et al. 1989; Žibert and Šajn 2008). Individual plants began to be shut down, and technological modernizations began to be introduced in 1993, but critical emission values continued to be exceeded in the soil long after that for copper (up to 24 times), lead (up to 13 times), and zinc and cadmium (up to 6 times). The concentrations of heavy metals increased with depth and were also detected in the groundwater (Grilc et al. 2005).

Pollution in Celje is also connected with climate conditions, especially the winter atmospheric inversion, which lasts 95 days a year on average, the calm that lasts for more than 30% of the year (Cegnar 2003), and the local flow of air from the edges to the city center due to a heat island. The range of influence of the zinc smelting plant for the presence of anthropogenic zinc in the soil has been estimated to be between 9 and 14 km (Žibert and Šajn 2008). Even though the spatial dimensions of this degradation in the Celje Basin are very extensive (Špes 1998), ecological restoration has only been carried out on 17 ha of the old zinc works. Revitalization of the degraded area will also have positive socioeconomic effects because the contaminated layers of soil were dug out and encapsulated in clay or concrete (Voglar and Leštan 2008), on top of which is now the parking lot of the emerging technological, development, cultural, and school center of Celje.

20.4 Mining Degradation

Mining has a long tradition in Slovenia. The two largest mines were the mercury mine in Idrija and the lead and zinc mine in Mežica. In the nineteenth century, coalmines were opened at Leše above the Mežica Valley, in the Trbovlje, Zagorje, and Hrastnik area (the so-called Black District), and in Velenje. Only the lignite mine in Velenje continues to operate today to supply the Šoštanj power plant. Mining caused ground subsidence, first at Leše and later also in the Black District and the area around Velenje. Land in the Black District was further degraded by a strip mine, which was used for mining waste disposal (Špes 1998).

The Šalek Lakes formed around Velenje as a result of ground subsidence. Coalmine subsidence areas emerged in the middle of the agricultural landscape at the bottom of the basin, which was partly populated. The villages of Škale, Družmirje, and Preloge partly or fully disappeared (Ramšak et al. 2004).

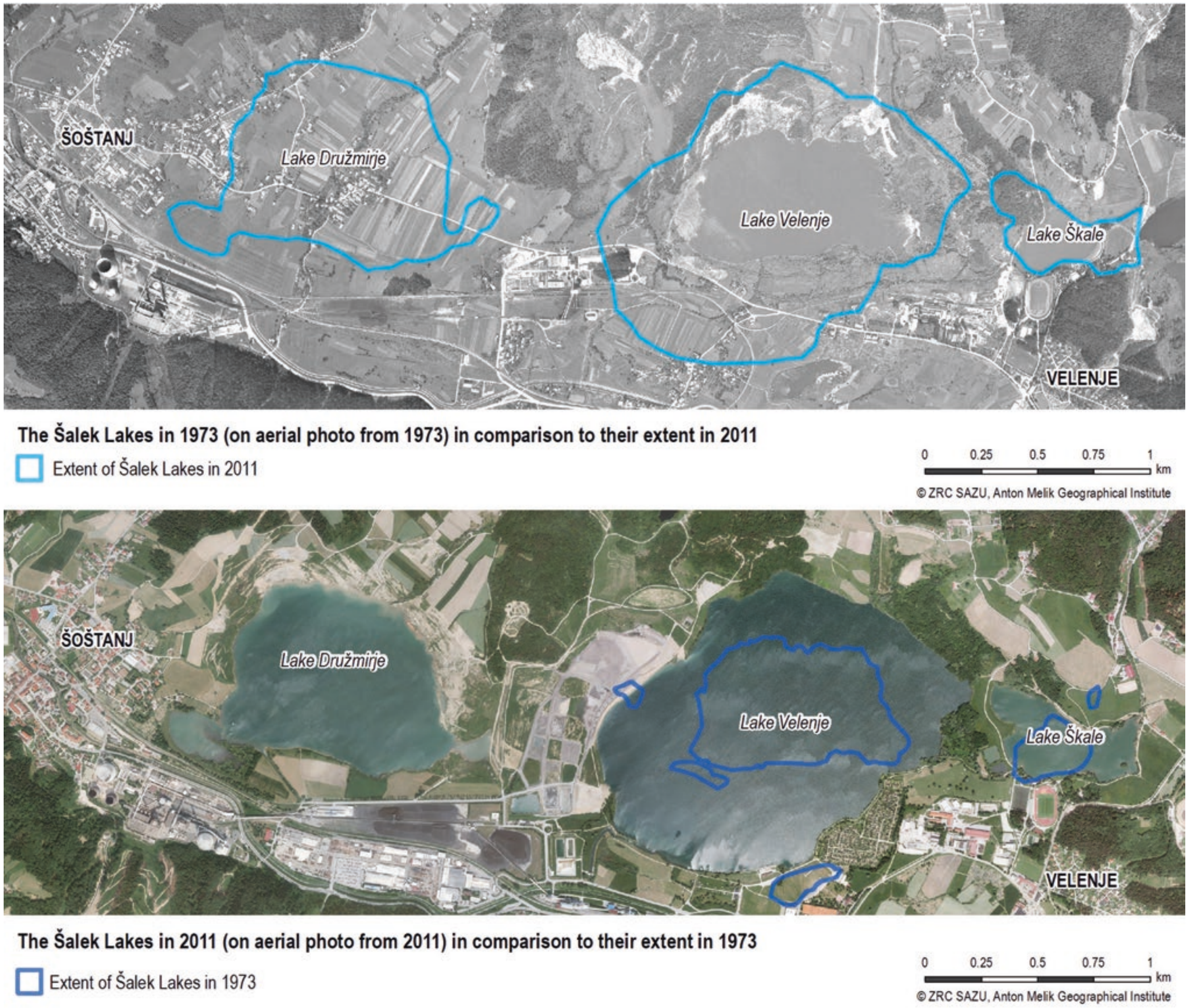

Fig. 20.4 The dynamics of the formation and development of the Šalek Lakes between 1973 and 2011. (Source: Surveying and Mapping Authority of the Republic of Slovenia)

The entire subsidence area covers over 15 km^2 and lies in the Paka watershed. Three large depressions (Fig. 20.4) formed due to subsidence and in the Škale, Velenje, and Družmirje lakes developed. A smaller part of Lake Velenje is separated by an embankment and used for recreation (Perko et al. 1999).

Lake Škale is the oldest, and it developed in the Škale area. During the 1970s, it was six times smaller than today, and it now covers 16.6 ha (Fig. 20.4). Because coal mining stopped in the area, the lake will not increase in size or depth.

The largest lake in 2011 was Lake Velenje (141.6 ha), which grew from 42 ha in 1973 to approximately 100 ha (Table 20.1, Fig. 20.4). Dumping coal ash from the coal-fired power plant in Šoštanj directly into the lake in the past and drainage water from ash disposal sites resulted in biochemical pollution of the lake water, including a very high pH and high concentrations of heavy metals. Until 1995 the lake was biologically dead, but the introduction of a closed ash transport system that year resulted in remediation of the lake water (Kotnik et al. 2000).

Table 20.1 Lake Velenje from 1960 to 2011 (partially adapted from Ramšak et al. 2004)

Year	Area (hectares)	Volume (million m^3)	Max. depth (m)
1960	25.0	2.6	–
1970	22.1	1.1	–
1980	93.0	13.5	34.0
1990	123.0	20.8	55.5
2000	139.0	26.0	54.1
2011	141.6	30.5	54.0

Lake Družmirje began to form in 1975. It measured 46 ha in 1996, 63 ha in 2005, and 79 ha in 2011. Over the past four decades, the lake has flooded the entire village of the Družmirje. According to the projections of the Velenje Coalmine, it is expected to cover approximately 170 ha by 2020, thus becoming the largest lake in the Šalek Valley in terms of area and the quantity of water.

Ground subsidence is the most visible consequence of coalmining in the Šalek Valley, where the process of human-induced degradation is still going on today. In addition to spatial degradation and the destruction of infrastructure and cultural heritage (e.g., the millennium-old church at Škale), the effects of coalmining and the sinking of settlements also have a strong social dimension: over 1500 people were forced to move out due to ground subsidence (Ramšak et al. 2004). Moreover, a great deal of farmland and cultural landscape has also been lost.

Despite the spatial degradation caused directly or indirectly by coalmining in the Šalek Valley, over the years the lakes have become an attractive landscape element with great potential for tourism and recreation. Their importance and appeal are enhanced by secondary habitats that have formed in and next to the lakes after successful remediation attempts. They have increased the diversity of plant and animal species and improved the aesthetic experience of the area, thus turning into a development opportunity for the Šalek Valley.

20.5 Responses to Human Impact on the Environment: Raising Awareness Through the Story of the Eko Krog Nature Conservation and Environmental Protection Society

Despite increasing concerns about a healthy living environment and related wider support for environmental protection (Lukšič and Bahor 2007), environmental degradation continues due to an ineffective system and the interests of the business sector, where in places environmental pollution continues to be perceived as an inevitable side effect (Polajnar Horvat 2014). An example of this is the air pollution caused by uncontrolled emissions from the Lafarge Cement factory in the Trbovlje area, which incinerates hazardous waste. As a response to this issue and seeking to maintain a healthy environment, in 2005 the residents of the Trbovlje established a society for nature conservation and environmental protection called Eko Krog (Pihler 2017).

The story of Eko Krog's legal battle against Lafarge Cement extends back to 2006, when Lafarge Cement applied for an environmental permit to produce cement and then in 2007 also a permit to incinerate industrial (mainly hazardous) waste (Pihler 2010). The co-incineration of waste is increasingly used by cement works because it allows them to replace part of traditional, mainly fossil, fuels with alternative ones: communal waste, plastic, waste tires, bone meal, waste lubricants, oils, varnishes, and sludges from treatment plants—that is, hazardous waste (Nobelov … 2017). After obtaining the two permits, the cement works heavily polluted the air in the valley for over a decade. After initial doubts and even opposition from the residents of the Trbovlje area regarding efforts to stop the co-incineration of waste, claiming that the cement works provided new jobs, which there was a great lack of, and also donated funds to various institutions, after several years of systematic awareness raising by Eko Krog, the residents became aware of the heavy air pollution and actively supported revoking the environmental permit for incinerating hazardous waste (Fig. 20.5). After a decade of fighting against air pollution in the Trbovlje area, in 2015 the Eko Krog society and its adherents, such as the Municipality of Zagorje, the Ravenska Vas local community, and the civil initiative for the future of Trbovlje, using legal means and awareness-raising campaigns, managed to stop the co-incineration of waste and hazardous substances at the factory. Lafarge Cement was left without an environmental permit and was thus forced to halt its operations, which had greatly contaminated the environment and threatened people's health. This story illustrates a long-lasting and ultimately successful struggle of the local population against the business sector or a large international corporation, which influences policy and subsequently legislation due to its own interests and pursuit of profit (Nobelov … 2017).

20.6 Restoration of the Degraded Environment and Future Outlook

Environmental degradation in Slovenia is the result of past unsustainable use of natural resources (i.e., mineral raw materials, including coal) and the pollution of urban air, soil, and vegetation (i.e., forests) caused by the processing industry, which reduced the quality of life. Later on, technological and socioeconomic development and increased awareness contributed to the restoration of certain degraded areas.

With Slovenia's entry into the European Union in 2004 and already during the pre-accession period, Slovenia harmonized its legislation with EU legislation and adopted many legislative environmental protection measures, such as the 2002 Waters Act (Zakon … 2002), the 2004 Environmental Protection Act (Zakon … 2004), and the 2006 Resolution on the National Environmental Protection Program.

The remnants of degradation in today's landscape mostly show in the form of degraded urban areas (Fig. 20.6). Slovenia barely has any guidelines for the further spatial and functional development of degraded areas, except for the restoration of large abandoned mining areas.

Fig. 20.5 A protest by members of the Eko Krog nature conservation and environmental protection society against the co-incineration of waste at the Lafarge Cement factory in Trbovlje. (Photo by Lidija Maurer, GIAM ZRC SAZU Archive)

Fig. 20.6 The former Litostroj industrial area in Ljubljana still awaits revitalization. (Photo by Aleš Smrekar, GIAM ZRC SAZU Archive)

Because no systemic register of degraded areas is available, it is impossible to plan the future development of these areas—either inside built-up zones or outside them, such as in the majority of environmentally protected areas—at the national, regional, or municipal levels.

A major issue in planning the development of degraded areas is also fragmented ownership and small parcels; according to the current records, over 450 ha (47%) of degraded land is privately owned. An even greater issue is degraded areas without known owners (11%; Špes et al. 2012). Accordingly, already at the initial stage of degraded land reactivation, conflicts arise between the interests of private owners and developers and the interests of the local community.

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21 Slovenia's Protected Areas

Aleš Smrekar, Katarina Polajnar Horvat, and Daniela Ribeiro

Abstract

The conservation of the natural environment and its values in Slovenia goes back to the last decade of the nineteenth century, and the beginnings of the first and only national park go back to 1924. The 1999 Nature Conservation Act established a national framework for protecting 13% of Slovenia's territory. Slovenia is among the European countries with best-preserved natural conditions and the greatest biological and landscape diversity. This is reflected by the size of Slovenian territory that is protected: more than 52% of the country lies in ecologically important areas and approximately 37% within Natura 2000 sites. Various examples are used to present the management of national assets. Slovenia has 1 national park (IUCN category II/V; the example presented is Triglav National Park), 3 regional parks (IUCN category V/II; the example presented is Kozje Regional Park), 44 landscape parks (IUCN category V; Kolpa Landscape Park is presented), 1 strict nature reserve (IUCN category I; the *Hrastova loza* Strict Nature Reserve is presented), 56 nature reserves (IUCN category IV; the *Hrastov gozd v Krakovem pri Kostanjevici* Nature Reserve is presented), and 1164 natural monuments (IUCN category III; the cave *Križna jama* is presented).

Keywords

Environmental protection · Nature conservation · Protected area · Sustainable development · Natura 2000

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21.1 Introduction

In Slovenia efforts to protect areas with great natural wealth and beauty have a history going back more than a century (Bizjak et al. 2008). The idea of protecting the natural environment and its values in Slovenia emerged when the first serious negative effects of human activity on it began to show as a result of economic development and especially intense industrialization (Polajnar Horvat 2015). Hence, it is no surprise that the first nature conservation campaigns were connected with forestry as an economically important activity. Leopold Hufnagl managed the forest estates of one of the largest landowners in Slovenia, the Auersperg family. In 1892 he prepared the first forest management plan, which was revolutionary at that time. He replaced clear-cutting with selection cutting, which continues to form the basis of forest management today. At the same time, he added a small note to the plan, saying that "virgin forest should be preserved here," thereby being the first in Europe and among the first in the world to exclude virgin forest from commercial use (Pachschwöll 2011). Accordingly, Leopold Hufnagl is considered the pioneer of planned nature conservation in Slovenia. In the early twentieth century, awareness of the values of the natural environment and the need to protect it began to take shape in Slovenia. The first steps in nature conservation in Slovenia were taken in the early twentieth century by progressive individuals that sought to protect individual parts of the natural environment by describing natural values, drawing attention to their degradation and threats, and taking public initiatives for their conservation (Berginc et al. 2007). The concept of nature conservation continued to develop throughout the twentieth century, and it now forms the basis for the formation and development of a sustainable society (Zorn and Kladnik 2015)—that is, a society whose actions do not harm generations to come.

