

THE NATURAL MERITAGE OF PRIMORJE-GORSKI KOTAR COUNTY

Simply Beautiful
THE NATURAL HERITAGE OF PRIMORJE-GORSKI KOTAR COUNTY

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With its diverse and well-preserved natural heritage, Croatia is often considered an oasis of nature in the heart of Europe, and Primorje-Gorski Kotar County, in terms of both its animate and inanimate nature, can be seen as a microcosm of the country.

The county comprises three basic subregions: Gorski Kotar, the coastal area, and the Kvarner islands. These are not geographically homogeneous but consist of a number of different morphogenetic, pedological, hydrographic, climatic and vegetation zones. These differences have resulted in an exceptional biological diversity, and only a few regions in this part of the world can pride themselves on having such a diverse range of habitats, landscapes, and plant, animal and fungi species in such a relatively small area.

The Priroda Public Institution is responsible for the most important natural heritage in Primorje-Gorski Kotar County. The Institution started work in September 2006 and today manages 28 protected natural areas divided into the following categories: strict and special reserves, natural monuments, forest parks, protected landscapes and park architecture monuments.

Besides protected areas, a large amount of the important natural heritage of Primorje-Gorski Kotar County has been included in the Natura 2000 European ecological network, which was launched in order to preserve and establish favourable conservation status for endangered and rare wild species and habitats of particular importance to both the Republic of Croatia and the European Union. In Primorje-Gorski Kotar County, there are 110 Natura 2000 sites, covering 74.89% of the land surface area and 16.36% of the sea surface area. For the most part, the Priroda Public Institution manages this ecological network, although certain parts are the responsibility of Risnjak National Park and Učka Nature Park.

FOREWORD

FOREWORD

The strategic aim of the Priroda Public Institution is the sustainable management of protected and important natural heritage, and its basic activities are directed towards the protection and preservation of biodiversity and the sustainable use and valorisation of natural heritage.

A particular challenge in nature conservation is involving all the relevant stakeholders and sectors, and protecting natural heritage for the future, especially the most endangered and rarest species and habitats whose importance is not just local, regional or national but also European.

One of the key tasks of the Priroda Public Institution is educating the public. To date, the Institution has produced more than 30 publications that present the diversity of the biology and landscapes of Primorje-Gorski Kotar County.

Primorje-Gorski Kotar County began producing publications on natural heritage protection back in 2004 when the book *The Natural Heritage of Primorje-Gorski Kotar County* was published for the first time. The first edition was greeted with great public interest and in 2005 a second revised edition was published. The book contains information on the county's natural heritage that was collected during the drawing up of the first county physical plan. The book was edited by the former County Institute for Sustainable Development and Physical Planning, which was responsible for issues related to environmental protection.

In 2010, the Priroda Public Institution produced a thirty-minute-long promotional film entitled *Simply Beautiful – The Natural Heritage of Primorje-Gorski Kotar County*, which presented all the protected areas in images and words and which was translated into three languages: English, German and Italian.

Primorje-Gorski Kotar County attaches great importance to caring for the natural environment, which it considers to be one of the key features of the county's identity and also a vital resource, especially in terms of developing tourism. One of the forms that this takes is the publication of books and other publications concerned with important natural heritage. These present information on the natural heritage of the county to a wider audience in a straightforward and easily understandable way.

In terms of its natural wealth, Primorje-Gorski Kotar County is one of the richest counties in Croatia, and this edition is dedicated to all its inhabitants and visitors in the hope that the information contained in this book will encourage people to get to know and look after the important and diverse natural heritage that surrounds us. Let this book also be an invitation to walk through the protected and important natural areas of this simply beautiful green-blue county.

Zlatko KOMADINA President of Primorje-Gorski Kotar County

FOREWORD



Primorje-Gorski Kotar County



The plant world of Primorje-Gorski Kotar County comprises more than 2,700 species, which in terms of flora makes this region one of the richest in Croatia. For instance, certain Kvarner islands are home to more than 1,300 plant species, which exceeds the total number of species present in some European states that cover a much larger area. The predominant endemic species are Kvarner-Liburnian and Illyrian-Adriatic ones, such as Horvat's onion, Rijeka thistle, Pag alison, Adriatic iris, several species of woodruff and popcorn orchid, Kvarner hart's tongue fern, Istrian bellflower, Kvarner groundsel, Kvarner cerinthe, Hirc's violet, Dalmatian knapweed, white corydalis, strawberry milkweed, Tommasini milkweed, scree broom, Adriatic violet, littoral buckthorn, Liburnian daisy, Gouani's seseli, Liburnian carnation, narrow-leaved broom, Illyrian iris, Illyrian widow flower, Haynald's altamatha, yellow karst knapweed, narrow-leaved hawksbeard, narrow-leaved rock bell, Trieste carnation, garlic cress, karst savory, and littoral drypis.

In the highlands of the county, endemic Illyrian-Dinaric species can also be found, such as white pincushion, white grafia, Maly's seseli, Kitaibel's columbine, three-flower milkweed, Illyrian eyewort, Scopoli's rock cress, Istrian iris, Borbás honeysuckle, and Croatian barberry. A number of endemic southeastern-Alpine species grow here which connect the flora of the Alpine and Dinaric ranges, such as tufted harebell, Justin's bellflower, white purple broom, and stemless lousewort.

The county is also home to rare species of flora that are relics from earlier geological periods and which have survived geological upheaval and climate change, such as Tertiary relict species (the Mediterranean spleenwort found in the cracks of damp half caves on Kvarner islands), glacial ones (the pedunculate oaks on the island of Krk and the creeping willow found in frost areas in mountain dolines), and boreal ones (peat moss, calla, and species of hare's-tail cottongrass in Gorski Kotar).

EDITOR'S NOTE

EDITOR'S NOTE

Certain endemic plant species cannot be found anywhere in the world outside of Primorje-Gorski Kotar County. For instance, the stenoendemic Učka bellflower, which only grows on the rocks of Mount Učka and nowhere else. Other endemic species, the richest and largest populations in the entire world, can be found in very restricted areas of Primorje-Gorski Kotar County. Two of the most well-known are Velebit degenia and scree broom (Genista holopetala). Staff from the Priroda Public Institution were responsible for finding Velebit degenia inside the boundaries of Primorje-Gorski Kotar County (in the area of Mount Velika Kapela). Besides this find, their field work has also led to the discovery of numerous previously unknown sites with scree broom, and the discovery and documenting of certain interesting grassland associations that were previously undocumented and unknown to science, such as the endemic Marchesetti bellflower (Campanula marchesettii) and narrow-leaved moor grass (Sesleria tenuifolia) grasslands in the wind-exposed areas of the Grobnik Mountains or the endemic communities of Genista holopetala and Carex mucronata with black bog-rush in the dolomites of the Zala stream region at the foot of Mount Obruč.

Because of the diversity of its habitats, Primorje-Gorski Kotar County is also unusually rich in terms of fauna. Within its boundaries, there are 81 mammal species, which account for two-thirds of the number of known mammal species in Croatia. A special feature of the county is that it is home to a number of rare and endangered but also charismatic species, including the last population of griffon vultures in Croatia, stable populations of bears and wolves, the critically endangered lynx, a resident population of dolphins in the waters off Cres and Lošinj, the golden eagle, lesser kestrel, the Apollo butterfly, rare and endangered reptiles and amphibians, relict groups of beetles that are thought to be indicators of ancient natural forests, and numerous endemic species, including subterranean karst fauna.

The waters of Primorje-Gorski Kotar County are also rich and diverse in terms of their flora and fauna. The most important submarine communities are coralligenous, seagrass, photophilic algae, silty-sand, homogeneous fine-sand, and coarse organogenic sand communities.

It was a great pleasure to work on this book. One of the main reasons why we decided to publish a completely new edition of this book on natural heritage is that with the accession of Croatia to the European Union more than a hundred Natura 2000 areas were listed as important natural areas. All those areas that are considered to be rare and endangered at the European level are described in greater detail in this new edition, together with their habitats and species. As in the previous edition, the book covers the 31 protected areas of Primorje-Gorski Kotar County, which besides the Priroda Public Institution are also managed by Risnjak National Park and Učka Nature Park.

The introduction to the book outlines the natural characteristics of the county, its geology, soil types, hydrological conditions, climate and plants and wildlife. It provides basic information on protected areas and areas that are part of the Natura 2000 ecological network. The remainder of the book is divided into five thematic chapters on the underwater world, islands, coast, highlands and subterranean world. These chapters provide readers with basic information, insights and interesting facts about the county's natural heritage. Because of the exceptionally large number of important habitats and species, some of the natural assets are only mentioned briefly in this book. However, the majority of the most important ones are dealt with in detail.

In this book, we would like to recall the scientists who paved the way for the protection of nature in Croatia. One of the most important of these is Dragutin Hirc, whose significance and influence have recently been rediscovered and re-evaluated. At the end of the 19th century and the beginning of the 20th, Hirc with tremendous zeal and diligence embarked upon the almost impossible task of recording, investigating,

EDITOR'S NOTE



EDITOR'S NOTE

and describing in detail the natural world of what is today Primorje-Gorski Kotar County, and had several works published that are still widely cited. The most notable of these are *Hrvatsko primorje* (*The Croatian Littoral*) of 1891, *Gorski kotar* of 1898, *Prirodni zemljopis Hrvatske* (*A Natural Geography of Croatia*) of 1905, and his comprehensive *Flora okolice bakarske* (*The Flora Around Bakar*). After more than a century, Hirc's research and work continue to be a great source of inspiration, and it is fitting that each chapter of this edition begins with a short quote from one of his works.