A key step in the efforts to ensure comprehensive nature conservation was taken through the adoption of the 1999 Nature Conservation Act (Zakon o ohranjanju … 1999),

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D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_21

which offered the legal framework for establishing protected areas in Slovenia and provides actions for biodiversity conservation and a system to protect natural values in order to contribute to nature conservation in Slovenia. It provided for the broadest possible legal regulation of this area within Slovenian legislation, making society recognize the advantages offered by the natural environment. The Ministry of the Environment and Spatial Planning, the Slovenian Environment Agency, and the Water Directorate of the Republic of Slovenia are the bodies responsible for protecting nature in the country (Erhart and Juvančič 2016).

Today Slovenia is among the European countries with best-preserved natural environment and the greatest biological and landscape diversity (Ciglič and Perko 2013). This is reflected by the size of Slovenian territory that is protected: more than 52% (approximately 10,500 km^2) of the country lies within ecologically important areas and more than 37% (approximately 7700 km^2) within Natura 2000 sites (Natura 2000 … 2016).

21.2 Typology of Nature Protection in Slovenia

The mission of the International Union for Conservation of Nature (IUCN) is to encourage and assist societies around the world to preserve the integrity and diversity of nature and to ensure the sustainable use of natural resources. Slovenia has been a member of the IUCN since 1993 (ARSO 2017). In Slovenia, protected areas are divided into categories that are internationally recognized (IUCN categorization; Bizjak et al. 2008).

The Nature Conservation Act (Zakon o ohranjanju … 1999) differentiates between large and small protected areas. The act recognizes six types of protected areas taking into account the IUCN criteria. Large protected areas comprise national parks, regionals parks, and landscape parks. Small protected areas include strict nature reserves, nature reserves, and natural monuments. In the national park, the natural environment remains primordial to a large extent; however, there are smaller areas where human influence takes place harmoniously connected with nature. A regional park is a vast area of unspoiled nature and natural values, which are intertwined with the areas where human influence is greater, but nonetheless balanced with nature. A landscape park is an area with an emphasized quality and long-term interaction between man and nature, which has significant ecological, biotic, or landscape values. A strict nature reserve is an area in which processes take place without human influence. A nature reserve is an area maintained by the balanced functioning of man in nature. A natural monument is an area that contains one or more natural values that have an exceptional shape, size, content, or position or that is a rare example of a natural value (Erhart and Juvančič 2016).

By June 2017, around 2700 km^2 of Slovenia was considered protected, which corresponds to 13.3% of the country's territory. These encompass 1 national park (IUCN: II/V), 3 regional parks (IUCN: V/II), 44 landscape parks (IUCN: V), 1 strict nature reserve (IUCN: I), 56 nature reserves (IUCN: IV), and 1164 natural monuments (IUCN: III) (ARSO 2017; Fig. 21.1).

There are also other areas important from the point of view of nature protection, such as the network of Natura 2000 sites, ecologically important areas, and natural values. The establishment of the Natura 2000 network was one of the contractual obligations of Slovenia when joining the European Union in 2004 (Erhart and Juvančič 2016). Natura 2000 sites in Slovenia are determined by the Decree on Special Protection Areas (Uredba … 2004). This decree stipulates the main conservation objective: conserving, maintaining, or improving the existing characteristics of living and nonliving nature that contribute to a favorable conservation status of species and habitats. Clearly defined and detailed conservation objectives and measures for Natura 2000 sites are determined on the basis of the ecological requirements of species and habitats and are specified in the Natura 2000 Management Programme for Slovenia for 2015–2020 (2015; Klemenčič 2016). Currently 355 areas are identified as Natura 2000 sites, of which 324 are established under the Habitats Directive (1992) and 31 under the Birds Directive (2009). These two types of areas overlap because more than half of the areas proposed under the Habitats Directive lie within the proposed special protection areas under the Birds Directive. Natura 2000 sites in Slovenia cover a total area of 7684 km^2, of which 7678 km^2 is land and 6 km^2 marine (Nose Marolt 2015).

Ecologically important areas are the largest in size, and they ensure the connectivity of habitats of rare and endangered species that are maintained on the basis of international treaties. The Nature Conservation Act (Zakon o ohranjanju … 1999) defines a natural value as a rare, valuable, or interesting natural phenomenon, as well as any other valuable phenomenon, component, or part of living and nonliving nature, a natural area or part of a natural area, ecosystems, the landscape, or the designed landscape (Zakon o ohranjanju … 2004). Natural values are regulated by the Rules on the Designation and Protection of Natural Values (Pravilnik … 2004), which stipulate that activities affecting natural values can be carried out only if there are no other spatial or technical possibilities and in such a way that these do not destroy or change the properties of the natural value (Erhart and Juvančič 2016) (Fig. 21.2 and Table 21.1).

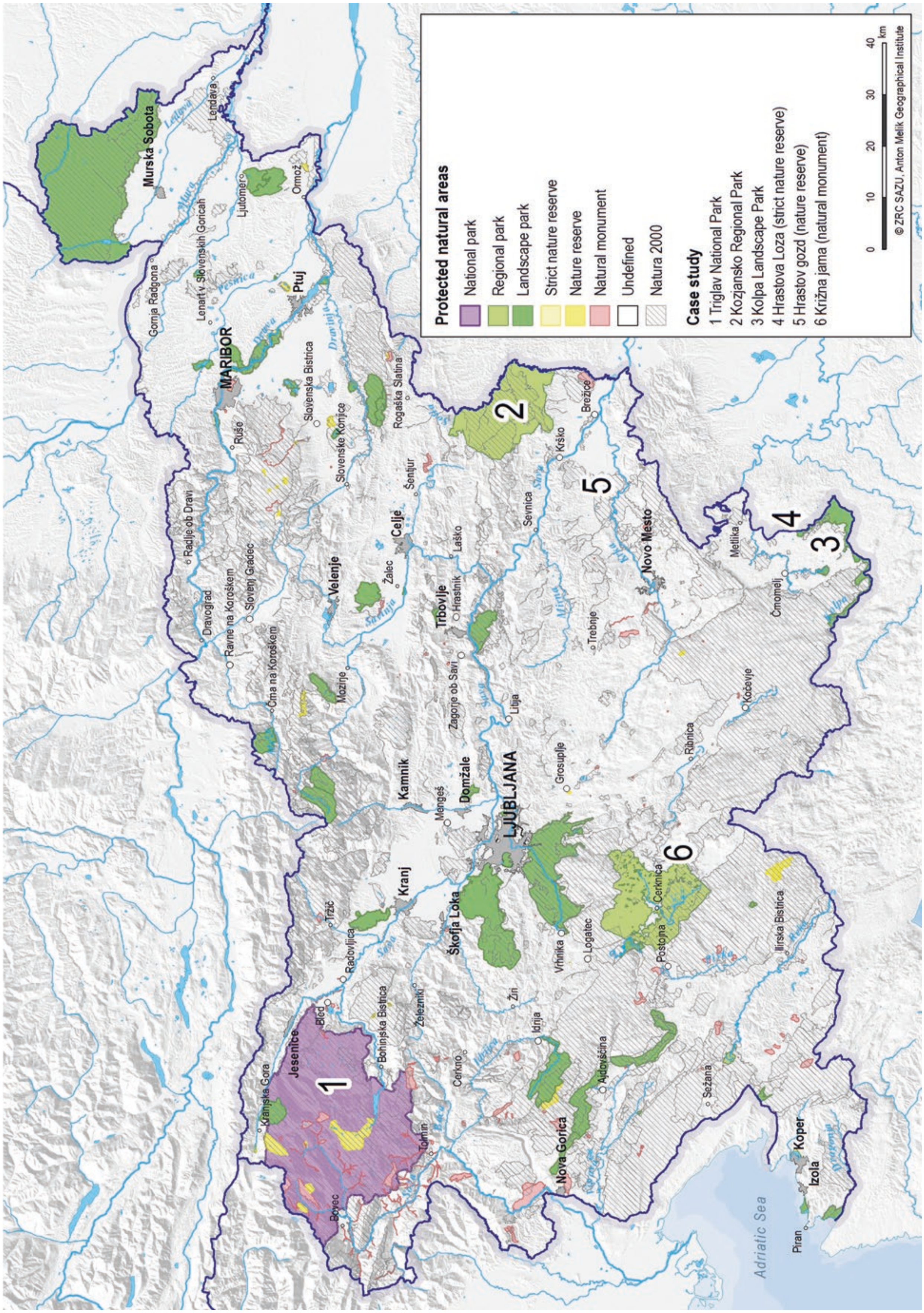

Fig. 21.1 Protected areas in Slovenia

Fig. 21.2 Protected areas selected as case studies. Top, left to right, Triglav National Park. (Photo by Peter Skoberne, GIAM ZRC SAZU Archive), Kozje Regional Park. (Photo by Jošt Gantar, www.slovenia.info Archive), Kolpa Landscape Park. (Photo by Daniela Ribeiro, GIAM ZRC SAZU Archive); bottom, left to right, *Hrastova loza* Strict Nature Reserve. (Photo by Andrej Hudoklin, GIAM ZRC SAZU Archive), *Hrastov gozd* Nature Reserve. (Photo by Jure Tičar, GIAM ZRC SAZU Archive), and *Križna jama* Natural Monument. (Photo by Gašper Modic, GIAM ZRC SAZU Archive)

Table 21.1 Protected areas in Slovenia (ARSO 2017)

Category	IUCN level	No. of areas	Area (ha)	Share of Slovenian territory (%)
National parks	II/V	1	83,982.0	4.14
Regional parks	V/II	3	42,991.4	2.12
Landscape parks	V	44	129,971.2	6.41
Strict nature reserves	I	1	1.8	0.0001
Nature reserves	IV	56	5495.9	0.27
Natural monuments	III	1164	19,269.2	0.95

21.3 The National Park: Establishment and Development of Triglav National Park

Slovenia has only one national park. It covers an area of 83,982 ha or 4.1% of Slovenian territory, and it is the largest protected area in the country (Bizjak et al. 2008). The Nature Conservation Act (Zakon o ohranjanju … 1999) stipulates that the major part of the park must include at least two protected zones with a stricter protection regime, whereas areas affected by human activity can be present in its smaller part, provided that they meet the required nature conservation criteria. In Slovenia, the idea of the need to protect nature began gaining momentum in the early twentieth century. Based on a 1903 decree by the Austrian Ministry of Education and Religion (Skoberne 2011), Albin Belar produced in 1907 a catalog of Carniola's natural monuments (*Die Naturdenkmalpflege in Österreich mit besonderer Berücksichtigung des Landes Krain*), including the Triglav Lakes Valley, in which he added the following note, among others: "It is by all means recommended that a protected area be established at the Seven Lakes in order to prevent any human impact and save the last remnants of an exceptional high-mountain virgin forest for posterity" (Skoberne 2015). After long negotiations, these efforts were interrupted by the First World War. In the new Kingdom of Yugoslavia established after the war, there was no legal basis to declare a protected area, and therefore in 1924 its initiators (i.e., the Slovenian Museum Association) signed a 20-year lease contract with the landowner (i.e., the Carniolan Religious

Fund). A protection regime was put in place in a 1400-ha area of the Triglav Lakes Valley, with hunting and visit by tourists being the only two activities permitted. The reason for protecting this mountain valley was excessive grazing, which was now no longer allowed. The locals perceived the grazing prohibition primarily as townsfolks interfering with their rights (Skoberne 2015). One of the most zealous environmental protection activists wrote the following 2 years after the lease had been concluded: "Today we again stand and fight for the park. We have been awakened from our sweet dream that the park's existence was guaranteed by the news that assertive circles now seek to take it away from us and hand it over for livestock by employing convoluted legal paragraphs. Let everyone in Slovenia's centers with a sense for nature take action to protect our beautiful park against menacing materialists" (Kunaver 1926: 164).

After the Second World War, the political and ownership changes and the desire to reestablish grazing made it impossible for the park to be reinstated, and hence it was not until 1961 that Triglav National Park was established (Odlok … 1961). It covered 2000 ha and was thus not significantly larger than the original one. However, this only partially satisfied the proposers, and so activities for the park's expansion continued until a new law (Zakon o Triglavskem … 1981) was passed in 1981, increasing the park's size to 83,807 ha. This meets the criteria for classification as a national park, and its central part corresponds to the international IUCN category II (Dudley 2008). This law was another compromise, reflecting the interests of tourism, agriculture, and hunting. However, this was the first time a manager was assigned to the park. In 2010, this law was amended (Zakon o Triglavskem … 2010), redefining individual protected areas as well as protection and development guidelines and conferring specific powers on the park's manager. The dispute between the locals and nature protection activists overgrazing and other land use has continued to come to the fore in various circumstances ever since the first protection proposals—that is, during every discussion on subsequent protection regulations, in the procedures for adopting the management plan, and ultimately in everyday developments. Subjective reasons are clearly hidden behind objective issues, in which the manner of communication is an extremely important factor. The ideas of values and protection measures coming from the outside can be misinterpreted as imposing a certain lifestyle on the locals and neglecting their role in nature conservation. On the other hand, locals' activities may be a source of potential threat to the natural environment. Because of negative experiences on both sides, this vicious circle of mistrust, which is actually much more complex than it may seem at first glance, is extremely difficult to overcome (Skoberne 2015).

21.4 A Regional Park: Kozje Regional Park as Good Park Practice

Slovenia has three regional parks that cover 2.1% of its territory. They comprise regionally specific ecosystems and landscapes with extensive parts of pristine nature and areas of natural values, which alternate with the parts of nature where human impact is stronger but still in balance with nature. Regional parks must include at least two protection zones with a stricter protection regime, which can be of a smaller size (Zakon o ohranjanju … 1999). Regional parks allow for various forms of development, the most important among which are education, recreation, tourism, and agriculture (Plut et al. 2008). Kozje Regional Park is the second-oldest protected area in Slovenia, following Triglav National Park (Od ustanovitve … 2017). It covers 206 km^2 in eastern Slovenia, where hills and plains "exist in harmony" (Območje 2017). It was established in 1981 (Zakon o Spominskem … 1981) as Trebče Memorial Park in order to preserve the historical tradition and natural features of the Kozje region (*Kozjansko*) and support further development of the area. In 1999 the Nature Conservation Act (Zakon o ohranjanju … 1999) changed the park's name, status, and manager, turning this protected area into a regional park (IUCN level V) called Kozje Park and managed by a public institute (Od ustanovitve … 2017).