We hope that nature lovers will be able to find plenty of useful information or something new to read and learn about in this book, or just refresh their knowledge. In writing this book, we had two basic aims. First of all, we wanted to pay tribute to everyone whose work has contributed to the gaining of new knowledge about the natural heritage of the county and the preservation of the wealth that has been bestowed upon us by the bounty of nature. A second but no less important aim was for the book to encourage all generations, but especially younger ones, to learn to love nature and perhaps, inspired by certain new knowledge that they have gained from this book, to visit it as often as possible and thus learn directly from the source, out in the field, as true natural scientists do.

For the fact that this book could be published in this size and form, we are grateful to numerous institutions and individuals who work in the area of Primorje-Gorski Kotar County and from whom we have requested and received valuable information or photographs.

In particular, we would like to thank the staff of the Croatian Environment Agency, the Croatian Natural History Museum in Zagreb, the Biology and Geology Departments of the Faculty of Science, the Institute for Quaternary Palaeontology and Geology of the Croatian Academy of Sciences and Arts, the Rijeka Natural History Museum, Risnjak National Park and Učka Nature Park Public Institutions, the Delnice,

Senj and Buzet Forest Administrations of Croatian Forests and their forestry offices, Croatian Water, units of local self-government, tourist boards, the Biom, Jezero, Hyla and Ožujka associations, and the members of various non-governmental organisations and hiking clubs who are too numerous to be mentioned here.

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We would also like to extend our special gratitude to Primorje-Gorski Kotar County and the Environmental Protection and Energy Efficiency Fund for providing the Priroda Public Institution with significant financial support for the preparation and publication of this book.

Sonja ŠIŠIĆ, B.S. (Econ), M.Sc. Director of Priroda Public Institution

EDITOR'S NOTE

CONTENTS

FOREWORD	5
EDITOR'S NOTE	9
INTRODUCTION	17
The natural features of Primorje-Gorski Kotar County	19
Protected areas in Primorje-Gorski Kotar County	31
Natura 2000 ecological network in Primorje-Gorski Kotar County	37
THE UNDERWATER WORLD	41
Life in the sea	43
Mudflats and sandflats not covered by sea water at low tide	49
Coastal lagoons	53
Large shallow inlets and bays	
Submerged or partly submerged sea caves	
Reefs	
Posidonia beds	67
Sandbanks which are slightly covered	
by sea water all the time	
Common bottlenose dolphin	75
THE ISLANDS	79
Kvarner islands	81
Island of Krk	89
Lake Jezero near Njivice	95
Lake Ponikve	101
Soline Cove	107
Vrbnik	109
Kuntrep (Glavine-Mala Luka)	111
Košljun	117
Holm oak forest in Glavotok	121
Island of Prvić and Grgur Channel	
Island of Sveti Grgur	131

Island of Rab	135	Gumance	307
Dundo Forest	141	Trstenik	313
Lopar	147	Rečice	323
Komrčar	153	Lividraga and Bjeljevina	325
Island of Dolin	157	Risnjak	329
Island of Cres	161	Source of the River Kupa	
Ornithological reserves on the island of Cres	171	River Kupa	345
Old oak at Sveti Petar		Velika Belica	351
Island of Lošinj		Mala Belica	355
Pod Javori		The Gerovčica stream	359
Čikat	187	Debela Lipa-Velika Rebar	363
Islet of Veli Osir		Golubinjak	369
Islet of Zabodarski	195	Lokve-Sunger-Fužine	375
Island of Zeča		Lič Polje	383
Vele Srakane and Male Srakane		Japlenški Vrh	389
Island of Susak	201	Vrajži Prolaz and Zeleni Vir	395
THE COAST	207	Forests around Skrad	403
		The old yew in Međedi	409
Angiolina Park		Area around the Kupica	411
Margarita Park		Kamačnik	417
Sveti Jakov Park		The park by the castle in Severin na Kupi	421
Canyon and valley of the River Rječina		Matić Poljana	425
The old oaks at Guljanov Dolac		Bjelolasica	429
Gornje Jelenje towards Platak		Bijele Stijene and Samarske Stijene	433
Bakar-Meja		THE UNDERGROUND WORLD	443
Zebar Pleteno above Novi Vinodolski		Subterranean life	
		Zametska Cave	
Krmpotsko		Gotovž Ponor	
The slopes of Veli Vrh above Tomišina Draga	233	Lokvarka Cave	
THE MOUNTAINS	259	Caves not open to the public	
Učka and Ćićarija	261		101
Lisina	275	AND FINALLY, A LOOK INTO	165
Gorski Kotar	281	THE FUTURE	
Obruč	299	LITERATURE	467



Because of the green vegetation that sweeps down from the highlands to the Kvarner islands and clear blue sea, Primorje-Gorski Kotar County is known as *the green-blue county* The colours of its beautiful nature, green and blue, provide the basis for its distinctive slogan.









Primorje-Gorski Kotar County is characterised by many important natural areas with well-preserved landscapes and beautiful nature. This is testified to by the interest of the Croatian and foreign naturalists who have visited the region and left behind written records of its importance since the second half of the 18th century, from the Venetian abbot and naturalist Alberto Fortis, whose writings on the Kvarner islands go back to 1774, to the Croatian botanists Dragutin Hirc, Ljudevit Rossi and Ivo Horvat, who worked in the 19th and 20th centuries, as well as their numerous modern followers.

The county is located in the west of the Republic of Croatia and can be divided into three specific areas that differ with regard to their natural-geographic, socio-economic and historical-cultural characteristics. These areas are the **highlands**, **coastal area and Kvarner islands**. It is precisely because of its specific geographic location that the county is so rich in terms of its nature. It is characterised by various types of landscape, from the mountains of Gorski Kotar and areas of luxuriant forest, to the barren karst islands of Kvarner and the sea.

The highlands include the forested expanse of Gorski Kotar and the mountainous areas of Učka and Ćićarija. The highest peaks here are Kula on Bjelolasica (1,534 m), Risnjak (1,528 m), Snježnik (1,506 m), Obruč (1,376 m) and Vojak on Učka (1,401 m). It is particularly noteworthy that in the area of Primorje-Gorski Kotar County there are as many as 73 peaks higher than 1,250 metres.

Area of Primorje-Gorski Kotar County			
Area	Area (km²)	Area in relation to the territory of the Republic of Croatia (%)	
Mainland and islands	3,587	6.3	
Sea	4,344	13.2	
Total	7,931	8.9	

THE NATURAL FEATURES OF PRIMORJEGORSKI KOTAR COUNTY







Yew tree on karst

The geological bedrock of the county chiefly comprises carbonate rocks. These have been shaped over time by the atmospheric conditions and surface water into various karst relief forms, such as limestone pavement and sinkholes on the surface, various subterranean *speleological* objects, and underground and karst springs.

The coastal area can be divided into the Liburnia, Rijeka and Crikvenica-Vinodol areas. This is the most densely populated part of the county, and is characterised by a number of small coastal towns that blend into the karst landscapes and their extensive network of picturesque dry stone walls and terraces that bear witness to the area's rich rural tradition.

The marine part of the county consists of the greater part of Kvarner Bay with Rijeka Bay, the Velebit Channel, Vinodolski Channel, Kvarnerić and Kvarner as separate marine units that divide the four main groups of islands: Krk, Rab, Cres and Lošinj. In Primorje-Gorski Kotar County, there are 55 islands, approximately 60 rocks, and more than 10 reefs.

In terms of the county's geological substrate, there are two important types of rock: permeable and impermeable. The permeable rocks are carbonate rocks subject to karstification. They are particularly marked by surface dryness and deep groundwater flow. In terms of their properties, a distinction is made between dolomite and limestone. Because dolomite erodes more easily, a smoother and more rounded relief develops, which is also generally greener. Limestone is usually karstified with surface and underground karst forms, including cliffs, rocks, stones, sinkholes and various types of cave.

The small amount of impermeable rock present is of great importance to the hydrology of the county, as waterways have developed on it. Paleogene flysch rocks are examples of this. The county also has very small areas of volcanic rock at Benkovac Fužinski and Lepenice. The loess islands of Susak and Srakane are certainly unusual too. Thick layers of sand have been deposited here on the carbonate base, which can be explained by the aeolian theory of the sand being brought by the wind during the ice ages.





Stream in Kamačnik

The fantastic hydrological phenomena, especially the karst springs, clear rivers and streams, canyons and rugged valleys with torrents, and the unusual diversity of the landscape attract numerous nature lovers who enjoy these wonderful sites.

Soil type is closely connected to geological bedrock, and there are as many as 58 different soil types in the area of the county, which indicates the diversity of the ecological conditions in the region. The most widespread soil types found on carbonate rock are red and brown soil on limestone in the lowlands, and mountain black soils in higher areas. As far as other soil types are concerned, rendzina is present on eroded dolomite and certain other loose bedrock. Rankers have developed on flysch and silicate bedrock, while deeper profiles, which may be partly on carbonate bedrock, are occupied by loess. Dystric brown soil occurs mainly in the hilly areas of Gorski Kotar on various geological bedrock types and in climatic conditions characterised by plenty of rainfall. Podzols are highly washed-out acidic soils that cover the acid silicate bedrock in the coniferous woods of Gorski Kotar. The rare types of soil present, which in part require protection, include eutric brown soils, certain hydromorphic soils, salty soils near the coast, and sierozems. The most important arable soils are anthropogenic deeply ploughed soils and soils on terraces created through the hard work of peasants.