Kozje Park is an area with an extremely high level of biodiversity, pristine nature, and regionally specific ecosystems, which is why it has been included among the most important nature conservation areas in Slovenia and Europe. Specifically, since 2004 a major portion (i.e., 69%) of the park has been classified under Slovenia's ecologically important areas and the EU Natura 2000 sites. Since 2010, the Kozje region and the Sotla Valley have been designated a UNESCO Man and Biosphere (MAB) site (Program … 2016).

In over 30 years, the park has developed into a public institute with modern management. In line with its regulations, it serves as an instrument to ensure a favorable conservation status of Natura 2000 species and habitats and to manage the area. It is known for several excellent park practices in relation to conserving biodiversity and a favorable status of numerous Natura 2000 species and habitats, for providing exemplary coexistence of nature and man, and for its well-preserved natural environment, rich natural and cultural heritage, and implementation of sustainable development principles (Program … 2016). One of these practices is also the Kozje Apple Festival, a traditional main event held in Kozje Park. The event seeks to present the work and efforts invested in protecting natural values and conserving the agricultural cultural landscape in the Kozje region. Meadow orchards with standard-sized trees are among the most prioritized and most important habitats in the park in terms of nature conservation. They are inhabited by several endangered bird species, which is why these habitats have been designated a Natura 2000 site in accordance with the Birds Directive (2009). An apple from these meadow orchards symbolizes nature conservation, the continuation of ancestral tradition and heritage, abundance, and healthy food, and it also serves as an identification symbol for Kozje Park and locals' identification with the protected area (Praznik … 2017). Every year the event attracts around 15,000 visitors from across Slovenia (Združenje … 2017). The festival is thus an important event with a nature conservation, environmental, and ethnological character, in which the local population and other stakeholders participate, and it also serves as an important environmental-awareness-raising venue that can provide a model of environmentally friendly marketing that other Slovenian protected areas can follow.

21.5 A Landscape Park: Kolpa Landscape Park and Its Development Potential

Landscape parks are the most common type of large protected areas in Slovenia. There are 44 of them altogether, covering 5.7% of Slovenian territory. They are the result of a long-lasting interconnection between man and nature and are comprised of areas with great ecological, biotic, or landscape value. Landscape parks permit the highest degree of human impact, which together with the natural environment ultimately helps create landscape diversity (Zakon o ohranjanju … 1999). Kolpa Landscape Park is located in the White Carniola region, in southeastern Slovenia along the border with Croatia. It has an area of 43.31 km^2 (Hladnik and Letič 2010). Kolpa Landscape Park was declared in 1998 by a municipal ordinance (Odlok … 1998) and is managed by the Public Institute of the Kolpa Landscape Park, which carries out activities under the provisions of the *Official Gazette of the Republic of Slovenia* no. 85 from 2006 (Uredba o Krajinskem … 2006). The main purpose of establishing Kolpa Landscape Park was to preserve natural values, biodiversity, and landscape diversity and to implement measures to ensure the conservation of Natura 2000 sites and ecologically important areas. Fifty-four percent of its area is part of the ecological network Natura 2000. The purpose of the park is therefore to integrate economic and social development and cross-border cooperation (Kolpa … 2017). Its main attraction is certainly the Kolpa River and its valley, which changes its character several times through the territory of the park (Hladnik and Letič 2010; Kolpa … 2017). In addition to the Kolpa River and other important natural values, such as natural monuments and a nature reserve, the cultural landscape is an important element for the park, intertwined with forests with leaf litter, dolines, and agricultural commons, which have been designed and preserved through diligent work to this day (Hladnik and Letič 2010; Kolpa … 2017). The park is also known for its rich cultural heritage, such as courtyards, castles, and numerous grain mills and sawmills along the Kolpa River (Kolpa … 2017).

Due to the natural and cultural elements, Kolpa Landscape Park can be viewed as an area with high conservation value and high development appeal and can therefore be promoted as a specific development area. In this case, as a protected area included in the IUCN at category V, protection and development are equally important (Lampič et al. 2011).

21.6 A Strict Nature Reserve: The Oak Woods (*Hrastova loza*)

Strict nature reserves are areas of naturally preserved geotopes, habitats of endangered, rare, or typical plant or animal species, or areas important for the conservation of biodiversity where natural processes take place without human impact (Zakon o ohranjanju … 1999); the presence of persons other than wardens is only exceptionally allowed in these areas and only for research and educational activities. The Oak Woods (*Hrastova loza*) Strict Nature Reserve (IUCN Ib), located in Kolpa Landscape Park, was designated in 1998 to protect beech stands with grey heron (*Ardea cinerea*) nests. The strict nature reserve encompasses an area of 0.02 km^2, where natural processes take place completely without human influence. Activities that threaten the conservation of this protected area are therefore prohibited. People are not allowed in the area, except those carrying out monitoring, research, or educational work (Kolpa … 2017). The protection regime for this small protected area is defined by the *Official Gazette of the Republic of Slovenia* no. 85 from 2006 (Uredba o Krajinskem … 2006). This includes prohibitions on approaching nesting sites during nesting time and changing the composition of zoocenosis by introducing other types of animals (Uredba o Krajinskem … 2006). The area is extremely important for the conservation of biodiversity and as such is defined as a zoological and ecosystem natural value and a strict nature reserve (Kolpa … 2017).

21.7 A Nature Reserve: The Oak Woods (*Hrastov gozd*) Virgin Forest in the Krakovo Forest near Kostanjevica na Krki

Nature reserves are areas of geotopes, habitats of endangered, rare, or typical plant or animal species, or areas important for the conservation of biodiversity that are being maintained through balanced human activity in the natural environment (Zakon o ohranjanju … 1999). The Krakovo Forest is located in southeastern Slovenia, on a flood plain along the Krka River, a transitional area of moderate warm humid climate with warm summers (Cfb) (Ogrin 1996). This is one of the most important Slovenian wetlands and also the largest contiguous flat wooded area of common oak, European hornbeam, and black alder. It is inhabited by various endangered plant and animal species (Landestrost 2017). In the central part of the forest, a 40.5-ha section has been protected as a nature reserve since 1952 and is exempt from forest management (Naravni … 2017). Hardly any traces of forest management can be found in it, which makes it an exceptional place for studying the forest's ecology and natural development. Oaks up to 40 m tall and over 250 years old grow in it.

21.8 A Natural Monument: Cross Cave (*Križna jama*), an Example of Slovenia's Fascinating Underworld

Natural monuments are defined as "areas that contain one or more natural values of exceptional shape, size, content, or location, or that are rare specimens of natural values" (Zakon o ohranjanju … 1999). In Slovenia, caves play an important role in the Natura 2000 network because they are the subject of preservation at more than 70 Natura 2000 sites (out of a total of 355; Natura … 2015). Cross Cave (*Križna jama*), a natural value like all caves in Slovenia, is also considered a natural monument. *Križna jama* is a water cave, 8 km long, in Inner Carniola. It is one of Slovenia's longest caves, although only around 10% of its length is open to visitors. The underground watercourse that flows through several dozen underground lakes makes this cave attractive for tourists. The cave is also the notable site of a rich find of cave bear bones. In terms of number of species, Cross Cave is among the most biodiverse karst caves in the world. The cave is among the average group of show caves in terms of visitor numbers, and so the cave does not suffer from mass tourism. Visits are guided and limited (in the water section) to put less pressure on the cave. The modest tourism infrastructure is maintained by revenue from tourism and volunteer work. From the protection point of view, the most important aspect is that the cave is managed sustainably; for example, parts of the cave are off limits to tourists to prevent threats to bats (Prelovšek 2010, 2011).

21.9 Development of Protected Areas and Their Role in Society

The lack of management plans for some protected areas and their actual management is especially reflected in the acceptance of protection among the local population. Protected areas and other important areas from the point of view of nature protection are poorly recognized and valued in Slovenia. This is mostly the result of the past definition of protected areas. Thus, even though these areas are exceptional at the EU level, their actual economic value is usually not recognized (Lampič and Mrak 2008).

Protected areas combine all of the core values of an area: environmental, economic, and cultural or social. Indeed, they are particularly valuable areas that, in addition to their principal value, also have important potentials that are crucial for the sustainable development of the entire country (Lampič and Mrak 2008).

These areas are a fundamental element in the conservation of Slovenia's rich natural and cultural environment. The preserved natural environment as well as a well-maintained cultural landscape has resulted in a high percentage of the country that has been identified as protected areas according to IUCN categories. Since 2004, the Natura 2000 areas have been additionally defined. The establishment of protected areas was necessary for nature conservation, but Slovenia's biodiversity and landscape diversity can only be maintained through human activities (e.g., farming and animal husbandry).

Protected areas offer the opportunity for conserved areas to become an internationally recognized asset of Slovenia (Podobnik 2008).

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Part V

Slovenia and the World

22 Slovenia: Comparisons

Drago Kladnik and Matjaž Geršič

Abstract

Slovenia's position relative to other countries is shown based on 147 indicators grouped into 22 categories. Data were collected from a variety of sources and systematically processed, and Slovenia was compared with 197 countries of the world, 47 European countries, and 27 European Union countries. Although Slovenia is a small central European country with only two million inhabitants, in some areas it ranks at or near the very top in an international or at least European context, for example, with respect to the relative proportions of forest and of protected areas, average age of the population and the closely related age index, the proportion of the labor force in industry, agricultural machinery, the proportion of electricity from nuclear fuels, and especially success in sports. It is also remarkably successful with regard to the quality of life and residence, as reflected in the Global Peace Index, the End of Childhood Index, and the Gini Index of Income Equality. It also ranks very high according to the number of research and technical journal articles per million people.

Keywords

Comparisons · Indicators · Rankings · European Union · Europe · World

22.1 Purpose and Method of Presentation

This chapter places Slovenia in a global context, showing how its territory and population in certain fields form an important and integral part of the global community. For the global scale, it took into account 198 countries, among which a few (Kosovo, Palestine, Taiwan, and Western Sahara) fail to meet all the criteria for independence and hence are only partially recognized by the international community.

Because Slovenia is a small country on a global scale, we also position it within its home continent of Europe and within the European Union, which it has been a member of since May 1, 2004. Through its membership in this wider economic and political association, Slovenia as a typical central European country at the transition between the developed western and northern part of the continent and its less developed eastern and southern part is exposed to contact with the older and better known and valued member states on the one hand, and on the other hand with the countries that entered the EU at the same time as Slovenia or are still waiting to do so. Russia, Turkey, and Kazakhstan were included among European countries: much of their territory is indeed in Asia, but based on their other continental and population characteristics, they are also embedded in dimensions, developments, and achievements for Europe and Europeans. Calculations for these countries at the level of Europe as a continent in general take into account only the proportional shares characterizing their European parts.

In order to compare Slovenia to the world, Europe, and the EU, we selected 147 indicators grouped into 22 different sets based on their related content (Table 22.1). These were formed in such a way as to cover a wide spectrum of information, from territorial features and natural conditions to characteristics of parliamentary democracy. Some indicators are straightforward and reflect only one characteristic or value, whereas others are composite and their final value is the result of calculations based on a series of partial characteristics expressed in numerical values. For the majority of indicators, the absolute or relative numerical values were taken from databases that are publicly accessible on the Internet; for particular indicators that are more complex in terms of content, detailed methodological explanations are also available, laying out in detail everything that was taken into account in the indicator and how the calculation of their

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© Springer Nature Switzerland AG 2020
D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_22

Table 22.1 Selected indicators of Slovenia's characteristics relating to its main natural, social, and economic features and their relative positions at the levels of the EU, Europe, and the world

Complex	Indicator	Slovenia	European Union	Rank within European Union (number of countries taken into account)	Europe	Rank within Europe (number of countries taken into account)	World	Rank within world (number of countries taken into account)
Territory and natural conditions	Total area (km²)	20,372	4,479,961	**25** (28)	10,180,000	**37** (48)	148,300,000	**152** (198)
	Length of land boundaries (km)	1,211	13,291	**19** (28)	38,252	**27** (48)	396,373	**117** (198)
	Length of coastline (km)	47	65,993	**23** (28)	114,759	**30** (48)	718,483	**146** (198)
	Mean elevation (m)	492	354	**5** (27)	300	**12** (44)	840	**70** (167)
	Highest point (m)	2,864	4,807	**8** (28)	5,633	**12** (48)	8,850	**77** (178)
	Average yearly temperature (°C)	8.9	8.8	**14** (28)	5.3	**23** (46)	15.6	**156** (191)
	Average precipitation (mm per year)	1,162	742	**2** (28)	656	**6** (41)	990	**77** (179)
	Renewable internal freshwater resources per capita (cubic meters)	9,054	2,966	**5** (28)	22,562	**10** (22)	5,923	**50** (177)
Vulnerability and environmental threat	Terrestrial protected areas (% of total land area)	54.0	19.7	**1** (28)	13.2	**2** (46)	11.4	**2** (187)
	Environmental Vulnerability Index	362	341	**7** (28)	307	**7** (45)	288	**27** (191)
	Natural Disaster Risk Index	3.41	3.39	**11** (28)	3.25	**18** (41)	5.36	**135** (173)
	Biocapacity (global hectares per person)	2.35	2.24	**14** (27)	5.09	**18** (40)	5.79	**56** (176)
	Ecological Footprint (global hectares per person)	5.81	5.18	**10** (27)	5.15	**10** (40)	4.37	**22** (176)
	Biocapacity: deficit or reserve (global hectares per person)	−3.46	−2.94	**21** (27)	−0.06	**32** (40)	1.42	**153** (176)
	Greenhouse gas emissions ($MtCO_2e$)	18.0	4225.4	**24** (28)	7523.0	**32** (42)	43633.2	**114** (182)
	Greenhouse gas emissions ($MtCO_2e$ per million inhabitants)	9.11	8.20	**11** (28)	9.46	**13** (42)	6.05	**43** (182)
Basic demographic data	Population	1,978,029	515,136,688	**23** (28)	795,332,727	**34** (48)	7,323,187,457	**145** (198)
	Population density (number of people per km²)	97.6	115.0	**17** (28)	78.0	**27** (48)	49.4	**84** (198)
	Urban population (%)	49.6	74.7	**28** (28)	73.6	**43** (47)	54.0	**123** (196)
	Largest town (number of inhabitants)	279,000	10,601,122	**25** (28)	14,164,000	**36** (48)	25,703,000	**150** (198)
	Population growth rate (% yearly)	−0.29	0.23	**22** (28)	0.40	**36** (47)	1.06	**185** (197)
	Net migration rate (% yearly)	0.4	2.5	**20** (28)	2.3	**28** (45)	0.0	**55** (194)
Population diversity	Proportion of immigrant population (%)	11.3	10.4	**13** (28)	9.9	**22** (47)	3.3	**48** (196)
	Proportion of dominant ethnic group (%)	83.1	87.3	**12** (21)	81.2	**18** (39)	66.9	**72** (167)
	Proportion of dominant religious group (%)	57.8	61.3	**25** (28)	59.5	**31** (48)	60.4	**125** (183)
	Linguistic Diversity Index	0.167	0.258	**19** (28)	0.297	**29** (47)	0.564	**147** (196)
	Ethnic Diversity Index	0.222	0.184	**12** (28)	0.239	**26** (44)	0.404	**137** (190)
	Religion Diversity Index	0.287	0.444	**17** (28)	0.412	**27** (44)	0.466	**130** (189)
	Cultural Diversity Index	0.170	0.157	**15** (26)	0.203	**11** (37)	0.349	**102** (148)