Hydrological conditions in the county reflect the geological structure of the area and the amount of precipitation. A network of numerous surface waterways in the form of rivers and streams has developed on the region's impermeable rocks. The most important waterway in the county is the River Kupa, which is also the largest highland river in Croatia. Its source is a completely undisturbed karst spring of the Vaucluse type that rises at the foot of steep cliffs from a clear pool that is more than 150 metres deep. The islands of Cres and Krk are the only Croatian islands that have large permanent bodies of surface water. Lake Vrana on the island of Cres is considered an international hydrological phenomenon, while the Suha Rečina stream (Vela rika) is the only permanent watercourse on the Adriatic islands.





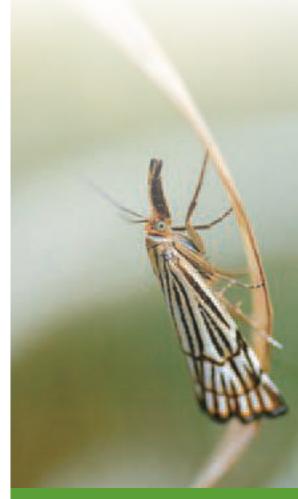
The Velo Snižno Dale in the Platak area with a small sinkhole – "a frost area within a frost area"

Frost areas are a particularly interesting phenomenon of karst sinkholes and dales. These occur due to an influx of cold air which remains at the bottom of the dale, which leads to an inversion in temperature, with lower altitudes being noticeably cooler than higher ones. Such areas have their own mesoclimate. If there is also a sinkhole in the bottom of the karst dale, then a frost area within a frost area can occur, such as the one in the photograph (Velo Snižno Dale at Platak), where the microclimatic conditions are conducive to the development of vegetation typical of tundra, such as lichens, mosses and dwarf shrubs.

The climatic conditions of the county vary due to the relief barrier created by the northwestern Dinarides, which prevent the sea from having a stronger influence on the hinterland and conversely the continental interior from affecting the littoral. The local climate is mainly influenced by altitude and the proximity of the sea, which means that the Kvarner islands and coastal area receive the greatest benefit from the Mediterranean climate. On the slopes of the littoral, a sub-Mediterranean climate predominates, while most of Gorski Kotar is characterised by a pronounced continental climate. The most frequent winds in the county are the northerly *bura* and southerly *jugo*.

Plants and wildlife. Primorje-Gorski Kotar County is the meeting point of two different floristic-geographic regions, which has resulted in the presence of flora from both regions and the fact that today several thousand higher plant species can be found in the county. The wealth of plant life is enhanced by the presence of numerous endemic species distributed over small areas and also relict species that are considered to be rare representatives of past times.

The county also has diverse vegetation zones. From the shores of the Kvarner islands to the peaks of the mountains, there are six different vegetation zones. Evergreen forests and holm oak macchia are present in the warmer parts of the Kvarner islands and intermittently on the Liburnian coast up to Medveja. Most of the vegetation on the island of Krk, northern parts of the island of Cres, and the majority of the littoral area is of the deciduous sub-Mediterranean kind. At altitudes from 450 to 900 metres on the slopes of the coastal mountains, there is a belt of Mediterranean mountain vegetation with forests and thickets of European hop-hornbeam and also special types of rocky pasture rich in flora. Mount Učka and most of Gorski Kotar are found in the beech forest zone, while the zone on the edges of Gorski Kotar towards the interior consists of moderate-



Grass moth

The gentle grass moth, or *Chrysocrambus cratarella*, is a typical example of the *Crambidae* family. These are small nocturnal moths that live in grasslands. During the day, they hide and rest on blades of grass, while during the night they are active and often fly towards sources of light. A peculiarity of this moth is that it has long palpi which form a kind of elongated, hairy, forward-pointing nose-like appendage on its head. Its caterpillars hide and feed on grass.



Forest

In the area of Primorje-Gorski Kotar County, there are some thirty primary forest communities (out of a total of about 50 such communities in Croatia). In areas which because of environmental conditions are not covered in forest, rock, mountain meadow, floodplain, wetland, peatland and various other communities have developed. These non-forest communities are of great scientific importance, as they represent rare and endangered species of vegetation.

ly moist sessile oak and common hornbeam. The highest parts of Gorski Kotar are in the mountain dwarf pine zone, which also contains rock vegetation and mountain meadows.

Besides an abundance of plant life, the county is also rich in fauna. The subterranean karst fauna is particularly noteworthy, as it is almost entirely endemic. The county is one of the few areas in Europe which today is still home to the continent's large carnivores: the brown bear, wolf and lynx. The only population of griffon vultures in Croatia nest on the cliffs of Kvarner's islands. There is also a resident population of dolphins in the waters off Cres and Lošinj. The island of Krk is home to numerous species of amphibians and reptiles, and is herpetologically one of the richest islands in the Mediterranean. The Kupa Valley has more than 500 different species of butterfly, which is why it is known as "the valley of butterflies".

The underwater world of the county is very rich in flora and fauna too. Of the most important underwater communities, the coralligenous and seagrass communities are particularly noteworthy. Because of its abundant sea life, the coralligenous biocenosis attracts many recreational divers. However, the presence of numerous attractive and rare organisms, together with its amazing underwater environment, means that it is important for such underwater areas to be protected. Posidonia beds are another very important underwater biocenosis. Posidonia oceanica or Neptune grass is an excellent indicator of the state of the environment and is a particularly important shelter and spawning ground for fish and other demersal organisms. The waters of the Lošinj archipelago have the most extensive and well-preserved meadows of Posidonia oceanica in the county, which makes this group of islands particularly important in preserving the diversity of life underwater. Other significant underwater communities include infralittoral algae, muddy sands of sheltered coasts, and fine monotonous sands.





Pond on the island of Krk

The natural features of the County also reflect the coexistence of man and the natural environment. The small still-water habitats of karst ponds on Kvarner islands have often appeared with the help of man. In the arid karst landscape, they provided a source of water for livestock and agriculture but also small oases for wildlife. They are particularly important resting places for visiting migrating birds during their long and arduous journeys.

The sustained protection and management of important natural areas in the world dates back to 1879, when Yellowstone Park in the United States of America was proclaimed a national park. At that time, the reasons for establishing protected natural areas were exclusively aesthetic and related to the landscape. Today, protected areas serve significantly more numerous and useful functions.

The idea of protecting natural heritage in Croatia began to emerge at the end of the 19th century with the establishment of various associations of nature enthusiasts, and the efforts of naturalists, researchers and hikers, who as people who regularly took part in activities outdoors recognised the importance of preserving and protecting the natural environment.

A significant contribution to recognising the natural importance of Primorje-Gorski Kotar County and to developing environmental protection in the area was made by the naturalists Dragutin Hirc and Ivo Horvat.

Conservation and protection of the natural environment in the Republic of Croatia is regulated by the Nature Protection Act, which covers 408 areas.

The wealth of natural heritage in the county has created the need for special protection of important natural areas. To preserve the natural heritage of the county, 31 of its important natural areas have been given protected status.

Nature protection is carried out by means of preserving biodiversity, landscape diversity and geodiversity, and by protecting natural areas. This can take the form of protected areas, protected species, and protected minerals and fossils.

PROTECTED AREAS IN PRIMORJEGORSKI KOTAR COUNTY



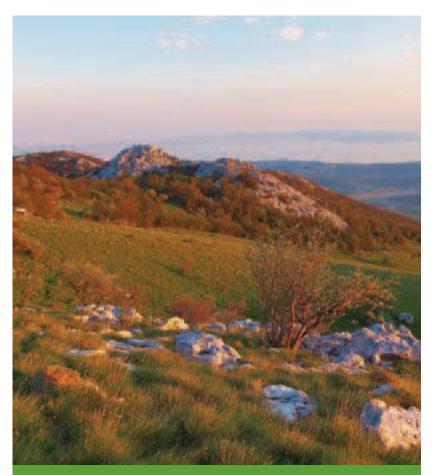
Dragutin Hirc (1853-1921) was one of the notable researchers, travel writers and naturalists whose work paved the way for the development of protection of the natural environment in the Republic of Croatia. Most of Hirc's research was dedicated to studying the nature in what is today Primorje-Gorski Kotar County. Its coastal and mountain regions are described in his most successful travel books: Hrvatsko primorje (The Croatian Littoral) of 1891 and Gorski kotar of 1898, while his important botanical work covered the Kvarner islands, Primorje, Učka and Gorski Kotar. As an avid hiker, he traversed the whole of Croatia, including certain areas several times. He was especially fond of certain parts of Primorje-Gorski Kotar County, particularly his "favourite hill", Veliki Risnjak, which he visited seven times.

The Act classifies nine different categories of protected area:

- strict reserve,
- 6 national park,
- special reserve,
- 6 nature park,
- regional park,
- 6 protected landscape,
- **6** park architecture monument.

Protected areas are managed by public institutions. Three public institutions operate in the county: Risnjak National Park Public Institution (headquartered in Crni Lug), Učka Nature Park Public Institution (headquartered in Liganj), and the Priroda Public Institution (headquartered in Rijeka).