(continued)

Table 22.1 (continued)

Complex	Indicator	Slovenia	European Union	Rank within European Union (number of countries taken into account)	Europe	Rank within Europe (number of countries taken into account)	World	Rank within world (number of countries taken into account)
Sex and age characteristics of population	Sex ratio (male/female)	0.95	0.96	**17** (28)	0.95	**27** (47)	1.02	**154** (196)
	Median age (years)	44.1	42.7	**4** (28)	40.7	**6** (47)	30.1	**7** (197)
	Age up to 15 years (%)	13.35	15.46	**27** (28)	16.69	**44** (47)	25.44	**191** (197)
	Age 15 to 64 years (%)	67.70	65.47	**6** (28)	66.53	**15** (47)	65.88	**141** (197)
	Age over 64 years (%)	18.95	19.07	**15** (28)	16.78	**17** (47)	8.68	**18** (197)
	Age index (up to 15 years / over 64 years × 100)	141.9	123.3	**4** (28)	97.4	**5** (47)	34.1	**6** (198)
	Life expectancy at birth, total population (years)	78.2	80.2	**19** (28)	77.8	**27** (45)	69.0	**42** (194)
	Life expectancy at birth, male (years)	74.6	77.4	**19** (28)	74.5	**27** (45)	67.0	**51** (194)
	Life expectancy at birth, female (years)	82.0	83.2	**16** (28)	81.2	**23** (45)	71.1	**33** (194)
Indicators of natural population growth	Birth rate (‰ yearly)	8.3	10.1	**28** (28)	10.9	**43** (46)	18.5	**194** (196)
	Mother's mean age at first birth (years)	29.0	28.5	**19** (28)	27.1	**31** (42)	23.5	**118** (132)
	Total fertility rate (number of children per woman)	1.40	1.61	**26** (28)	1.65	**41** (45)	2.41	**189** (196)
	Death rate (‰ yearly)	11.5	10.2	**9** (28)	10.4	**14** (46)	7.8	**29** (196)
	Natural population growth (‰ yearly)	−3.2	0.0	**24** (28)	0.6	**37** (46)	10.7	**190** (196)
Health	Average male height (cm)	180.3	177.8	**8** (25)	176.4	**11** (35)	168.4	**11** (82)
	Average female height (cm)	167.4	163.1	**4** (23)	163.3	**7** (34)	156.3	**7** (118)
	Physicians (number per 1,000 inhabitants)	2.77	3.53	**25** (28)	3.27	**35** (45)	1.41	**48** (170)
	Hospital beds (number per 1,000 inhabitants)	4.6	5.3	**19** (28)	5.9	**26** (45)	2.8	**43** (180)
	Infant mortality rate (‰ yearly)	4.0	4.0	**16** (28)	6.2	**22** (45)	34.1	**27** (195)
	HIV/AIDS (% of infected adults)	0.08	0.25	**12** (16)	0.31	**17** (25)	0.80	**116** (135)
	Obesity rate (% of adults)	27.4	25.2	**5** (28)	25.3	**7** (43)	12.4	**39** (190)
	Smoking prevalence, males (%)	23.6	33.7	**24** (27)	38.4	**35** (40)	35.5	**97** (125)
	Smoking prevalence, females (%)	18.9	24.7	**25** (27)	22.5	**31** (40)	6.8	**39** (127)
	Improved drinking water source (% of households)	99.5	99.7	**23** (28)	99.5	**32** (44)	91.1	**51** (192)
	Improved sanitation facility access (% of households)	99.1	97.1	**13** (28)	93.7	**15** (44)	67.7	**30** (191)
Security	Murders (number per 100,000 inhabitants per year)	1.21	1.04	**11** (28)	3.02	**21** (48)	5.33	**153** (197)
	Suicides (number per 100,000 inhabitants per year)	15.0	9.9	**6** (28)	11.3	**9** (42)	10.5	**32** (182)
	Road fatalities (number per 100,000 inhabitants per year)	6.4	5.5	**14** (28)	8.3	**24** (44)	17.4	**147** (175)
	Incarceration rate (number of prisoners per 100,000 inhabitants)	73	116	**24** (28)	180	**36** (46)	147	**143** (191)
	Global Peace Index (GPI)	1,364	1,586	**5** (26)	1,761	**6** (41)	2,102	**7** (163)

(continued)

Table 22.1 (continued)

Complex	Indicator	Slovenia	European Union	Rank within European Union (number of countries taken into account)	Europe	Rank within Europe (number of countries taken into account)	World	Rank within world (number of countries taken into account)
Education	School life expectancy (years)	17.0	16.9	**10** (28)	16.3	**14** (44)	13.1	**14** (160)
	Literacy (% of adults)	99.7	99.4	**17** (28)	99.0	**24** (46)	86.1	**38** (181)
	Literacy, males (% of adults)	99.7	99.6	**17** (28)	99.5	**25** (46)	89.9	**41** (181)
	Literacy, females (% of adults)	99.7	99.3	**16** (28)	98.5	**22** (46)	82.2	**34** (181)
	End of Childhood Index	985	972	**1** (25)	955	**1** (39)	814	**1** (172)
Unemployment, earnings, and contentedness	Unemployment rate (% of active population)	11.2	9.4	**6** (28)	8.8	**12** (47)	7.3	**62** (177)
	Unemployment rate (youth ages 15–24)	20.2	25.3	**11** (28)	22.9	**18** (43)	15.3	**92** (146)
	Average monthly net salary (after tax, USD)	1155	1778	**16** (28)	1400	**19** (43)	870	**36** (111)
	Population below poverty line (%)	14.3	18.2	**17** (24)	17.8	**24** (37)	20.8	**125** (157)
	Gini Index of Income Equality	25.7	31.4	**1** (27)	33.5	**3** (42)	38.7	**3** (161)
	Social Progress Index	84.32	85.04	**13** (26)	78.76	**16** (39)	64.97	**21** 129
	Legatum Prosperity Index	21	24	**13** (28)	37	**16** (41)	75	**21** (148)
	Corruption Perceptions Index (country ranks)	141	144	**15** (28)	127	**25** (43)	88	**141** (176)
	Ease of Doing Business Index	29	24	**16** (28)	35	**19** (44)	94	**29** (188)
	World Happiness Report	5.768	6.407	**21** (28)	6.103	**26** (43)	5.266	**62** (154)
Gross domestic product (GDP)	GDP (USD billion)	43.99	16,516.54	**23** (28)	19,988.37	**29** (47)	119,300.00	**83** (196)
	GDP per capita (USD)	33,100	39,200	**17** (28)	33,200	**24** (47)	16,300	**42** (197)
	GDP, real growth rate (% yearly)	2.5	1.9	**12** (28)	1.8	**20** (47)	3.0	**100** (196)
	Health expenditures (% GDP)	9.2	10.0	**11** (28)	9.6	**16** (45)	10.1	**37** (190)
	Education expenditures (% GDP)	5.5	5.3	**10** (27)	5.2	**14** (42)	4.8	**42** (164)
	Research and development expenditure (% GDP)	2.59	2.01	**6** (28)	1.92	**7** (43)	2.05	**11** (129)
	Military expenditures (% GDP)	0.93	1.40	**21** (28)	1.63	**31** (44)	2.42	**120** (154)
Activity sectors	GDP, proportion of agriculture (%)	2.3	1.5	**15** (28)	2.0	**28** (47)	6.3	**158** (195)
	GDP, proportion of industry (%)	33.6	24.5	**6** (28)	25.8	**11** (47)	30.2	**69** (195)
	GDP, proportion of services (%)	64.1	74.0	**23** (28)	72.2	**32** (47)	63.5	**77** (196)
	Labor force in agriculture (%)	3.7	5.0	**15** (28)	7.3	**27** (47)	31.7	**146** (179)
	Labor force in industry (%)	31.7	21.9	**2** (28)	24.1	**4** (47)	23.6	**13** (177)
	Labor force in services (%)	64.6	73.1	**25** (28)	68.6	**35** (47)	44.7	**69** (177)
Public finance	Taxes and other revenues (% of GDP)	43.8	45.2	**11** (28)	39.8	**16** (47)	26.3	**24** (195)
	Public debt (% of yearly GDP)	81.8	86.8	**11** (28)	76.6	**11** (46)	59.6	**28** (177)
	Reserves of foreign exchange and gold (USD billion)	0.75	1,185.57	**26** (28)	2,377.63	**38** (43)	11,242.90	**131** (169)
	External debt (USD billion)	46.30	39,751.18	**24** (28)	43,235.44	**29** (45)	75,890.00	**62** (191)
	Inflation rate (% yearly)	0.5	0.1	**7** (28)	1.3	**19** (47)	3.6	**150** (195)

(continued)

Table 22.1 (continued)

Complex	Indicator	Slovenia	European Union	Rank within European Union (number of countries taken into account)	Europe	Rank within Europe (number of countries taken into account)	World	Rank within world (number of countries taken into account)
External trade	Exports (USD billion)	20.56	4,977.78	**22** (28)	5,898.93	**28** (47)	15,780.00	**65** (195)
	Imports (USD billion)	20.52	4,784.59	**22** (28)	5,548.88	**28** (47)	15,130.00	**67** (195)
	Export/import ratio	1.00	1.04	**10** (28)	1.06	**16** (47)	1.04	**53** (195)
	Proportion of exports in GDP (%)	46.7	30.1	**10** (28)	29.5	**13** (47)	20.4	**26** (195)
Land use, agriculture	Agricultural land (%)	22.8	43.8	**24** (28)	31.9	**37** (48)	34.4	**144** (197)
	Arable land (%)	8.4	25.4	**26** (28)	19.2	**38** (48)	10.6	**118** (147)
	Arable land (hectares per person)	0.08	0.21	**24** (28)	0.53	**35** (47)	0.20	**130** (188)
	Permanent crops (%)	1.3	2.7	**13** (28)	1.5	**20** (48)	1.1	**99** (197)
	Irrigated land (km²)	60	183,071	**22** (28)	256,288	**33** (48)	3,242,917	**145** (194)
	Fertilizer consumption (kg per hectare of arable land)	267.38	152.65	**4** (28)	94.20	**5** (42)	123.06	**25** (157)
	Agricultural machinery (tractors per 100 km² of arable land)	5,895	814	**1** (28)	488	**1** (43)	144,0	**1** (174)
	Forest (%)	62.3	34.7	**3** (28)	38.9	**3** (48)	27.8	**20** (196)
	Total fisheries production (metric tons)	1,853	6,846,853	**27** (27)	16,860,874	**40** (46)	192,902,618	**171** (188)
Tourism	International tourism, number of arrivals	2,411,000	457,916,000	**24** (28)	567,521,000	**29** (46)	1,087,303,400	**62** (183)
	International tourism, number of departures	2,642,000	407,564,000	**20** (28)	505,138,000	**26** (38)	1,087,303,400	**56** (124)
	International tourist arrival/departure ratio	0.91	1.12	**18** (28)	1.12	**21** (38)	1.00	**75** (119)
	Tourists' overnight stays (thousands)	4,868	1,661,903	**23** (28)	1,788,619	**27** (40)	2,403,009	**47** (88)
	Average length of tourist stay (days)	2.49	4.36	**17** (28)	3.74	**22** (40)	3.83	**53** (88)
	International tourism, receipts (USD million yearly)	2,697	438,817	**20** (28)	525,749	**24** (42)	1,436,984	**59** (154)
	International tourism, receipts (USD per inhabitant)	1,363	837	**10** (28)	623	**13** (42)	196	**25** (154)
Energetics	Electricity, installed generating capacity (MW)	3,370	982,812	**23** (28)	1,444,062	**31** (47)	6,301,000	**93** (196)
	Proportion of electricity from hydroelectric plants (%)	32.0	14.7	**5** (28)	18.9	**13** (47)	18.4	**72** (196)
	Proportion of electricity from other renewable sources (%)	1.7	22.7	**27** (28)	16.0	**34** (47)	1.5	**79** (196)
	Proportion of electricity from fossil fuels (%)	31.9	48.7	**23** (28)	52.7	**33** (47)	64.3	**154** (196)
	Proportion of electricity from nuclear fuels (%)	34.4	13.9	**4** (28)	12.4	**4** (47)	6.8	**4** (196)
	Electricity production (billion KWh)	16.53	3,159.96	**21** (28)	4,997.49	**29** (45)	23,140.00	**83** (194)
	Electricity consumption (billion KWh)	14.57	2,842.59	**22** (28)	4,579.17	**30** (45)	21,360.00	**80** (194)
	Electricity production/consumption ratio	1.13	1.11	**8** (28)	1.09	**13** (45)	1.00	**103** (194)
	Energy use (kg of oil equivalent per capita)	3.18	3.21	**11** (21)	3.01	**13** (25)	4.12	**19** (34)
	Energy use (kg of oil equivalent per USD 1,000 of GDP)	109.1	87.1	**16** (21)	84.9	**18** (25)	109.2	**26** (34)

(continued)

Table 22.1 (continued)

Complex	Indicator	Slovenia	European Union	Rank within European Union (number of countries taken into account)	Europe	Rank within Europe (number of countries taken into account)	World	Rank within world (number of countries taken into account)
Land transportation	Railway length (km)	1,229	237,353	**25** (28)	334,660	**31** (47)	1,148,186	**86** (196)
	Railway network density (km / 100 km² territory)	6.06	5.29	**13** (28)	3.35	**15** (47)	0.89	**19** (196)
	All roads length (km)	38,985	6,284,985	**23** (28)	8,510,978	**30** (47)	64,285,009	**91** (195)
	Paved roads length (km)	38,985	4,771,793	**21** (26)	6,527,535	**25** (45)	20,670,558	**53** (178)
	Motorway length (km)	612	81,193	**24** (27)	128,791	**27** (46)	436,068	**57** (187)
	Motorway network density (km / 100 km² territory)	30.19	18.57	**10** (27)	12.88	**11** (46)	2.94	**14** (187)
	Registered vehicles	1,395,704	325,351,364	**23** (28)	421,598,866	**30** (47)	1,801,387,018	**81** (194)
	Registered vehicles per 1,000 inhabitants	706	632	**8** (28)	530	**12** (47)	247	**17** (194)
Telephony and internet	Fixed line telephones (per 100 inhabitants)	38	31	**14** (28)	35	**22** (46)	15	**30** (195)
	Mobile/cellular phones (per 100 inhabitants)	119	122	**17** (28)	125	**25** (46)	96	**75** (195)
	Internet users (% of households)	73.1	79.7	**19** (28)	73.9	**26** (46)	43.3	**46** (193)
Science	Researchers in research and development (per million people)	4,216.8	3,414.6	**8** (28)	2,922.9	**11** (41)	1,143.1	**17** (119)
	Scientific and technical journal articles, classified in SCI in SSCI (yearly number)	3,514.2	599,306.6	**20** (28)	711,681.7	**26** (47)	2,136,723.4	**51** (187)
	Scientific and technical journal articles, classified in SCI in SSCI (per million people)	177.7	116.3	**4** (28)	88.7	**7** (47)	29.4	**9** (187)
Sports	Olympic Games medals (total number)	38	8,204	**20** (28)	9,919	**26** (48)	16,841	**45** (198)
	Total number of Olympic Games each country has participated in	14	35	**25** (28)	29	**33** (48)	18	**86** (198)
	Olympic medals (per million inhabitants)	19.21	15.93	**10** (28)	12.47	**13** (48)	2.30	**18** (198)
	Olympic medals (by number of Olympic Games each country has participated in, per ten million inhabitants)	13.72	3.72	**3** (28)	4.30	**5** (48)	0.68	**7** (198)
	Sports Efficiency Index (inhabitants per point)	4,359	28,654	**1** (24)	44,759	**2** (32)	815,913	**3** (62)
	FIFA Ranking (July 2017)	51	48	**19** (28)	62	**25** (46)	95	**51** (189)
Parliamentary democracy	Number of seats in national parliament	90	7,085	**25** (28)	10,078	**36** (48)	38,980	**132** (197)
	Population per seat	21,678	72,708	**7** (28)	83,068	**17** (48)	187,516	**53** (197)
	Proportion of seats held by women (%)	36.7	28.5	**7** (28)	26.3	**10** (47)	22.6	**24** (188)
	Governmental Effectiveness Index	83.65	83.47	**13** (28)	69.50	**18** (45)	53.99	**27** (184)
	Rule of Law Index	0.67	0.74	**16** (21)	0.64	**17** (32)	0.52	**28** (113)

Data sources: Greatest Sporting Nation (2015), Governmental Effectiveness Index (2016), Rule of Law Index (2016), Encyclopedia of Nations (2017), FIFA (2017), Save the Children (2017), IndexMundi (2017), NationMaster (2017), NUMBEO (2017), Social Progress Index (2017), The World Bank (2017), The World Factbook: CIA (2017), The Legatum Prosperity Index (2017), Wikipedia (2017), and World Health Organization (2017) values was performed. Among the indicators cited are 17 for which we calculated the values ourselves based on several selected indicators. We used these because we wanted to further elucidate some patterns that reveal the position and role of Slovenia at particular comparative levels.

The main part of this chapter contains an extensive table in which the indicators taken into account are grouped into sets according to content. The largest number of indicators (11) is in the set relating to health, and the smallest number (3) is in the sets relating to telephony and the Internet and to science. Each indicator takes up one line in the table, and its characteristics expressed in numerical values are expressed in nine vertical columns. The first two (the set and the indicator) are informative.

The remaining seven columns contain numerical values: the third column gives the absolute or relative value for Slovenia, the fourth column for the EU, the sixth column for all of Europe, and the eighth column for the entire world. The other three columns show Slovenia's comparative ranking: the fifth column shows Slovenia's place within the EU, the seventh column Slovenia's place among European countries, and the ninth column Slovenia's place compared to the countries of the world. The rankings of Slovenia are given in the columns, with the number of countries taken into account are given in parentheses because data are not available for all countries. In this way the rankings are offset to some extent, generally speaking to a greater degree when the comparison was made based on a smaller number of countries.

22.2 Territory and Natural Features

Slovenia is one of the smaller countries of the world. Its smallness relative to other countries is especially noticeable within the European Union, in which only Malta, Luxembourg, and Cyprus are smaller. On the global scale it is at the beginning of the last quarter of countries. Because its land borders are fairly circuitous, Slovenia's ranking according to the indicator length of land boundaries shifts considerably higher. It has a very short coastline, and based on this indicator, it ranks at the very bottom: the most countries ranked lower on the world scale are those that are landlocked, without access to the sea. In terms of average elevation, it is at the top of the second third of countries on the global scale, at the top of the second quarter in Europe, and at the bottom of the first fifth in the EU. It ranks similarly in a comparison of the highest points of countries (Fig. 22.1). Globally it is among the colder countries, ranking at the beginning of the last quarter in terms of average yearly temperature but right at the halfway point compared to other countries in Europe and the EU. Precipitation is above the world average, and Slovenia stands out especially when compared to countries of the European Union (second place) and Europe (sixth place). Thanks to abundant precipitation, it has plentiful reserves of drinking water (Fig. 22.2). Calculated per capita, the result places Slovenia fifth in the EU, tenth in Europe, and fiftieth in the world.

Fig. 22.1 Slovenia's relief is greater than average compared to other countries: its highest point, Mount Triglav (2864 m), places it seventy-seventh in the world and twelfth in Europe with respect to this indicator. (Photo by Bojan Erhartič, GIAM ZRC SAZU Archive)

Fig. 22.2 Due to abundant precipitation, Slovenia has fairly plentiful reserves of drinking water; pictured is the Bled Gorge (*Blejski vintgar*), which was carved out by the Radovna River. (Photo by Bojan Erhartič, GIAM ZRC SAZU Archive)

Slovenia ranks at the very top with respect to the proportion of protected areas. In 2014 as much as 54% of the country's territory was protected in some way. At the same time, due to its location in an earthquake zone, varied topography, and frequent episodes of extreme weather, it also ranks high on the Environmental Vulnerability Index and Natural Disaster Risk Index. Furthermore, it is among countries that stand out with respect to having a high ecological footprint, and somewhat less so with respect to biocapacity. The ratio between these last two indicators indicates a deficit in the available biocapacity characteristic of Slovenia, but this deficit is less than it would be otherwise because of Slovenia's large extent of forestation (Fig. 22.3). With respect to greenhouse gas emissions, Slovenia is not among the globally significant polluters; however, if emissions per million inhabitants are taken into account, the picture is quite different: based on this indicator, Slovenia ranks at the top of the second third of EU countries, at the top of the second quarter of countries in Europe, and toward the bottom of the first quarter of countries in the world. The growing extent of forested areas is favorable for environmental quality, but on the other hand, this is accompanied by overgrowth and hence gradual decline of the cultural landscape of less favored areas. Slovenia is ranked third in the EU and in Europe as a whole, and in twentieth place in the world, with respect to the extent of forested area.

22.3 Social Dimensions

Slovenia is also one of the smaller countries of the world, in Europe, and in the EU in terms of population. In the EU only Estonia and Latvia, along with the three countries smaller in area than Slovenia, have smaller populations. The population density in Slovenia is above the global and European averages, but below average within the EU. It is interesting that, with respect to the share of the population living in towns in the urbanized EU, Slovenia is at the very bottom, although it ranks somewhat higher within Europe, and it is in 123rd place in the world. Slovenia's largest and capital city, Ljubljana (Fig. 22.4), is also small in terms of the population of the largest town of a country, ranking 150th at the global level. Population growth is negative; hence, Slovenia ranks very low on all three scales, but the country's position improves based on the net migration rate because it has traditionally attracted migrants from less developed Balkan countries. With respect to the proportion of the immigrant population, it is in the middle relative to Europe and at the tail end of the first quarter of countries globally.

The homogeneity of Slovenia is slightly above average with respect to the proportion of the dominant ethnic group. With respect to the proportion of the dominant religious group (Fig. 22.5), it is slightly more heterogeneous than the global average. All of this is reflected in the indexes of linguistic, ethnic, and religious diversity.

Fig. 22.3 Forest covers three-fifths of Slovenia's territory; the photo shows a scene from the high karst Trnovo Forest Plateau. (*Trnovski gozd*; photo by Bojan Erhartič, GIAM ZRC SAZU Archive)

Fig. 22.4 The capital city of Ljubljana is a small but attractive central European town with an old city center beneath a majestic castle. (Photo by Bojan Erhartič, GIAM ZRC SAZU Archive)

Among the most worrying are Slovenia's unfavorable demographic indicators, which clearly reflect serious deficiencies in the population structure and its dynamics. The sex ratio shows a clear predominance of women over men. In terms of median age, which divides the entire population into two exactly equal halves, the Slovenian population ranks near the very top in Europe and globally. The unfavorable value of this indicator is also confirmed by the age index, which reflects the ratio between the elderly and the young population. Slovenia ranks high at the global level for life

Fig. 22.5 Slovenia is a country of many churches, reflecting the membership of the majority of the population in the Catholic faith. (Photo by Bojan Erhartič, GIAM ZRC SAZU Archive)

expectancy at birth, but its position in Europe, and even more so in the EU, is in the bottom half. Data showing a low birth rate, according to which Slovenia is in last place in the EU and among the lowest in the world, are also a source of concern. Women on average give birth for the first time at a relatively older age, and Slovenia is also ranked close to last at the global level according to the number of children per woman. Data for Slovenia's death rate are somewhat more favorable, but it still remains above the European average and well above the global average. The result is a negative rate of natural population growth, which stands out at all levels of comparison.

Slovenians tend to be tall, especially the women. At the same time, they have a higher than average obesity rate, ranking fifth in the European Union, seventh in Europe, and thirty-ninth globally. In terms of physicians and hospital beds, Slovenia comes in at the end of the first quarter of countries globally but near the tail end in Europe and even closer to last in the European Union. This does not mean that the Slovenian healthcare system is inefficient, as confirmed by the fairly favorable data on infant mortality and HIV/AIDS infection. The smoking prevalence of Slovenians is close to the average globally but considerably lower than average in the EU. Indicators for drinking water supply and access to sanitation are also favorable.

Slovenia is a relatively safe country, as expressed by the Global Peace Index, according to which it ranks fifth in the EU, sixth in Europe, and seventh in the world. Of all the indicators in this set, the most favorable is the incarceration rate (Slovenia's is among the lowest, especially within the EU), and the least favorable is the suicide rate, according to which the country ranks near the top on all three scales.

The education system is appropriately structured, as reflected not least of all in the high literacy rate. Slovenia performs even better according to the End of Childhood Index: Along with Norway, it tops the list in Europe and globally. Data on unemployment are also favorable; however, data for the youth unemployment rate are somewhat less so. According to the average monthly net salary, Slovenia ranks near the bottom of the first fifth of countries at the global level, in the middle in Europe, and in the lower half within the EU. Thanks to a considerable degree of economic equality, expressed best in the Gini Index of Income Equality (according to which Slovenia is first in the EU and third in Europe and the world), Slovenia ranks among countries with a low proportion of the population below the poverty line. Despite this, the country's inhabitants are not among the happiest, neither in the EU nor in Europe. At the global level, Slovenia fares somewhat better, as shown not only by this index but also by the Legatum Prosperity Index. Although Slovenians are under the impression that the country is quite corrupt, the indicator on corruption does not confirm this because Slovenia is somewhere near the average for Europe and well down the list globally.

22.4 Economic Indicators

Slovenia is in eighty-third place globally with respect to gross domestic product (GDP), which is considerably higher than its position in terms of area and population. Within Europe it is in twenty-ninth place and, in the EU, twenty-third, the same as its position with regard to population size. It ranks in the lower half of the EU with respect to GDP per capita, but at the very top of the lower half of countries in Europe. Its rank globally is relatively high, at the top of the second fifth or forty-second place. Annual growth of GDP is substantial.

Slovenia also ranks high in terms of the proportion of GDP spent on health and education, and even higher (sixth place in the EU, seventh place in Europe, and eleventh place in the world) in the proportion of GDP spent on research and development. It ranks considerably lower with regard to the proportion of GDP spent on the military. With regard to the relative proportions of activity sectors in the structure of GDP, the role of industry stands out positively. According to this indicator, Slovenia is in sixth place within the EU, eleventh place in Europe, and sixty-ninth place in the world, and if one considers the relative proportions of the labor force in industry, it is even higher: in second place in the EU, fourth place in Europe, and thirteenth place in the world. At the global level, the role of the service sector is slightly above average and the role of agriculture below average, whereas at the European level, the role of the service sector is below average and the role of agriculture slightly above average, and this is even more noticeable in a comparison with other EU countries.

Globally, Slovenia also ranks high according to the Ease of Doing Business Index, although its position relative to other EU countries, near the top of the bottom half, is unexceptional. With respect to the level of taxes and public debt, it ranks high on all scales. The ratio between foreign exchange reserves and external debt is also unfavorable; however, the latter is fairly high in all developed countries, and so Slovenia is near the bottom of the scale within the EU. In recent years, the annual rate of inflation has fallen substantially, which can be observed particularly in a global comparison but is somewhat less noticeable within the EU. Important elements of Slovenian economic power are its export orientation and foreign trade more generally. Slovenia is in sixty-fifth place globally according to the value of annual exports and in sixty-seventh place according to the value of imports. It is higher on the scale with respect to the external trade balance and especially the proportion of exports in GDP, according to which it is in tenth place in the EU, thirteenth place in Europe, and twenty-sixth place in the world.

As mentioned above, Slovenia is an exceptionally heavily forested country and consequently significantly closer to the bottom of the scale with respect to the percentage of agricultural and arable land. It ranks considerably higher with respect to the percentage of permanent crops (vineyards, orchards, olive groves, hop fields, etc.). Because Slovenia has abundant precipitation, the area of irrigated land is very small; for this reason, summer droughts are also increasingly common. The country is at the very top globally in terms of agricultural machinery, as reflected in the indicator number of tractors per 100 km^2 of arable land. These are mainly small tractors used on small family farms with scattered holdings of arable land; generally speaking, each farm has several tractors. Unfortunately, Slovenia is also in a leading position in Europe and the world with respect to extensive use of chemicals in agriculture, as reflected in the indicator on the quantity of chemical fertilizer per area unit of arable land. It is well behind other countries in marine and freshwater fisheries production.

An important economic activity is tourism. Slovenia is in sixty-second place globally in terms of tourist arrivals, but it ranks lower down the scale relative to European countries and even lower relative to EU countries. It ranks somewhat higher with respect to the number of people that travel to foreign countries, with the number of international arrivals slightly lower than the number of Slovenians that travel abroad. Because the average length of stay by international tourists in Slovenia is shorter than the average, the country on the global scale, in Europe, and in the EU is ranked at the beginning of the bottom half of the countries taken into account. Revenues from tourism are growing; according to the indicator receipts per inhabitant, Slovenia ranks high on all three scales: tenth in the EU, thirteenth in Europe, and twenty-fifth in the world.

22.5 Infrastructure Indicators

Infrastructure facilities are good, as evidenced by the aforementioned indicators of improved drinking water source and improved sanitation facility access. Slovenia has a well-developed energy system. Based on installed generating capacity, it ranks in the top half of countries globally, but of course it is closer to the bottom within Europe and the EU. It ranks somewhat better according to annual production and consumption of electrical energy: it produces more than it consumes. With respect to the relative proportions of sources of energy, Slovenia diverges noticeably from global averages. The proportion of hydroelectric power (Fig. 22.6) is well above the global and European averages, and the proportion of energy from nuclear fuels is even more so. For nuclear fuels, Slovenia occupies a very high fourth place on

Fig. 22.6 Hydroenergy plays a highly important role in Slovenian energy production due to the country's water resources. In recent decades, a chain of hydroelectric plants has been newly constructed on the Sava River, among them the Krško hydroelectric power plant. (Photo by Bojan Erhartič, GIAM ZRC SAZU Archive)

all three scales, and it is in fifth place in the EU according to the proportion of hydroelectric power. For this reason, the production of energy from fossil fuels and from renewable sources other than hydroelectric (wind and solar energy) is below average: within the EU, Slovenia ranks nearly last, although somewhat higher on the global scale. Slovenia ranks high on all scales according to energy use per capita and in energy consumption in GDP.