The total surface area of the protected natural areas in Primorje-Gorski Kotar County amounts to 263.3 km², which represents 3.35% of the total (land and sea) area of the county. The total surface area of the protected natural areas on land is 218.54 km², or 6.09% of the total land area. The only protected marine area is the waters around the island of Prvić, including the Grgur Channel, whose surface area comes to 44.76 km², or 1.05% of the total marine area of the county.



Grasslands in wind-exposed areas in the Grobnik Mountains

The plant communities of the Mediterranean-montane grasslands on the coastal slopes of the Grobnik Mountains have suffered significant changes in their botanical composition since the time that they were intensively studied by Professor Horvat and his colleagues. This is principally due to the process of the slopes being covered in woody plants. So far, this process has been best resisted by grasslands of narrow-leaved moor grass (*Sesleria juncifolia*). It can also partly be attributed to the strong gusts of the *bura* wind that often blow across the grassy expanses of the Grobnik Mountains. The places where the *bura* has the most pronounced effect are known locally as *burnjaci* or wind-exposed areas.

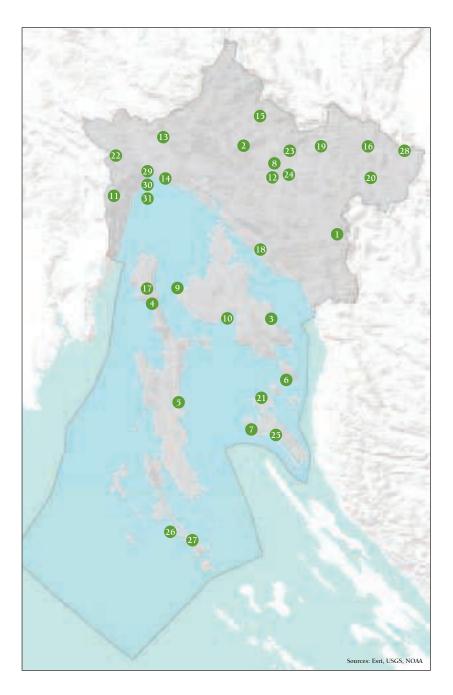


Ivo Horvat (1897-1963) was a prominent botanist and university professor, but also one of the pioneers of nature protection in Croatia. He called the mountains of Gorski Kotar "the gate to Croatia", as in the past many mountain species from the Alps made their way through them to the Dinarides and vice versa. He carried out part of his research on Risnjak, where he conducted detailed mapping of the vegetation. Of his numerous scientific works, the most important is the monograph Vegetacija planina zapadne Hrvatske (The Vegetation of the Mountains of Western Croatia). The results of the scientific research conducted by Professor Horvat and his colleagues provided the basis for the proclamation of Risnjak as a national park in 1953. In Croatia, the significance of his work is testified to by the fact that since 2006, Nature Protection Day and the International Day for Biodiversity, which takes place on 22 May, has seen the Ivo Horvat Prize awarded to individuals who have made an outstanding contribution to the protection of the environment.

Map of protected areas in Primorje-Gorski Kotar County

In Primorje-Gorski Kotar County, 31 natural areas and individual features of importance are protected by means of eight different categories. Most of these protected areas were proclaimed in the period from the 1950s to the 1980s. The first to be protected, when it was declared a special forest vegetation reserve in 1949, was Dundo Forest on the island of Rab.

- 1. Bijele Stijene and Samarske Stijene
- 2. Risnjak
- 3. Kuntrep (Glavine-Mala Luka)
- 4. Fojiška-Pod Predošćica
- 5. Mali Bok-Koromačna
- 6. Island of Prvić and Grgur Channel
- 7. Dundo Forest
- 8. Debela Lipa-Velika Rebar
- 9. Glavotok
- 10. Košljun
- 11. Učka
- 12. Lokvarka Cave
- 13. Ponor Gotovž
- 14. Zametska Cave
- 15. Source of the Kupa
- 16. Old yew in Međedi
- 17. Old oak at Sveti Petar
- 18. Old oaks in Guljanov Dolac
- 19. Vrajži Prolaz and Zeleni Vir
- 20. Kamačnik
- 21. Lopar
- 22. Lisina
- 23. Japlenški Vrh
- 24. Golubinjak
- 25. Komrčar
- 26. Čikat
- 27. Pod Javori
- 28. Castle park in Severin na Kupi
- 29. Angiolina Park
- 30. Margarita Park
- 31. Sveti Jakov Park



List of protected areas in Primorje-Gorski Kotar County by national protection category

STRICT RESERVE

Bijele Stijene and Samarske Stijene

NATIONAL PARK

Risnjak

SPECIAL RESERVES

Kuntrep (Glavine-Mala Luka) (ornithological)

Fojiška-Pod Predošćica (ornithological)

Mali Bok-Koromačna (ornithological)

Island of Prvić and Grgur Channel (zoological-botanical)

Dundo Forest (forest vegetation)

Debela Lipa-Velika Rebar (forest vegetation)

Glavotok (forest vegetation)

Košljun (forest vegetation)

NATURE PARK

Učka

NATURAL MONUMENTS

Lokvarka Cave (geomorphological)

Gotovž Ponor (geomorphological)

Zametska Cave (geomorphological)

Source of the Kupa (hydrological)

Old yew tree in Međedi (individual tree specimen)

Old oak tree at Sveti Petar (individual tree specimen)

Old oaks in Guljanov Dolac (individual tree specimens)

PROTECTED LANDSCAPES

Vrajži Prolaz and Zeleni Vir

Kamačnik

Lopar

Lisina

FOREST PARKS

Japlenški vrh

Golubinjak

Komrčar

Čikat

Pod Javori

PARK ARCHITECTURE MONUMENTS

Castle park in Severin na Kupi

Angiolina Park

Margarita Park

Sveti Jakov Park





Raising of the Natura 2000 flag on the island of Rab

In Primorje-Gorski Kotar County, there are 110 Natura 2000 European ecological network sites, three of which are Special Protection Areas for the Conservation of Wild Birds (Kvarner islands, Gorski Kotar and Northern Lika, and Učka and Ćićarija), while the other 107 are special conservation areas for other wildlife species and habitat types. This ecological network also protects a total of 112 plant, animal and fungus species in the county, and 47 different types of habitat. The Natura 2000 ecological network covers 74.89% of the land surface area of the county, and 16.36% of the marine surface area, which means that in terms of its biodiversity and ecological network coverage Primorje-Gorski Kotar County is significantly above the average for the Republic of Croatia.

Besides natural areas protected by national legislation, a large amount of the important natural heritage of Primorje-Gorski Kotar County is part of the ecological network of the European Union: Natura 2000. Natura 2000 network areas can be:

- 6 Special Protection Areas for the Conservation of Wild Birds, and

The establishment of Natura 2000 areas seeks to preserve or reestablish a favourable status for more than a thousand threatened or rare species (Natura 2000 species) and approximately 230 natural and semi-natural habitat types (Natura 2000 habitat types) in the European Union.

With the accession of Croatia to the European Union, Natura 2000 ecological network areas were established on the territory of the Republic of Croatia, including 38 Special Protection Areas for the Conservation of Wild Birds and 743 Special Areas of Conservation of Natural Habitats and of Wild Fauna and Flora.

The Natura 2000 ecological network in the Republic of Croatia comprises about 30% of national territory, including 37% of its land area and 16% of its coastal waters. In terms of its biodiversity and conservation of natural heritage, Croatia is above the European Union average, as Natura 2000 sites make up only about 18% of the territory of the European Union.

This book describes the areas protected by law and also sites established as part of the Natura 2000 ecological network in Primorje-Gorski Kotar County. We have collected some useful information about them and hope that this will interest people and encourage them to visit the natural heritage of the county and find out about it for themselves.

NATURA 2000 ECOLOGICAL NETWORK IN PRIMORJE-GORSKI KOTAR COUNTY



Official logo of the European Union Natura 2000 ecological network

Map of Natura 2000 Special Protection Areas for the Conservation of Wild Birds in Primorje-Gorski Kotar County

The Natura 2000 ecological network in Primorje-Gorski Kotar County comprises three Special Protection Areas for the Conservation of Wild Birds:

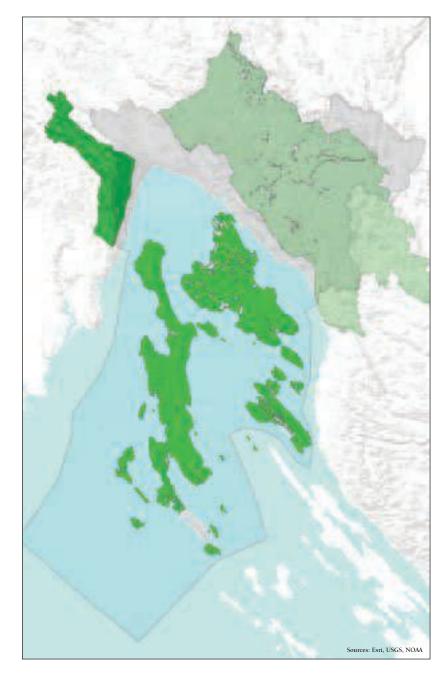
- 1. The area of Gorski Kotar and Northern Lika, together with Velebit, is the most important area in the Republic of Croatia for the nesting of forest hole-nesting birds, such as the boreal owl (Aegolius funereus). The Gorski Kotar and Northern Lika region is the most important site for the western capercaillie (Tetrao urogallus) and hazel grouse (Bonasa bonasia), and is also an important area for another 30 bird species.
- 2. The Kvarner islands are important for being the only area in Croatia with nesting colonies of griffon vultures (*Gyps fulvus*) and lesser kestrels (*Falco naumanni*). The area is also home to a large proportion of the country's populations of the stone-curlew (*Burhinus oedicnemus*) and greater short-toed lark (*Calandrella brachydactyla*). In total, the Kvarner islands are home to 40 significant bird species.
- **3.** The area of Učka and Ćićarija is important for being home to a large proportion of the country's birds of prey, such as the golden eagle (*Aquila chrysaetos*), short-toed snake eagle (*Circaetus gallicus*), and peregrine falcon (*Falco peregrinus*). Besides the conservation of birds of prey, the area is also important for a further 19 bird species.

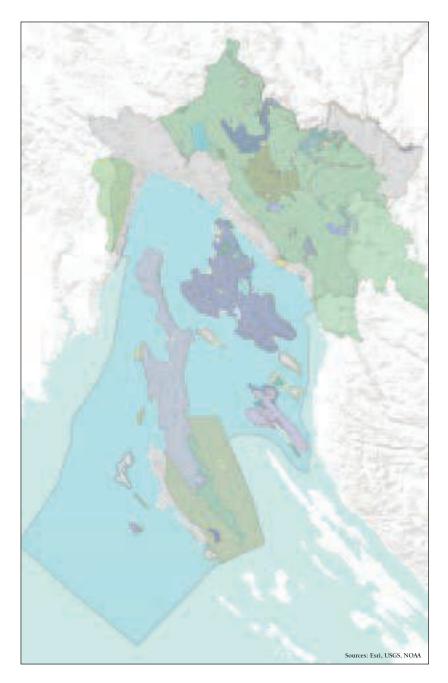
Key:

Gorski Kotar and Northern Lika

Kvarner islands

Učka and Ćićarija





Map of Natura 2000 special conservation areas for species (other than birds) and habitat types in Primorje-Gorski Kotar County

The Natura 2000 ecological network special conservation areas for wildlife and habitat types in Primorje-Gorski Kotar County comprise 107 areas.

The important marine habitat types consist of colonies of Posidonia (Neptune grass), reefs and submerged sea caves, while the common bottlenose dolphin (*Tursiops truncatus*) is a covered species.

In the Gorski Kotar, Učka and Čićarija regions, there are important habitats of dry continental grassland, beech and fir forest, and dwarf pine forests. The species covered are the wolf (Canis lupus), lynx (Lynx lynx), brown bear (Ursus arctos), and stone crayfish (Austropotamobius torrentium).

The numerous important habitats on the islands include carbonate rock habitats with chasmophytic vegetation, Eastern Mediterranean dry grasslands, and holm oak forests. The species covered include Hermann's tortoise (*Testudo hermanni*), Geoffroy's bat (*Myotis emarginatus*), and the great capricom beetle (*Cerambyx cerdo*).

Many of the Natura 2000 network areas overlap and are shown on the map in different colours.

We also have the sea that washes the blooming shores, and we have the land, and paradise on it.

Dragutin Hirc, Hrvatsko primorje (The Croatian Littoral) (1891)





The seas make up more than 70 percent of the Earth's surface and have an average depth of more than four kilometres. It is estimated that sea organisms have at their disposal a living space 250 times larger than that available to land inhabitants. However, even though the seas provide a huge living space, the greatest diversity of sea organisms is concentrated in the shallow area by the coast. This area extends from the shore to a depth of about 200 metres, a zone which can still be penetrated by light. This area is called the littoral zone. Since it has a maximum depth of 125 metres, the whole marine area of Primorje-Gorski Kotar County is in the littoral zone.

Because of the constant strong influence of natural forces on the area where the land meets the sea, this county has some of the most impressive coastal landscapes in the Adriatic. The spacious sandy beaches of the Lopar peninsula on the island of Rab, the rugged cliffs of Prvić, and the salty marshes of Soline Cove on the island of Krk are just some of the examples of the county's diverse landscapes.

However impressive the view of the coastal landscape may be, even more impressive is the way its plants and animals have adapted to this environment. Along the coastline, where the influence of the sea starts, there are halophytes, plants which during their evolution have developed different mechanisms to fight against the large amounts of salt in the air and soil. Some of them collect salt in their cells, some have an additional coat of wax or hair on their surface, while others excrete excess salt through their leaves.

The upper tidal limit is reached by descending from the land towards the sea. This line is difficult to determine on sandy and pebbly beaches, though on rocky coasts it is easily visible as a line between the light lower and dark upper areas, where the dark area is a belt of microscopic cyanobacteria (blue-green algae).

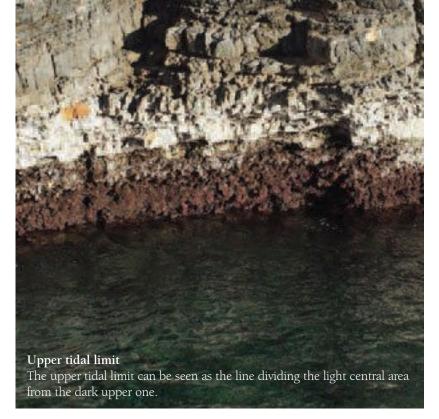
LIFE IN THE SEA





Coastal landscape on the island of Cres

Because of the constant strong influence of the forces of nature on the area where the land meets the sea, the Primorje-Gorski Kotar County has some of the most impressive coastal landscapes in the Adriatic.



The tidal area is one of the most difficult places to live. For example, littoral rock pools can be completely dry, or filled with rain, sea or salt crystals. These conditions require extreme adaptability, so only a small number of species manage to survive here.

Bivalves and gastropods can withdraw into their shells, thus conserving precious moisture, while sea anemones can retract their tentacles to reduce the amount of their body exposed to desiccation. Certain algae, such as *Fucus virsoides*, can even survive if they lose 90 percent of the water from their organism during low tide.

The stability of conditions beneath the lower tidal limit allows far greater biodiversity. Under the sea, life appears in countless forms and sizes. The majority of life is found in the surface area, within the reach of light. However, not all light penetrates uniformly. Certain



Glasswort (Salicornia europaea) accumulates large amounts of soda in its cells to protect itself from the increased amount of salt in the surrounding air and soil.





wavelengths are quickly lost under the surface. Blue light reaches furthest, while red light is quickly lost. Such conditions limit photosynthesis, which means that organisms which use sunlight for their growth can survive only up to a certain depth. For example, Neptune grass (*Posidonia oceanica*) can be found at depths of up to 30 metres in the northern Adriatic. Red algae can carry out photosynthesis below this depth because their pigments are able to use blue light.

Away from the mainland and islands, the bottom of the northern Adriatic Sea descends to an average depth of about 65 metres, and transforms into a gentle hilly plain covered in muddy or sandy material. Marine sediment not only includes sand and mud created by the erosion of land rocks but also consists, to a significant extent, of fragments of bivalve and gastropod shells, bryozoan skeletons, sea urchin shells, and pieces of red algae.

The diversity of marine habitats in the county is large due to its geomorphological coastal features, which have been shaped in karst limestone. Of the eight marine habitats found on the eastern Adriatic coast that are vital for marine protection at the European level, seven are found in Primorje-Gorski Kotar County. These are:

- 6 mudflats and sandflats not covered by sea water at low tide,
- 6 coastal lagoons,
- 6 large shallow inlets and bays,
- submerged or partly submerged sea caves,
- 6 reefs,
- 6 posidonia beds
- **6** sandbanks which are slightly covered by sea water all the time.





The eastern and western Adriatic coasts differ greatly. Whereas on the west coast flat seabeds with muddy sediments predominate, on the east coast they are mainly rocky and steeper. Given such a configuration, shallow mudflats and sandflats which are not covered by sea water at low tide are very rare. These usually occur in estuaries or shallow enclosed coves. Since there are no larger rivers in the county to build up estuarine deposits, the largest shallow mudflats and sandflats in terms of surface area can be found in several coves on the islands of Susak, Rab and Krk. In spite of their low levels of biodiversity, these habitats are ecologically very important. Many birds, such as the genus *Calidris*, find food in these areas. Their diet mainly consists of annelid sandworms. There can be more than 70 of these per square metre.

Mudflats and sandflats not covered by sea water at low tide in the Natura 2000 ecological network		
Site code	Site name	
HR3000005	Cres – Cape Pernat – Tiha Bay	
HR3000007	Cres – Cape Suha – Cape Meli	
HR3000012	Lošinj – Pijeska Cove	
HR3000014	Ilovik and Sveti Petar	
HR3000017	Waters around the island of Susak	
HR3000018	Waters around the island of Unije	
HR3000020	Krk, Mala Luka and Vela Luka on the Sokol peninsula	
HR3000024	Supetarska Draga on the island of Rab	
HR3000025	Kampor Bay on the island of Rab	
HR3000417	Sveta Eufemija Bay on the island of Rab	
HR3000454	Krk – from Cape Crikveni to Cape Sveti Nikola	
HR3000468	Waters around the Lopar peninsula – Rab	

MUDFLATS AND SANDFLATS NOT COVERED BY SEA WATER AT LOW TIDE



Klein's sole

Klein's sole (Solea kleinii) enters the shallow areas of sandy and muddy bays during high tide and returns to deeper waters with low tide. It feeds on the tiny invertebrates found just under the surface of the sand. Its body colour is perfectly adapted to its environment so that it is very difficult to notice it as it lies halfburied on the seabed. Klein's sole belongs to the group of flatfish characterised by an asymmetry between the left and right parts of their bodies. Even though flatfish fry are symmetrical at birth and at first spend their time swimming in the water column, while growing up they adopt a demersal way of life (near the seabed). While growing, Klein's sole undergoes a transformation whereby its eyes move to the right side of its body and its left side remains close to the sandy seabed.