The country has a well-developed railway and road network. Slovenia ranks quite high on the scales with respect to the density of both networks: thirteenth in the EU and nineteenth in the world according to railway network density and tenth in the EU and fourteenth in the world according to motorway network density. A high degree of motorization, enabling daily commuting between home and work, is the characteristic of Slovenia because public transport is poorly developed even as settlement is highly dispersed and a good half of the population lives in rural areas. Slovenia's ranking in terms of the number of registered vehicles per thousand inhabitants is a high eighth place in the EU, twelfth place in Europe, and seventeenth place in the world.

With respect to fixed line and mobile/cellular telephones, Slovenia is among the more highly developed countries in the world and average for the EU and Europe. This also holds true for access to the Internet, which is used by about three-fourths of households.

22.6 Other

This section looks at some other indicator sets that cannot be classified in the sections above. In two of them, science and sports, Slovenia's role is far from inconsequential. In terms of the number of researchers per million inhabitants, Slovenia is in eighth place in the EU, eleventh in Europe, and seventeenth in the world, and according to the number of scientific and technical journal articles per million inhabitants, its ranking is even higher: fourth place in the EU, seventh place in Europe, and ninth in the world. On a global scale it also ranks high according to the yearly number of published journal articles, occupying fifty-first place.

Slovenia is even more successful in the world of sports (Fig. 22.7), which is also reflected in the population's widespread involvement in recreational sporting activity (Fig. 22.8). In terms of the number of Olympic medals (Slovenian athletes have participated in only 14 Winter and Summer Olympic Games to date), Slovenia is in twentieth place in the EU, twenty-sixth place in Europe, and forty-fifth

Fig. 22.7 Slovenians are one of the most athletic nations in the world, as demonstrated by their successes in many areas, including winter sports, in which champion skier Tina Maze has had the most outstanding results. (Photo by Mitch Gunn, Shutterstock.com)

Fig. 22.8 Slovenians are also recreational sports enthusiasts. One of the most popular forms of recreation is mountain hiking. Pictured is the rock window below Mount Olševa (1929 m) in the Eastern Karawanks. (Photo by Janko Herlah, GIAM ZRC SAZU Archive)

in the world; if the number of medals is weighted by the number of inhabitants, Slovenia climbs to tenth place on the scale of success within the EU, thirteenth place in Europe, and eighteenth place globally. Taking further into account the total number of times a country has participated in the Olympic Games, Slovenia occupies third place within the EU, fifth place in Europe, and seventh place in the world. Slovenian athletes are successful in many sporting disciplines and also in team sports, as evidenced by the Sports Efficiency Index (Greatest Sporting Nation 2015), according to which in 2015 Slovenia was first in the EU, second in Europe, and third in the world. Success in team sports, notably basketball, handball, and volleyball, is confirmed by the relatively high ranking of the Slovenian national team in men's soccer by the International Federation of Association Football (FIFA 2017).

Finally, some indicators of parliamentary democracy should be considered. Because Slovenia is a small country in terms of population size, it is understandable that the number of members or seats in the parliament corresponds to that. Yet, with respect to population per seat, it is much higher in the rankings (seventh place in the EU, seventeenth place in Europe, and fifty-third place in the world) because small countries generally have a relatively larger number of MPs than large countries. The representation of women in the parliament is above average: according to this indicator, Slovenia occupies seventh place in the EU, tenth place in Europe, and twenty-fourth place in the world. The country has a fairly effective government in a comparative framework, and it is only slightly less successful in terms of the rule of law (sixteenth place in the EU, seventeenth place in Europe, and twenty-eighth place in the world), although residents often have a sense of inequality under the law.

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23 Slovenia's Records and Outstanding Features

Drago Perko and Matjaž Geršič

Abstract

Slovenia may be one of the smallest countries in the world, but it nonetheless possesses an above-average number of special features, or true geographical and similar records, at both the European and global levels. Some of them are completely coincidental, and others are connected with Slovenia's landscape diversity, turbulent history, and location at the intersection of Slavic, Germanic, and Romance cultural influences. They are all part of the Slovenia's natural and cultural heritage.

Keywords

Natural heritage · Cultural heritage · Records · Europe · World

23.1 Small Is Beautiful

The phrase "small is beautiful" from a book by the British economist Ernst Friedrich Schumacher (1973) is often used to champion small things in contrast with phrases such as "bigger is better." With an area of just over 20,000 km^2 and a population of two million, Slovenia likes to use this phrase alongside "less is more" because it is difficult to compete against large countries in Europe and the rest of the world in terms of absolute values.

However, in relative values per population or area, Slovenia outmatches the majority of countries—or even all of them in some areas. In addition, it features many natural, historical, and cultural artifacts and monuments that are of exceptional value at the Central European, European, and even global scale (Fig. 23.1). These range from the oldest musical instrument in the world, with which Neanderthals whistled across the Idrijca Valley on the border between the warmer Mediterranean and icebound Europe, and the world's oldest grapevine, which has borne fruit in the center of Maribor for over four centuries, to the southeasternmost glaciers in the Alps, which are disappearing before our eyes and reflect the rapid climate changes occurring around the world.

Slovenia has the greatest biodiversity per unit of surface area (Mršić 1997), and Slovenian caves are renowned for the greatest subterranean biodiversity in terms of the number of subterranean species alone. Many subterranean animals were first discovered and described in Slovenia. Nearly two-fifths of its territory is currently protected as Natura 2000 sites, which makes up the largest share among all EU countries. In addition, Slovenia is among the most wooded countries in the world. From the beginning to the end of the twentieth century, the share of forests increased from a third to nearly two-thirds.

Also because of this, in 2016 the Green Destinations organization selected Slovenia as the first green destination in the world based on 100 criteria and 15 key criteria. The criteria take into account all aspects of sustainability, the protection of living and nonliving nature, conservation of the cultural landscape, wastewater treatment and waste separation, reduction in fossil fuel dependency, conservation of cultural and natural heritage, local community participation and the promotion of local products, mobility, providing access to individuals with mobility impairments, and so on. In addition to countries, the Green Destination certificate can also be awarded to destinations within a country and tourist accommodation providers. So far, 25 destinations and 13 tourist accommodation providers have received this certificate in Slovenia (Prijatelj Videmšek 2016).

The Slovenian language also has certain special features. It is among the languages with the largest number of dialects, the reasons for which are primarily the great dynamics of Slovenia's terrain, which makes regular contact among people difficult, and the closeness of completely different European languages. More than 40 dialects exist in Slovenia's

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© Springer Nature Switzerland AG 2020
D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3_23

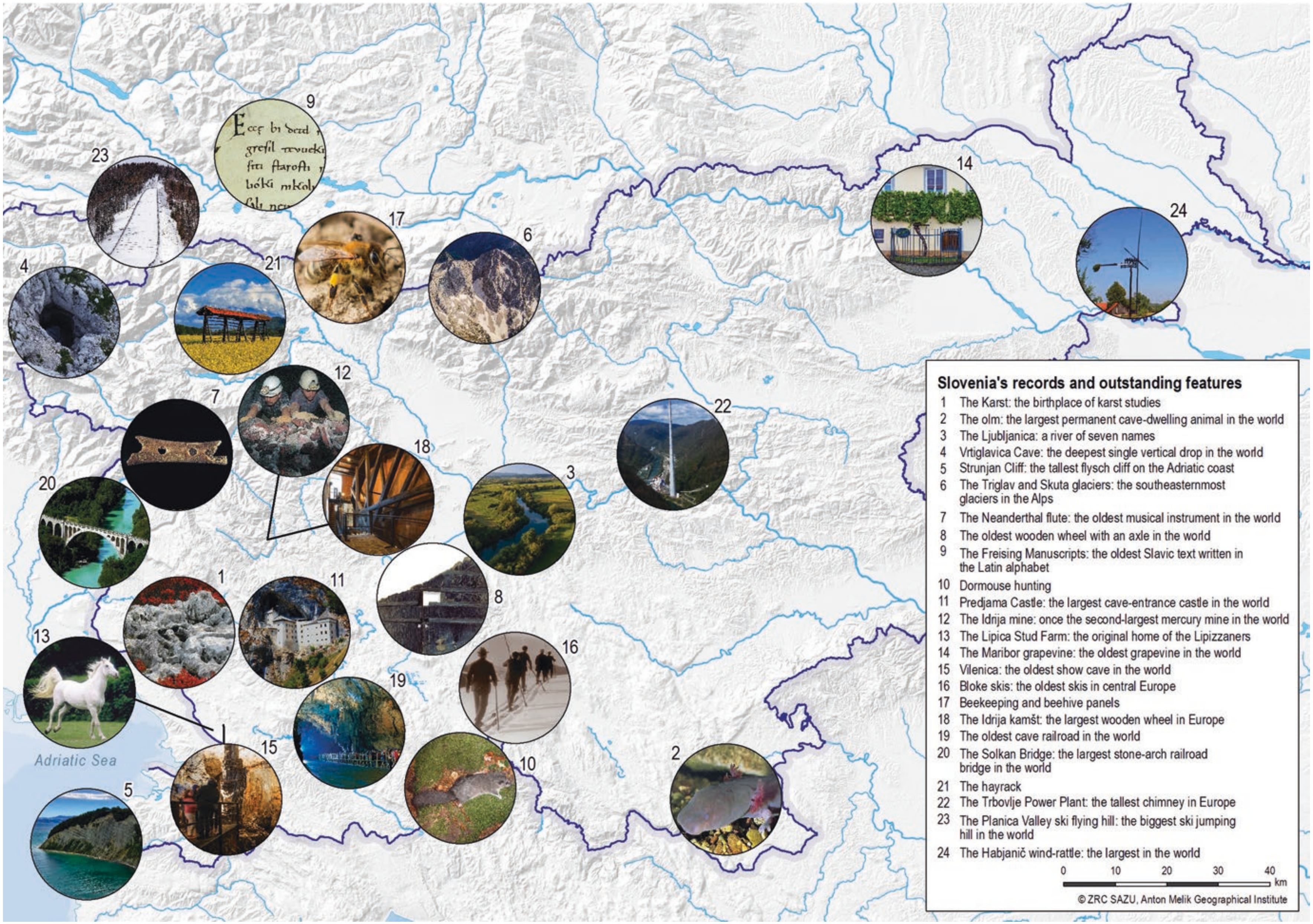

Fig. 23.1 Locations of record-holding Slovenian natural and cultural heritage

small territory (Logar and Rigler 1986; Logar 1996). Slovenian is also one of the few languages in the world that still use the dual number, which is put to good use especially by love poets.

In terms of culture, mention should be made of the Slovenian Philharmonic, which is one of the oldest in the world. Its predecessor, the *Academia Philharmonicorum Labacensis* (Ljubljana Philharmonic Academy), was established as early as 1701 (Sivec 1989).

Slovenia is also very good at sports. It is constantly among the best-performing countries per capita in the world, and on more than one occasion, it has even ranked the first in the world according to one of the sports performance indexes (greatestsportingnation.com), the last time in 2013 and 2014 (in 2017 it placed second behind Norway and ahead of New Zealand). The statistics are similar when it comes to the Olympic medals per capita.

The UNESCO World Heritage List currently includes four sites in Slovenia: Škocjan Caves with an underground river canyon has been on the list since 1986, the Ljubljana Marsh pile dwellings (as part of the Prehistoric Pile Dwellings around the Alps) since 2011, the Idrija mercury mine (together with the Almadén mine in Spain as part of the Heritage of Mercury) since 2012, and the forest reserves of the Krokar Virgin Forest and Snežnik–Ždrocle Forest since 2017 (as part of the Ancient and Primeval Beech Forests of the Carpathians and Other Regions of Europe). The Krokar Virgin Forest is of exceptional importance in Europe because it is one of the Ice Age refuge areas from which beech spread across all of Europe.

23.2 Natural Heritage

Nearly all examples of Slovenian natural heritage of global importance are connected with the karst landscape, which formed on carbonate rock. Carbonate rock covers over half of Slovenia's terrain, and karst relief covers over two-fifths (Šušteršič 1991).

23.2.1 The Karst: The Birthplace of Karst Studies

The Slovenian term *kras* "karst" denotes rocky terrain, and *Kras* is also the name of the low Karst Plateau between the Gulf of Trieste and the Vipava Valley. The unusual features on karst terrain and beneath it were already reported by Classical authors, firing people's imagination. Intermittent Lake Cerknica is one of the most interesting features, and the explanation of how it functions brought its author Johann Weikhard von Valvasor membership in the most prestigious scholarly society in the world, the Royal Society of London, in 1687. The explanations of karst features became increasingly more scientific, leading to the development of a new discipline: karst studies. Via the German word *Karst*, the term also became established in other languages, and some Slovenian words became part of international terminology, for example, *dolina* (doline, the most common small round karst depression), *polje* (a large karst depression with a flat bottom and a sinking creek), and *ponor* (sink(hole), a place where water sinks into the karst underworld) (Šušteršič et al. 1991; Hrvatin 1998; Rejec Brancelj 1998; Gams 2003).

23.2.2 The Olm: The Largest Permanent Cave-Dwelling Animal in the World

The olm, or proteus (Fig. 23.2), is the only European cave vertebrate and the world's largest permanently cave-dwelling animal. This amphibian has become the symbol of Slovenian natural science and natural heritage. In 1689, Johann Weikhard von Valvasor referred to it as "a dragon's offspring" in his *Die Ehre deß Hertzogthums Crain* (*The Glory of the Duchy of Carniola*), and in 1768 it was first scientifically described by Josephus Nicolaus Laurenti, who named it *Proteus anguinus*. The olm was also mentioned by Charles Darwin in his *On the Origin of Species* (1859) as an example for the reduction of structures through disuse (Darwin 2008).

Due to its pale pink, almost translucent skin, it is also referred to in Slovenian as the "human fish." The olm is adapted to a life of complete darkness and senses what goes on in its surroundings through smell and organs on its skin that can sense vibrations. It is up to 30 cm long if measured from its blunt snout to the end of its flattened tail. Its regressed eyes are covered by a layer of skin. The tiny teeth in its mouth form a sieve that keeps larger particles inside the mouth. The front legs have three digits and the hind legs only have two. The olm has bright red external gills behind its flattened pear-shaped head, on both sides of its body. This respiratory organ is typical of amphibian larvae, but the olm retains it throughout its life even though it also has simple lungs. It swims quickly by twisting its body like a snake and catches cave-dwelling aquatic invertebrates, but it can survive without food for several years.

After mating, the female lays up to 70 eggs, each about 12 mm in diameter. It places them between rocks and protects them. The larvae are around 2 cm long, and they gain an adult appearance after nearly 4 months, but it takes them 14 years to reach sexual maturity. Olms live up to 100 years. They were first protected in Slovenia as early as 1922.

In 1986 researchers discovered the black olm, which was a great surprise. The main features distinguishing it from the white olm include a shorter and wider head, a longer body, shorter legs and a shorter tail, almost normally developed eyes, and normal skin pigmentation. It lives in underground

Fig. 23.2 The olm (*Proteus anguinus*) or cave salamander. (Photo by Andrej Mihevc, GIAM ZRC SAZU Archive)

waters near Črnomelj in White Carniola, in an area smaller than 100 km^2 (Aljančič 1993; Orožen Adamič 1997; Jeseničnik 2008).

In 2016 there was live streaming from Postojna Cave of olm eggs hatching, using an infrared camera. The first of the 22 "little dragons" hatched at 10:48 am on May 30, when it literally shot out of the egg before the eyes of the world.

23.2.3 The Ljubljanica: A River of Seven Names

The Ljubljanica has its source at several karst springs near Vrhnika, after which it crosses the Ljubljana Marsh, flows through Ljubljana, and empties into the Sava northeast of the city, 41 km from its source.

Several archeological sites have been discovered along the river, which is also known for playing a role in the legend of the Argonauts. According to this legend, in their quest for the Golden Fleece, Jason and his crew departed from the Black Sea on their ship *Argo* and sailed up the Ljubljanica via the Danube and the Sava. At Vrhnika they dismantled their ship and carried it past Postojna to the Vipava River, where they launched it again and sailed to the Soča to reach the Adriatic. In Roman times, too, the last port on the Ljubljanica was located below Vrhnika (Latin: *Nauportus*). The Romans transported limestone blocks from the nearby quarry on ships to Emona, an urban settlement of that time in what is now Ljubljana. In the Middle Ages, merchants—just like the Argonauts—transported goods along the river up to Vrhnika, where they loaded them onto horse-drawn carts for transport to Italy past Postojna. Transporting goods along the Ljubljanica flourished up until the construction of the Vienna–Trieste railroad in 1857.

The Ljubljanica hides yet a greater secret: it is merely the last section of a significantly longer watercourse that rises near the Slovenian–Croatian border. On its journey to the north through the karst landscapes, it disappears below ground six times and resurfaces with a new name each time. Therefore, it has also been dubbed "the river of seven names."

This watercourse emerges as the Trbuhovica below Mount Snežnik in the Prezid Polje in Croatia; it only reaches the Babno Polje during periods of highest flow, but it usually already disappears below ground before that. Then it resurfaces as the Obrh, which flows across the Lož Polje and disappears below ground again. It then continues its exciting journey as the Stržen in the Cerknica Polje, only to disappear below ground once more. It reemerges as the Rak, which flows through Rakov Škocjan and disappears into the ground yet again. At Planina Cave it merges with the Pivka, which flows there from the Pivka Lowland through the famous Postojna Cave. This combined watercourse then resurfaces as the Unica, which meanders across the Planina Polje and disappears below ground. After its long journey through the karst underworld, it then finally emerges as the Ljubljanica. The seven names thus occur in the following order from south to north: *Trbuhovica*, *Obrh*, *Stržen*, *Rak*, *Pivka*, *Unica*, and *Ljubljanica* (Šušteršič 1994; Krušič 1997; Jeseničnik 2008).

23.2.4 Vrtiglavica Cave: The Deepest Single Vertical Drop in the World

In Slovenia's extreme west, in the area around Mount Kanin (2587 m) in the Julian Alps above the Soča Valley, an exceptional glaciokarst plateau formed at the contact between the former glaciers and the soluble carbonate bedrock. The glacial water that ran off vertically through the thick layers of limestone created numerous high-mountain karst shafts of exceptional depths. Two of them are over 1000 m deep, and another three are more than 500 m deep. Among these is also 643 m deep Vrtiglavica Cave (literally, Vertigo Cave), which forms the deepest single vertical drop in the world. This shaft also contains one of the tallest underground waterfalls in the world, roughly 440 m high, which flows from one of the horizontal passages that extend from the walls. The water from the falls reaches the bottom of the pit, where it flows deeper underground. The bottom was reached on October 12, 1996 by a joint Slovenian–Italian expedition (Gabrovšek 1997, 2000).

23.2.5 Strunjan Cliff: The Tallest Flysch Cliff on the Adriatic Coast

An 80-meter-high and 4-kilometer-long flysch cliff, the tallest on the Adriatic Coast, rises above Moon Bay (*Mesečev zaliv*) near Strunjan, on the longest section of unspoiled coast in the Gulf of Trieste between Izola and Piran.

Because flysch is a poorly resistant sedimentary rock mainly composed of layers of sandstone and marl, the steep cliff is exposed to constant geomorphic processes and is visibly receding from the sea and cutting into the land. Its bottom is eroded by sea waves, and its middle and upper parts are affected by the sun, rain, wind, and, to a smaller degree, frost. Erosion has formed interesting miniature geomorphic features. The rubble that falls from the cliff wall is accumulating at the base of the cliff and is overgrown by Mediterranean shrubs. The cliff is part of the Strunjan Nature Reserve, which belongs to the Strunjan Nature Park. The 200-m-long coastal belt is also protected in addition to this cliff (Gams 1970; Orožen Adamič 1990; Žumer 1990; Turk 1998; Jeseničnik 2008).

23.2.6 The Triglav and Skuta Glaciers: The Southeasternmost Glaciers in the Alps

Even though both of these glaciers are mere remnants of once extensive glaciers, they have a wider significance because, as the southeasternmost glaciers in the Alps and relatively low-lying glaciers, they are important indicators of climate change in Europe.

The once extensive Triglav Glacier is now nothing but a glacial patch, covering about 1 ha. It lies on the steep northeast slope below the peak of Mount Triglav (2864 m), at a relatively low elevation between 2450 and 2500 m. It has also been dubbed "the Green Snow" in Slovenian because of the previous characteristic greenish color of its layers.

In the second half of the nineteenth century, the glacial tongues extended up to the edges of Triglav's north face, where large ice blocks (seracs) broke off and fell into the Vrata Valley over the crags. During the 1950s, the western part of the glacier gradually disappeared, and during the 1980s its remnants disintegrated into two parts. What has remained is only the upper part directly below the crags of Mount Triglav. In the twenty-first century, the typical transverse and longitudinal glacial crevasses can no longer be noticed, and snow grooves are now being formed instead, confirming heavy melting.

Ongoing monitoring of the glacier has taken place since 1946, and the research carried out on the glacier is the oldest permanent research project in Slovenia in general. Initially, the glacier area was measured by marking the glacier's edges in color every year, but since 1976 a special panoramic camera has been used to capture the glacier from the same spot. In addition, since 1996 photogrammetric devices (laser theodolites) have been used, and since 2005 aerial photography has been employed to measure the glacier. In the summer of 2000, the first measurements of the glacier's thickness were also performed using a georadar. The greatest thickness measured was 9 m, and the average was just under 3 m. Analysis of photos showed that from 1992 to 2008, the glacier's volume decreased from over 400,000 m^3 to just 10,000 m^3 (Gabrovec et al. 2014).

In the early twentieth century, the glacier covered over 40 ha. By the time official measurements began to be carried out, its size had shrunk to 15 ha. In 2007, the glacier reached its minimum size of barely 0.6 ha, which did not change significantly in the following years. The size recorded in 2018 is 0.8 ha.

The Skuta Glacier (Fig. 23.1) lies in a cirque at an elevation between 2020 and 2120 m below the north face of Mount Skuta (2532 m) in the Kamnik–Savinja Alps. It is mostly the shady location that keeps it from disappearing. It is fed by snowfall and by snow that is transported from the nearby ridges and rock faces by winds and avalanches. The glacier has been systematically observed since 1948, when it covered 3 ha. Fifty years later it was nearly half that size, and another 10 years later, it already covered less than a hectare. Its thickness has shrunk even more than its area (Košir 1987; Pavšek 2004). In 2006, measurements using a steam drilling machine showed that its average thickness was only slightly over 7 m, and its volume was just under 80,000 m^3. In the following years, its thickness shrank by up to 1 m several times, especially in places where it was not covered in rubble. Therefore it was presumed it would completely disappear even before 2020. However, its shrinking has stopped over the past few years. The last measurements performed in 2018 showed that its area has increased to 1.6 ha, which makes it even larger than the Triglav Glacier.

23.3 Cultural Heritage

Slovenia's cultural heritage is not connected to the karst terrain, but the majority of the most interesting examples can nonetheless be found in Western Slovenia, where karst is more common.

23.3.1 The Neanderthal Flute: The Oldest Musical Instrument in the World

In 1995, a femur of a young cave bear with four holes carved out, which make it possible to produce sound, was found at the Paleolithic site Divje Babe in the Idrija Hills. Modern dating methods were used to confirm that the bone was around 60,000 years old, which makes this Neanderthal flute the oldest musical instrument in the world (Trampuž Orel et al. 2005; Jeseničnik 2008; Turk 2011).

23.3.2 The Oldest Wooden Wheel with an Axle in the World

In 2002, part of a wooden wheel with an axle was discovered on the southwestern edge of the Ljubljana Marsh, at the pile-dwelling site of Stara Gmajna near Vrhnika. Research showed that the wheel and the axle were made with great skill. Because they rotated simultaneously, they were probably part of a two-wheeled cart, which was typically used in hillier areas. Precise dating has confirmed that the find is 5150 years old, which means this is the oldest wooden wheel with an axle in the world (Šinkovec 2003; Veluščček 2013).

23.3.3 The Freising Manuscripts: The Oldest Slavic Text Written in the Latin Alphabet

In 1806, the German linguist and librarian Bernhard Joseph Docen published a report announcing the discovery of Slavic manuscripts written in the Latin alphabet. The parchment sheets were bound into a Latin codex (a pastoral manual of the Bishop of Freising) with white pigskin covers on wooden boards, which is kept by the Bavarian State Library. The first thorough study of the manuscript was carried out in 1822 by Jernej Kopitar, who ascribed its authorship to an unknown Freising missionary. This is why the manuscripts were later named the Freising Manuscripts.

They are composed of three separate documents on a total of nine parchment sheets. They were part of a mission handbook of the Freising Bishop Abraham. They were marked with Roman numerals based on their order of appearance in the codex. The first and the third manuscripts contain general confessional prayers, and the second manuscript features a sermon on sin and repentance, with which the priest invited people to confession and prepared them for it.

Paleographic research has shown that these manuscripts written in Carolingian minuscule were most likely created between 972 and 1023. The Freising Manuscripts were most likely used in Austrian Carinthia, where the Freising Diocese had large estates.

These manuscripts are not only the oldest preserved Slovenian texts but also the oldest Slavic texts written in the Latin alphabet (Pogačnik 1987; Bernik et al. 2004).

23.3.4 Dormouse Hunting

In the past, Slovenia was considered the area with the largest population of dormice (*Glis glis*) in Europe, and therefore dormouse hunting was very popular and widely practiced. In the past, dormice were primarily hunted for their fat, which was used as home remedies, but also for food because they were an important (and in places also the only) source of protein for poor people. The pelts were used to make dormouse hats and other accessories. The hats were exported across Europe.

The oldest written record of dormouse hunting in Slovenia goes back to 1240. It was covered more extensively by Johann Weikhard von Valvasor in his 1689 *Glory of the Duchy of Carniola* and Belsazar Hacquet in the early nineteenth century. The works of both authors present interesting methods of making dormouse traps, which are still used in many places in order to preserve the tradition, especially in southern Slovenia, and much other information on dormouse hunting in the past (Urbanc 1998a; Kryštufek 2000).

23.3.5 Predjama Castle: The Largest Cave-Entrance Castle in the World

Predjama Castle is considered the largest castle in the world built in the mouth of a cave. The originally Gothic castle, 35 m tall and set in a 120 m cliff, was first mentioned in written sources in 1274. In the second half of the sixteenth century, it was refurbished in the Renaissance style (Fig. 23.3).

Fig. 23.3 Predjama Castle. (Photo by Janez Zalaznik, Shutterstock.com)

In 2014, the castle was included in the *Guinness World Records*.

The first few centuries in the castle's history were closely connected with the Lueg family or the Burgraves of Lueg. There is a well-known legend of the bravery and invincibility of one of them, Erasmus of Lueg, who fell into the Austrian emperor's disgrace for having cooperated with Matthias Corvinus, King of Hungary. The emperor ordered him killed. The legend says that the young and handsome robber baron took refuge at his castle, from where he made marauding forays through the secret underground tunnels beneath the castle and brought food and other supplies back through them, which made it possible for him to withstand the emperor's henchmen for a long time. The story goes that he was killed with the help of a servant who betrayed him by marking the place where Erasmus was at that time with a burning candle. As Valvasor put it, this was the place where he "had to do something that even the Sultan … must do in person."

The last private owners of the castle were the members of the Windischgrätz noble family, and after the Second World War, the property was nationalized. It now houses a museum that presents life at the castle and archeological finds from the cave tunnels next to the castle that testify to the human presence in this area since the Neolithic (Stopar 1995; Krušič 1997; Craig 2013).

23.3.6 The Idrija Mine: Once the Second-Largest Mercury Mine in the World

An important economic period in the history of Idrija, a mining town in Western Slovenia, begins with a legend, according to which in 1490 a local tub maker (Sln. *škafar*) was filling his tub with water in a spring and noticed sparkling droplets in the tub. Because the tub was too heavy to move, he took part of the shiny matter to Škofja Loka, where it was confirmed that he had discovered mercury.

After several centuries of extracting cinnabar ore and native mercury, the Idrija Mine became the second-largest mercury producer in the world, right behind Almadén, Spain. In the early sixteenth century, rich veins of ore were discovered in Anthony's Shaft. Gewerkenegg Castle was built in the immediate vicinity and was used to store mercury and house the mine's administration (Zupančič Pušavec and Žontar 1990; Bevk et al. 1993; Čar 1996; Urbanc 1998b; Leskovec and Peljhan 2009).

At the end of the sixteenth century, the entire mine came under the administration of the Austrian government, which remained its owner until 1918. In 2012, the mine was added to the UNESCO World Heritage List (Pellis 2016). Exhausted ore deposits led to the shutdown of the mine, and part of its shafts have been converted into a museum.

23.3.7 The Lipica Stud Farm: The Original Home of the Lipizzaners

Even though the Karst Plateau does not offer favorable conditions for livestock farming, the tradition of breeding horses in this area goes back to Antiquity, when the Romans bought horses there, known for their power, speed, and resilience. Local horse breeding continued to maintain this profile even later on.