Prawns – jumpy seabed cleaners

The transparent body of prawns of the genus *Palaemon* means that they are perfectly adapted to hiding in shallow seas. These little long-tailed prawns will readily approach a human body submerged in the sea in order to take tiny pieces of peeling skin and then move away with a sudden swing of the tail so they can enjoy their catch in peace. Prawns of the genus *Palaemon* spend almost all their time searching the seabed collecting tiny organic debris.







Coastal lagoons are shallow coastal extensions covered by sea water. There are only two coastal lagoons in the county that are part of the Natura 2000 ecological network: those on the islet of Trstenik and the island of Zeča. Even though they represent the same habitat type, these two sites differ from each other.

The barrier that separates the coastal lagoon from the surrounding sea on the island of Zeča only allows fresh sea water to pass into the lagoon when strong westerly and south-westerly winds blow. This is why the salinity of the sea water in the lagoon varies considerably throughout the year. In such extreme conditions, a healthy and varied population of halophyte plants has developed in the lagoons of the island of Zeča.

The movement of sea water into the lagoon on the islet of Trstenik is much greater due to the alluvial rocky barrier separating the lagoon from the surrounding sea. The bottom of the lagoon is covered in a thin layer of light mud underneath which, in conditions without oxygen, the decomposition of organic matter has created a deep black mud. It is very difficult to walk through the shallow parts of the lagoon because one's feet get stuck in the sticky black mud, which releases bubbles of hydrogen sulphide gas of a foul odour. Even though it seems lifeless, the mud is full of life. The worms and molluscs under the surface are not troubled by the foul odour, and the tracks of tiny crabs can be seen in the mud in all directions.

Coastal lagoons in the Natura 2000 ecological network	
Site code	Site name
HR3000027	Waters around the islet of Trstenik
HR4000031	Island of Zeča

COASTAL LAGOONS





Large shallow inlets, coves and bays are areas where the sea cuts deep into the land. Protected from waves and open sea currents, these areas are important in biological terms as spawning sites for many fish species. Although young fish can find safety and shelter in deep coves, such an abundance of small fish attracts predators. Thus, for example, it is not a rare sight in Krivica and Balvanida Coves on Lošinj to see panic-stricken small fish jumping out of the water to flee from predatory sea bass. The slow exchange of sea water is a frequent cause of mud sedimentation deposits on the bottom of the sea. In such areas, sea cucumber populations are at their densest. With their strong muscular pharynx, they can swallow the mud, digest all the organic particles, and excrete the remains of the filtrated sediment.

In the large shallow coves and bays of Kvarner Bay, there used to be dense colonies of pen shells, Croatia's largest bivalve, the shells of which can grow to a length of more than 70 cm. Because of their attractiveness, pen shells have always been admired as a decoration

Large shallow inlets and bays in the Natura 2000 ecological network	
Site code	Site name
HR3000008	Lošinj – Vela Draga and Mala Draga
HR3000009	Lošinj – Sunfarni Cove
HR3000010	Lošinj – Krivica Cove
HR3000011	Lošinj – Balvanida Cove
HR3000012	Lošinj – Pijeska Cove
HR3000020	Krk – Mala Luka and Vela Luka on the Sobol peninsula
HR3000030	Mala Draga – Žrnovnica
HR3000415	Jaz, Soline and Sulinj Coves on the island of Krk
HR3000472	Waters around Cape Čuf on the island of Krk

LARGE SHALLOW INLETS AND BAYS





Fanworms – worms with floral heads

While walking along the promenade of seaside towns and looking at the seabed, it is possible to notice colourful feathery flowers undulating softly under the surface of the sea. Their thick tubes are usually attached to supporting piers, anchoring blocks or even tied ropes. Their ability to adapt to conditions in harbours is rather straightforward for these organisms, because their natural habitats are large shallow inlets and bays with a very slow circulation of sea water. If you get close to them or just cast a sudden shadow with your hand, they will immediately disappear into their tube. They are actually worms – polychaetes – living in tubes attached to the seabed and their heads are transformed into rows of feathery tentacles. Sea water flows through these delicate structures, which often have very attractive colours, carrying oxygen and food. Tiny food particles, such as bacteria and planktonic larvae of different organisms, get stuck to the tentacles and are then gradually brought into the tube. Since their "floral heads" are exposed to various dangers, these worms have developed lightning-fast reactions that allow them to retract their tentacles into the safety of their strong leathery tubes.



and a sought-after souvenir. As a result, their populations were almost completely wiped out in many tourist areas due to excessive harvesting.

In 1994, after pen shells were listed as a strictly protected species, a year-long campaign started with the aim of warning the local population and tourists that harvesting and trading in this species are strictly forbidden in the Republic of Croatia. This protection has been successful, as in the last few years pen shells have returned to many of the sites where they were previously found in Kvarner Bay.





$Leopard\text{-}spotted\ goby-timid\ inhabitant\ of\ semi\text{-}darkness$

In terms of the number of species and also the number of individuals, gobies are one of the most numerous groups of fish in the Adriatic Sea. Their distinctive appearance, with their protuberant eyes, and fleshy cheeks and mouth, makes them very recognisable. One of the more attractive members of this group is the leopard-spotted goby (*Thorogobius ephippiatus*). This spotted goby, which has a length of only about ten centimetres, lives in semi-dark caves where it feeds on various tiny shrimps. It is a very timid species and will not allow divers to get close to it, but will retreat into the safety of the darkness of a cave. The crevices and semi-caves of the steep coastline in the area of Brseč are ideal sites for observing leopard-spotted gobies in Kvarner.

The karst features of the county's coastline have provided the necessary conditions for the creation of numerous sea caves. These can be completely submerged in sea water or only partly submerged, as in the case of Medvjeđa Cave on the island of Lošinj, which has air pockets of different sizes in some of its parts. Fresh water enters certain sea caves, while some sea caves were created by streams of fresh water when the sea level was lower. The proof of this can be seen in the submerged stalactites and stalagmites created by the constant dripping of fresh water over many years. As far as biodiversity is concerned, the main feature of sea caves is the sudden reduction in the amount of sunlight when moving from the entrance towards the interior. Algae, the key photosynthetic sea organisms, cannot survive in such conditions.

Submerged or partly submerged sea caves in the Natura 2000 ecological network		
Site code	Site name	
HR3000002	Plomin – Mošćenička Draga	
HR3000005	Cres – Cape Pernat – Tiha Cove	
HR3000007	Cres – Cape Suha – Cape Meli	
HR3000015	Vele Srakane and Male Srakane	
HR3000021	Waters around the island of Prvić	
HR3000022	Waters around the islands of Grgur and Goli	
HR3000030	Mala Draga – Žrnovnica	
HR3000198	Medvjeđa Cave near Lučica Cove (Lošinj)	
HR3000247	Cave beneath Kostrij (Vrbnička Cave)	
HR3000257	Vrtare Male pit cave	
HR3000446	Medvjeđa Cave (sea cave)	
HR3000465	Waters around the east coast of the island of Krk	
HR3000467	Waters around Kostrena	

SUBMERGED OR PARTLY SUBMERGED SEA CAVES









Reefs are a habitat type that includes varied biological communities found on rocky coastlines. Rocks exposed to waves have completely different inhabitants from those in submarine springs. However, all these communities belong to a habitat type called reefs. One of the most important reef communities in the Mediterranean, and also Primorje-Gorski Kotar County, has developed at depths of 30 to 100 metres in conditions of semi-darkness, strong sea currents, and steep rocky seabeds. The base of the community is made up of the calcareous red algae of the *Corallinaceae* family, from which the coralligenous community gets its name.

Coralligenous reefs are actually live reefs built from different sessile organisms (such as red algae, coral and crusty bryozoans)

Reefs in the Natura 2000 ecological network	
Site code	Site name
HR3000002	Plomin – Mošćenička Draga
HR3000004	Cres – Cape Grota – Merag
HR3000005	Cres – Cape Pernat – Tiha Cove
HR3000007	Cres – Cape Suha – Cape Meli
HR3000016	Waters around Plavnik and Kormat
HR3000017	Waters around the island of Susak
HR3000018	Waters around the island of Unije
HR3000021	Waters around the island of Prvić
HR3000022	Waters around the islands of Grgur and Goli
HR3000028	East side of Vele Orjule and Male Orjule
HR3000452	Krk – from Cape Negrit to Zaglav Cove
HR3000454	Krk – from Cape Crikveni to Cape Sveti Nikola
HR3000465	Waters around the east coast of the island of Krk
HR3000467	Waters around Kostrena
HR3000472	Waters around Cape Čuf on the island of Krk

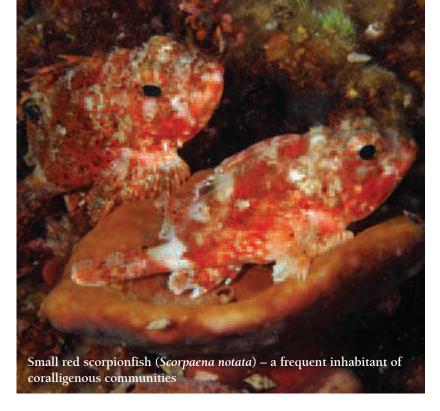
REEFS



Red gorgonian

Gorgonians are, like the majority of other coral groups, colonial organisms. A row of single polyps protrudes from a common base which resembles a tree with branches. Unlike hard coral, which builds strong calcareous skeletons, gorgonians are built of resilient organic matter. Their flexible two-dimensional structure enables them to bend under the force of the strong sea currents washing against the submarine cliffs. The polyps catch tiny particles of food, thus feeding the colony, which in the case of the red gorgonian (*Paramuricea clavata*) can grow to more than one metre in length.





which incorporate calcium carbonate into themselves, thus creating calcareous structures. Apart from biological construction, the coralligenous community is also marked by biological decomposition. For example, drilling molluscs and boring sponges drill into and dissolve the calcareous base, thus creating holes and crevices which provide shelter for many endangered species, such as the dusky grouper (*Epinephelus marginatus*), moray eel (*Muraena sp.*), red scorpionfish (*Scorpaena scrofa*) and spiny lobster (*Palinurus elephas*). The diverse colours and multitude of shapes in the world of calcareous algae, coral, gorgonians, sponges, bryozoans, and countless other organisms fascinate every visitor to the sea's depths. This is why the most popular diving sites are those with developed coralligenous structures. In Kvarner Bay, these are the north-west coast of the islands of Cres, Krk, Rab, Grgur, Prvić and Goli Otok.





Seahorse

The seahorse (*Hippocampus ramulosus*) is one of the many species that use *Posidonia oceanica* meadows as shelter, feeding grounds, and as a reproduction site. This unusual fish spends most of its time with its tail wound around flowering sea plants. Apart from their sessile way of life, seahorses also have a distinctive manner of reproduction. Unlike most fish, which lay eggs in their environment, female seahorses deposit eggs in the male's pouch on the ventral side of its tail. Three weeks later, young seahorses are "born" from the male's pouch following rhythmic contractions.

Neptune grass (*Posidonia oceanica*) is a seagrass species that is endemic to the Mediterranean Sea, which means that it does not live anywhere else in the world. It is a sea flowering plant, and like the majority of land plants, but unlike algae, it has a developed root, stem, leaves and flowers. It grows extremely slowly; its creeping rhizomes grow only a few centimetres a year. Neptune grass fruit, borne only once every few years, resembles olives and floats on the sea surface. In this way, the waves and currents carry the seeds to distant areas. Vegetative reproduction is employed much more frequently, by means of creeping stems, or rhizomes, little roots attached to the seabed, which over time are slowly covered by sediment. In order not to remain buried under the sediment, the stem creates upright shoots. This arrangement of rhizomes and shoots forms a mat whose holes are filled with sediment. Such

Posidonia beds in the Natura 2000 ecological network	
Site code	Site name
HR3000007	Cres – Cape Suha – Cape Meli
HR3000014	Ilovik and Sveti Petar
HR3000015	Vele Srakane and Male Srakane
HR3000017	Waters around the island of Susak
HR3000018	Waters around the island of Unije
HR3000024	Supetarska Draga on the island of Rab
HR3000025	Kampor Bay on the island of Rab
HR3000027	Waters around the islet of Trstenik
HR3000028	East side of Vele Orjule and Male Orjule
HR3000452	Krk – from Cape Negrit to Zaglav Cove
HR3000453	Krk – from Zaglav Cove to Cape Crikveni
HR3000454	Krk – from Cape Crikveni to Cape Sveti Nikola
HR3000465	Waters around the east coast of the island of Krk
HR3000468	Waters around the Lopar peninsula – Rab

POSIDONIA BEDS



submarine terraces reduce the loss of sediment caused by sea currents and waves and also play an important role in the circulation of nutrient salts and sea purification.

In large sea meadows, some Neptune grass plants can even be a few hundred years old, which makes them one of the longest-living organisms in the Mediterranean. Neptune grass meadows provide habitats, feeding and spawning grounds for more than 100 fish species. The greatest threats to the survival of this species in the county are wastewater, anchoring and trawling gear.



Several different biological communities that inhabit sandbanks have a common feature which is important to their existence, and that is a movable base. The sediment on this base is predominantly sandy but there can even be larger pebbles, pieces of rock, and also very tiny particles of mud. The biological communities that develop on such sites vary. Their adaptation and existence depend primarily on sediment granulation but also on currents and waves. Thus, for example, species inhabiting fine sand differ greatly from those found on gravelly seabeds.

Fine sandy seabeds have a greater biodiversity due to sediment stability. Such areas are home to many organisms that bury themselves in the sand, or sessile organisms, such as algae. Even though they may seem desolate at first glance, such sandy seabeds are home to numerous bivalves, polychaetes, crabs and sea urchins. Flatfish, such as sole, are also frequently found here.

Sandbanks which are slightly covered by sea water all the time in the Natura 2000 ecological network	
Site code	Site name
HR3000014	Ilovik and Sveti Petar
HR3000017	Waters around the island of Susak
HR3000018	Waters around the island of Unije
HR3000021	Waters around the island of Prvić
HR3000022	Waters around the islands of Grgur and Goli
HR3000024	Supetarska Draga on the island of Rab
HR3000025	Kampor Cove on the island of Rab
HR3000029	Coast between Cape Šilo and Vodotoč
HR3000417	Sveta Eufemija Cove on the island of Rab
HR3000453	Krk – from Zaglav Cove to Cape Crikveni

SANDBANKS WHICH ARE SLIGHTLY COVERED BY SEA WATER ALL THE TIME









Mediterranean scallop

The shells of the Mediterranean scallop (*Pecten jacobeus*) have been used for centuries as the symbol of St. Jacob in Spanish and French pilgrims' Christian festivities, with the result that the scallop has been named after the saint. At the edge of its mantle, there are many short tentacles between which there are tiny primitive eyes helping this mollusc to distinguish light from darkness. The shadow of a moving fish will cause a quick reaction and a closing of its shell or, in the cases of extreme danger, the expulsion of sea water from the front to allow the scallop to swim backwards.



The movability of pebbles on gravelly seabeds prevents the occurrence of sessile life forms. Only organisms which have adapted specially can live on pebbles, for example clingfish which can attach themselves to the base with their abdominal sucking disc.

In the channels between the islands, there is a shifting gravelly and sandy seabed where, due to the sea currents, there is no sedimentation of small particles. Special species of red algae live here which build limestone into their cells but which do not attach themselves to the seabed. These algae have a spherical shape and are called rhodoliths.





The common bottlenose dolphin (*Tursiops truncatus*) is the most well-known and widespread species of dolphin. Common bottlenose dolphins inhabit almost all of the seas and oceans in the world, including the Adriatic. Lengthy research into common bottlenose dolphins has been carried out in the northern Adriatic since 1987 by the Plavi Svijet (Blue World) Institute of Marine Research and Conservation from Veli Lošinj. This shows that the waters around Cres and Lošinj (Kvarnerić) are very important for the breeding and feeding of these sea mammals in the Adriatic. A catalogue of dorsal fin photographs is being compiled as part of the research.

During the day, dolphins engage in various activities: they feed, travel, rest, look after their calves, and are involved in many other social interactions with other members of their species. However, the presence of humans can interfere with these activities. Loud noise coming from ship engines and the pursuit of dolphins with boats cause stress and can lead to health problems, reduced reproduction rates, or avoidance of areas which were previously important feeding grounds.

The rules which enable every individual to enjoy watching dolphins in their natural environment with the lowest possible impact on their behaviour are simple and can be summarised as follows: do not get closer than 50 metres to dolphins; allow them to decide on their own if they will approach you or not; approach them slowly and sideways, never directly from the front or rear; put your boat engine to neutral and do not rush to catch up with them when they emerge; avoid sudden changes of speed or direction when close to them and follow the pod for 30 minutes at most. If you see calves or hear that the dolphins exhale loudly and bang their tail on the sea surface, change direction suddenly or dive for a long time, you should move away immediately.

Common bottlenose dolphin (<i>Tursiops truncatus</i>) reserve in the Natura 2000 ecological network		
Site code	Site name	
HR3000161	Cres — Lošinj	

COMMON BOTTLENOSE DOLPHIN







Amongst the grey rocks and hard cliffs, there is the azure-blue Adriatic Sea; the rocky coast is dotted with white houses, and far below, white sails glide along the silent sea towards a distant line, where behind the islands the blueness of the sky blends in with the blueness of the sea...

And your soul rushes towards Lošinj and Cres, rushes to the home of pretty marjoram and tiny basil ...

Dragutin Hirc, A Natural Geography of Croatia (1905)



The islamols



Although the harsh karst of the Kvarner islands may seem inhospitable at first glance, the area is very important for numerous species of wild bird. The inaccessible, well-preserved natural areas provide shelter, while the water habitats, such as the natural and semi-natural lakes and karst ponds, as well as the surrounding vegetation, provide food. Such sites are exceptionally important for long-distance migratory birds. As prominent features on the map, the Kvarner islands provide resting areas for thousands of tired and starving birds.

This is the reason why the Kvarner islands are recognised as an important area for bird conservation and have been made a Natura 2000 site. They are important for the conservation of 34 bird species, such as the golden eagle (*Aquila chrysaetos*), griffon vulture (*Gyps fulvus*), lesser kestrel (*Falco naumanni*), short-toed snake eagle (*Circaetus gallicus*), common kingfisher (*Alcedo atthis*), red-backed shrike (*Lanius collurio*), peregrine falcon (*Falco peregrinus*), and many others. The Kvarner islands are the only area in the territory of the Republic of Croatia where two endangered and rare species nest: the griffon vulture and the lesser kestrel. Steep, inaccessible cliffs provide the last shelter and nesting areas for griffon vultures, while the open rocky pastures are important for lesser kestrels, which were believed to be extinct in Croatia until recently.