In the sixteenth century—specifically, in 1580—Charles II, Archduke of Austria and ruler of Styria, Carinthia, Carniola, Istria, and Trieste, purchased an abandoned summer residence in Lipica from the Bishop of Trieste together with the appertaining estates to establish a stud farm there. Its main task was to supply elegant riding and carriage horses to the imperial stables in Graz and the Spanish Riding School in Vienna. Due to the stud farm's rapid development and a lack of hay, the Habsburgs purchased two additional estates nearby in the first half of the eighteenth century. They built several new stables, a blacksmith's workshop, a stable for sick horses, a storage for fodder, and a small church at Lipica. They also created several meadows, trails, two parks, and tree-lined avenues.

The stud farm bred local karst horses, but it also purchased breeding stallions and mares (Spanish, German, Danish, and Arabian ones) elsewhere. They developed a new breed, the white Lipizzaner, through crossbreeding.

The Lipizzaner is a native Slovenian horse improved by crossbreeding with Spanish, Neapolitan, and Arabian stock. Its main characteristic is its striking, harmonious, and elegant build. It is up to 168 cm tall, very resilient, and can live up to 30 years. The foals are black, bay, or gray, and the adults are mostly white. When they are 1 year old, a letter *L* is branded onto their left cheek, certifying that the horse is an original Lipizzaner born at the Lipica Stud Farm (Fig. 23.4).

The foundation stock is composed of 10 foundation mares from 18 bloodlines and 20 foundation sires from 6 bloodlines. In addition to horse breeding, the now world-famous stud farm, which preserves the economic heritage of the feudal era, also offers many other leisure activities to visitors (Krušič 1997; Rejec Brancelj 1998).

23.3.8 The Maribor Grapevine: The Oldest Grapevine in the World

Slovenia's natural monuments include the Maribor grapevine, which was added to the *Guinness World Records* in 2004. It has been proven to be over 400 years old and is thus considered the oldest grapevine in the world.

The grapevine at Lent, a part of Maribor along the Drava River, is depicted on the oldest panorama of the town of 1681. It is a Žametovka grapevine, which bears up to 55 kg of grapes a year. The wine produced from it is bottled into 250 ml bottles designed by the Slovenian artist Oskar Kogoj. These wine bottles are used as protocol gifts by the Slovenian government.

Fig. 23.4 Lipizzaners. (Photo by Marko5, Shutterstock.com)

The grapevine survived medieval fires in the town, Ottoman incursions and devastation, the phylloxera blight at the end of the nineteenth century, bombing during the Second World War, and the rise in the level of the Drava River because of dam construction. The latter seriously endangered its life cycle, but agronomists managed to rescue it just in time. The grapevine has become a symbol of resilience, endurance, and the rich Styrian wine culture (Krušič 1997; Jeseničnik 2008; Zafošnik 2010).

23.3.9 Vilenica: The Oldest Show Cave in the World

The karst Vilenica Cave is considered the oldest show cave in the world because an entrance fee was collected there as early as the first half of the seventeenth century. In 1633, its owner, Count Petazzi, entrusted its management to the nearby Parish of Lokev, deciding that the manager was entitled to all the profit generated from guided tours of the cave. The cave was visited by the natural scientist Belsazar Hacquet in 1778, and in the eighteenth century also by certain royalty, such as King Ferdinand of Naples and Sicily and Leopold II, Holy Roman Emperor. In the nineteenth century, it was mainly popular among travelers that broke their journey by disembarking in Trieste (Krušič 1997). Guided tours were discontinued in 1863 and only resumed in 1963 (Krušič 1997; Kranjc 2000; Puc 2000, Jeseničnik 2008).

23.3.10 Bloke Skis: The Oldest Skis in Central Europe

Ski production and their use during the long winter months have a long tradition on the Bloke Plateau, and Bloke skis are considered the oldest skis in Central Europe.

The first written record of skiing on the Bloke Plateau can be found in the 1689 *Glory of the Duchy of Carniola* by Johann Weikhard von Valvasor, which is the oldest document on skis in Central Europe. The term he used to describe the skis was "wooden boards."

Why did skiing develop exactly on the Bloke Plateau? This is a plateau with rough terrain at an elevation between 740 and 1038 m. In the cold half of the year, the snow cover, which was several meters thick, remained for several months, which made travel difficult. The locals used skis to hunt, cut trees in the forest, and for other needs (to go to church, funerals, and the like).

Ski production became its own special craft. Skis were made from the wood of deciduous trees and bent in boiling water, over fire, or by steaming. They were strapped onto boots with thongs made of horsehair or leather. Skiers used a single pole about 2 m long to aid movement. To make the skis run more smoothly, they covered the bottoms with melted tallow or beeswax. Because the region was relatively isolated, skiing did not spread elsewhere (Bogataj 1987; Urbanc 1998c).

23.3.11 Beekeeping and Beehive Panels

Beekeeping has a long tradition in Slovenia. The high-quality honey, which was also sold as sweetener to lands far away, was already reported on by Johann Weikhard von Valvasor in his 1689 *Glory of the Duchy of Carniola*. In eighteenth-century Carniola, the woven baskets and hollow trunks in which bees were kept started to be replaced by wooden boxes called *kranjiči* "Carniolan hives."

The credit for the establishment of beekeeping in the Habsburg Monarchy goes to Anton Janša, a talented painter, who dedicated his life to beekeeping instead. He became the first imperial beekeeping teacher at the Augarten beekeeping school in Vienna. He won renown throughout the monarchy for his lectures, in which he placed special emphasis on transporting bees to forage as one of his findings. Two of his works were published in German: *Abhandlung vom Schwärmen der Bienen* (Treatise on the Swarming of Bees, 1771) and *Des Anton Janscha hinterlassene vollständige Lehre von der Bienenzucht* (Anton Janša's Complete Guide to Beekeeping, 1775). The latter has also been translated into Slovenian (Janša 1792; Janša 1906).

In the eighteenth century, trade in honey and Carniolan bees boosted the economy of the Slovenian countryside while also awakening respect for these industrious creatures and stimulating creative folk imagination. People began to paint the front panels or boards of the Carniolan beehives, where there were also narrow openings where the bees could fly out. This creative art is unique to Slovenia (Fig. 23.5). The first beehive front panels were painted with exclusively religious motifs, but soon the images of the Virgin Mary and the saints were joined by biblical motifs, scenes from legends, and even secular, humorous, and satirical motifs. Beehive panel paintings were made by both trained painters and self-taught village painters, and they reflect folk beliefs, humor, timidity, and the widespread use of legends. This art is no longer as common today, and often the beehive panels are only painted in various colors, without any motifs.

Slovenian beekeeping is also connected with the bee subspecies *Apis mellifera carnica* or the Carniolan honey bee, which is extremely popular among beekeepers around the world. This is the only protected native bee subspecies in the European Union. This subspecies has an exceptional sense of orientation, is very gentle, and is ready to forage very early in the spring due to its fast development. All these characteristics are extremely important, especially for beekeepers, and so it is not surprising that the Carniolan honey bee is the

Fig. 23.5 Beehive panels. (Photo by Jerneja Fridl, GIAM ZRC SAZU Archive)

second most popular subspecies in the world. A stud book for purebred Carniolan honey bees has been kept since 2004, and a purebred queen mating station is located in the Zelenica Valley in the Karawanks (Rihar 1991a, b; Aimée et al. 1997; Božič 2000; Gregorc 2002; Pogačnik 2008).

23.3.12 The Idrija *Kamšt*: The Largest Wooden Wheel in Europe

A major problem in many mines, including the Idrija mercury mine, was pumping water from the shafts. Around 1790, in Idrija a system for pumping water referred to as a *kamšt* was built on the Idrijca River, from which a 2.5 km channel (Sln. *rake*) to the mine was set up. There a wooden wheel 13.6 m in diameter was installed. This is the largest wooden wheel in Europe and one of the largest in the world. The water pump was used to pump water from a depth of 340 m (Struna 1954; Čar 1990; Kavčič 2002; Jeseničnik 2008).

23.3.13 The Oldest Cave Railroad in the World

Yet another record is connected with cave tourism in Slovenia: rail tracks were laid in Postojna Cave as early as 1872. In 1914, the two-seat wagons, which were initially pushed by cave staff, began to be hauled by a gasoline-engine locomotive, and in 1959 the system was electrified. The Postojna Cave railroad is thus considered the oldest cave railroad in the world. In 1964, a parallel line was installed to serve more passengers. In Yugoslavia, the number of passengers reached nearly a million a year, after which it dropped drastically due to the political crisis (Toplak 2010). In recent years, after Postojna Cave obtained a new manager, the number of visitors has again been approaching record figures (Krušič 1997; Toplak 2010).

23.3.14 The Solkan Bridge: The Largest Stone-Arch Railroad Bridge in the World

Among bridges in Slovenia and elsewhere, a special record is set by the stone railroad bridge at Solkan, whose 85 m arch span makes it the largest structure of this type in the world. Only the Syratal Viaduct—a stone road bridge in Plauen, Germany—has a greater span, but that bridge is also significantly lower than the one at Solkan.

The Solkan Bridge is one of the 26 bridges on the Bohinj Line, which connected Jesenice and Gorizia, and formed a section of the line that connected Prague with Trieste, or Central Europe with the Adriatic. The bridge, which rises 36 m above the Soča River and is just under 220 m long, started being built in 1904. It was designed by the engineers Rudolf Jaussner and Leopold Oerley, and its construction was entrusted with the Viennese construction company Brüder Redlich und Berger. Over 4500 limestone blocks quarried near Trieste were built into the central arch. Construction was completed in 1905.

The main arch was blown up during the First World War, in 1916. A temporary steel construction was built after the war and used until 1927, when the renovation of the bridge, which began in 1925, was finally completed. The arch was rebuilt using cut stone, and it was almost identical to the original design. The Second World War was less damaging to the bridge, which did not suffer any major harm. The construction of the Solkan Bridge concluded the several centuries-long practice of building stone bridges, and it was also the apex of the Austrian bridge engineering school (Rustja 1990, 1998; Humar 1996; Jeseničnik 2008).

23.3.15 The Hayrack

The hayrack (Sln. *kozolec*) is another special architectural feature of the Slovenian countryside. As many as 80% of all hayracks in the world can be found in Slovenia. They are also common in western Italy and southern Austria. These structures used for drying fodder are also known elsewhere around the world, but nowhere else have they developed into constructions of such refined shapes as in Slovenia.

There are several types of hayracks, which is the result of differences in natural conditions and the building material available. The simplest type is the single straight-line hayrack, which is composed of a single line of pillars connected with lathes and covered with a narrow roof. They are especially common in Upper Carniola. The columns were usually hewn from oakwood, and in some areas they were also built from brick. Architecturally, the most picturesque type is the roofed double hayrack (Sln. *toplar*), which is composed of two parallel lines of columns connected with a single roof. In addition to drying fodder, these hayracks were also used for storing farm tools and carts. In the Sava Valley, especially in the vineyards, a split-level double hayrack can be found, with its roof extended on one side. In Lower Carniola, the Kočevje area, and around Lož, a type of hayrack that leans against an outbuilding predominates.

Where the hayracks are located in the landscape depends on their function, the terrain, the parcellation, and the cardinal directions. Hayracks are losing their former role due to the modernization of farming, increasingly becoming part of history and a decorative landscape element (Cevc 1991; Urbanc 1998d).

23.3.16 The Trbovlje Power Plant: The Tallest Chimney in Europe

In the mining town of Trbovlje in the center of the Sava Hills, there is a power plant with a 360-m-tall chimney, which is considered the tallest chimney in Europe. This makes this power plant the tallest structure in Slovenia. According to some sources, its chimney reaches 364 m.

The motive for building such a tall chimney, which replaced the old one, only 80 m, was the high level of sulfur dioxide pollution, which resulted from the fact that the town was located in a valley, was poorly ventilated, and was affected by temperature inversion in the cold half of the year. After the 1976 construction of the new chimney, the local pollution levels decreased significantly. This was the first major environmentally friendly project in Slovenia.

The new chimney started being built in 1974. Sixty-two reinforced concrete pilings 13 m long and 1.7 m in diameter were cast in solid rock, used as the foundation to build the reinforced concrete shell of the chimney. The chimney measures 27.5 m in diameter at its base and 7.7 m at the top. Inside the reinforced concrete shell, there is a firebrick flue that measures 5 m in diameter along its entire length. Nearly 12,000 m^3 of concrete, over 1000 tons of steel, and 950 tons of firebricks were used to build the chimney. The chimney meets the standards of earthquake-resistant construction and is designed to withstand earthquakes with an intensity of 10 on the 12-degree Mercalli–Cancani–Sieberg scale. The top of the chimney can sway up to a meter in strong winds (Krasnik 2004; Jeseničnik 2008).

23.3.17 The Planica Valley Ski Flying Hill: The Biggest Ski Jumping Hill in the World

In 1969, the first giant ski jumping hill in the world was built in the U-shaped Planica Valley near the tripoint between Slovenia, Italy, and Austria. It was designed by brothers Vlado and Janez Gorišek. Its construction point was at 153 m. The grand opening and the first official competition on the hill took place on March 21, 1969. Thus a new ski jumping discipline was born in Slovenia: ski flying. The ski flying hill witnessed the first jump over 200 m in human history and 28 world records, which is the largest number of records achieved at any ski jumping hill in the world.

Between 2013 and 2015, the ski flying hill was completely renovated. Its construction point is now at 200 m and makes it possible to jump over 250 m. There are currently only eight ski flying hills in the world. The one at Vikersund, Norway, is the same size as the one in the Planica Valley.

In the fall of 2015, the steepest zipline in the world with an average gradient of 20.9° and a maximum gradient of 30.5°was opened at the Planica ski flying hill, which is also the central structure of the new state-of-the-art Nordic Center, which in addition to cross-country skiing tracks features eight ski jumping hills of various sizes.

The first ski jumping competitions in Planica began in 1934. Over the past decades, the annual FIS Ski Jumping World Cup seasons have traditionally concluded in Planica, and in 2023 the venue will host the Nordic World Ski Championship (Ulaga and Sitar 1987; Bergant 1989a, b; Rožman 1994; Krušič 1997; Jeseničnik 2008).

23.3.18 The Habjanič Wind-Rattle: The Largest in the World

In the small village of Hermanci near Ormož on the south-eastern side of the Slovenian Hills (*Slovenske gorice*), the bricklayer Stanko Habjanič erected a 16-m-tall wind-rattle (Sln. *klopotec*) with blades spanning 20.58 m in 2010. It is considered the largest wind-rattles in the world and has been included in the *Guinness World Records*.

A wind-rattle is a wooden mechanical device on a tall pole with spinning blades and wooden hammers that produce a rhythmic sound, chasing away the birds that feed on the grapes in the vineyards. Wind-rattles are typical of the wine-growing regions in Slovenia, Austria, and Croatia. In Slovenia, they are most common in the Slovenian Hills and the Haloze Hills. They were first mentioned in written sources in the seventeenth century. They were initially installed in fields and only later in vineyards (Topole 1998).

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D. Perko et al. (eds.), *The Geography of Slovenia*, World Regional Geography Book Series,
https://doi.org/10.1007/978-3-030-14066-3

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