KVARNER ISLANDS



 $Kvarner\ islands-Prvi\acute{c}, Sveti\ Grgur,\ Goli\ Otok\ and\ Rab\ in\ the\ background$

Within the county's region, right here on the Kvarner islands, there are four special reserves, which were established for the preservation of birds and the habitats where they nest. On the island of Krk there is the Kuntrep (Glavine-Mala Luka) special ornithological reserve, on Cres the reserves of Fojiška-Pod Predošćica and Mali Bok-Koromačna, and also right nearby is the island of Prvić, a special zoological-botanical reserve.

Natura 2000 site		
Site code	Site name	
HR1000033	Kvarner islands	
Target bird species		

Common kingfisher (Alcedo atthis)

Rock partridge (Alectoris graeca)

Tawny pipit (Anthus campestris)

Golden eagle (Aquila chrysaetos)

Eurasian bittern (Botaurus stellaris)

Eurasian eagle-owl (Bubo bubo)

Eurasian stone-curlew (Burhinus oedicnemus)

Greater short-toed lark (Calandrella brachydactyla)

European nightjar (Caprimulgus europaeus)

Short-toed snake eagle (Circaetus gallicus)

Hen harrier (Circus cyaneus)

Black woodpecker (Dryocopus martius)

Little egret (Egretta garzetta)

Merlin (Falco columbarius)

Lesser kestrel (Falco naumanni)

Peregrine falcon (Falco peregrinus)

Red-footed falcon (Falco vespertinus)

Black-throated loon (Gavia arctica)

Red-throated loon (Gavia stellata)

Common crane (Grus grus)

Griffon vulture (Gyps fulvus)

Little bittern (Ixobrychus minutus)

Red-backed shrike (Lanius collurio)

Lesser grey shrike (Lanius minor)

Woodlark (Lullula arborea)

Jack snipe (Lymnocryptes minimus)

European honey buzzard (Pernis apivorus)

Mediterranean shag (Phalacrocorax aristotelis desmarestii)

Little crake (Porzana parva)

Spotted crake (Porzana porzana)

Little tern (Sterna albifrons)

Common tern (Sterna hirundo)

Sandwich tern (Sterna sandvicensis)

Important non-nesting (migratory) bird populations (water rail Rallus aquaticus)



Common tern

The common tern (Sterna hirundo) is a migratory bird that spends the winter days on the coasts in tropical and subtropical regions, whilst for nesting it chooses the uninhabited islands and reefs in the area of the Primorje-Gorski Kotar County. Dense colonies of gulls often inhabit the same islands and reefs along with the terns. Although the relationship between these two species is on the whole friendly, in the nesting season the gulls will gladly steal and eat the eggs or even the young in the terns' nests. On the islet of Mali Ćutin during the nesting season terns can quite often be seen nervously swooping down on gulls who come too close to their nests.



Common kingfisher

The common kingfisher (*Alcedo atthis*) is a distinctive inhabitant of the Kvarner islands. This little bird with its charismatic look is a skilled hunter, and during the winter days it can be seen in the shallow part of the little harbour in the cove of Valbiska as it stalks the small fish that it feeds on.



Peregrine falcon

The peregrine falcon (*Falco peregrinus*) is a bird of prey that feeds on other smaller species of birds, and less frequently on small mammals, amphibians, reptiles, and even insects too. When flying it can reach great speeds. On the open karst pastures of the island of Prvić it can be observed on the hunt, soaring along the steep cliffs of the Kvarner islands or sitting on the top of a prominent rock – an observation point, which gives it a view over the area where it nests.







Numerous cultural and historical monuments, such as the stone towers and buildings in today's villages, and the dry stone walls which form a network across the entire island, testify to the centuries-long settlement of the island of Krk. The reason for this is the vicinity of the mainland, the Mediterranean climate, the diversity of the relief, fresh water sources, and rich vegetation.

Apart from its rich cultural and historical heritage, the island of Krk has great natural importance and a variety of different landscape types. The north of the island resembles a plateau, with the barren land exposed to the gusts of the *bura* wind, while the central part, unlike the arid karst, is covered by thick green vegetation. The south is characterised by two parallel bare mountain chains, between which there lies the green oasis of the Bašćanska Valley with its luxurious vegetation. Because of the considerable diversity of its relief and

Natura 2000 site		
Site code	Site name	
HR2001357	Island of Krk	
Target species		
Hermann's tortoise (Testudo hermanni)		
Four-lined snake (Elaphe quatuorlineata)		
European rat snake (Zamenis situla)		
Lesser mouse-eared bat (Myotis blythii)		
Target habitats		
Eastern Mediterranean screes		
Calcareous rocky slopes with chasmophytic vegetation		
Vegetated sea cliffs of the Mediterranean coast with endemic Limonium spp.		
Caves not open to the public		
Annual vegetation of drift lines (Cakiletea maritimae p.p.)		
Mediterranean temporary ponds		
Eastern sub-Mediterranean dry grasslands (Scorzoneretalia villosae)		

ISLAND OF KRK



Dry stone walls of the island of Krk

Dry stone walls are one of the cultural-historical assets of this region. They are made using a special technique without the use of any kind of mortar. Their purpose was to fence off the pastures for those who farm flocks of sheep or the protection of arable land from soil erosion. Apart from a cultural value they are also particularly important for plants and wildlife because they are habitats for specific vegetation and diverse animal species.



European ratsnake

Due to its slightly exotic look, the European ratsnake (*Zamenis situla*) is certainly one of the most beautiful snakes in this area. Unfortunately, it is because of its attractive appearance that it is often the target of collectors. Despite not being venomous, it is killed out of ignorance, and along with illegal catching, this is the main reason that this Natura 2000 species is endangered. It feeds mainly on small rodents and so in the past it was often a welcome tenant of every garden. Although it inhabits the island of Krk, it is rarely encountered.

habitats, the island provides shelter to various plant, animal and fungi species.

Most of the island is in a deciduous sub-Mediterranean vegetation zone of downy oak (*Querecus pubescens*), and only small parts are in an evergreen eumediterranean vegetation zone of holm oak (*Quercus ilex*). Due to the altitudinal zonation here, there used to be another zone: a high-altitude, Mediterranean-montane vegetation zone of European hop-hornbeam (*Ostrya carpinifolia*). This was found in the highest plateaus and hills in the south of the island. However, livestock grazing has changed most of this zone into open rocky pasture.



Istrian bellflower

The Istrian bellflower (*Campanula fenestrellata* ssp. *istriaca*) is an endemic Kvarner-Liburnian species, and it is not unusual to see it on the walls of historic town centres and settlements. It most often grows in a community of Istrian bellflower and Dalmatian knapweed – the most significant community of plants, chasmophytes, that grow in the crevices of carbonate rocks. Carbonate rocks with chasmophyte vegetation are one of the targeted Natura 2000 habitats that are located on Krk and the other Kvarner islands.



White wagtail

Although a strictly protected species in Croatia, the white wagtail (*Motacilla alba*) is relatively common, particularly on the island of Krk. The existence of karst ponds, where it finds food and water, certainly contributes to this significantly because near these ponds there are quite often flocks of sheep, around which the wagtails are found. Wagtails feed on insect larvae and flies, and often on ticks, which is why this little bird is a more than welcome 'shepherd'. While on the ground, it is easily recognisable and visible by the specific up and down movement of its tail.

The distinctiveness of the island of Krk is further emphasised by its relict habitats: refuges of "continental" flora and vegetation. These can be found in the damp ravines of the area around Dobrinj, as well as in certain sinkholes and deeper dales. Such habitats retain cold moist air and have the flora of frost areas. The sides of the higher hills and habitats exposed to the *bura* wind are another type of relict habitat. The former European hop-hornbeam forests have today mostly been replaced by certain rare Mediterranean-mountain species.

An interesting fact is that there are 23 amphibian and reptile species on the island of Krk, which make up almost 40 percent of all such species in Croatia. In addition, there are 14 species of bat and numerous bird species.

The importance of nature protection was recognised early on. As a result, a special ornithological reserve was proclaimed in 1969 at Kuntrep (Glavine-Mala Luka) on the island of Krk. This was the first one in the world designed to protect griffon vultures. Apart from this reserve, the island also has the protected and special forest vegetation reserves of Glavok and the islet of Košljun in Puntarska Draga Cove.

The whole island of Krk is part of the Natura 2000 ecological network as an area important for the conservation of other species, such as the Hermann's tortoise (*Testudo hermani*) and European rat snake (*Zamenis situla*), and also for the preservation of habitats, including Mediterranean intermittent ponds and calcareous rocky slopes with chasmophytic vegetation. There are also several individual Natura 2000 sites important for the conservation of species and habitats, which will be covered later on in this chapter.



Pond on the island of Krk

One of the priority habitat types of the ecological network are Mediterranean temporary ponds. The island abounds with natural, semi-natural and artificial ponds; there is an estimated several hundred of them. Their significance comes primarily to the forefront in the areas under the influence of the Mediterranean climate, where dry habitats mainly predominate. The ponds are home to many marshland and aquatic plant species and animals as well as a source of food and water for numerous other species, whereby they significantly contribute to the biodiversity of the island.

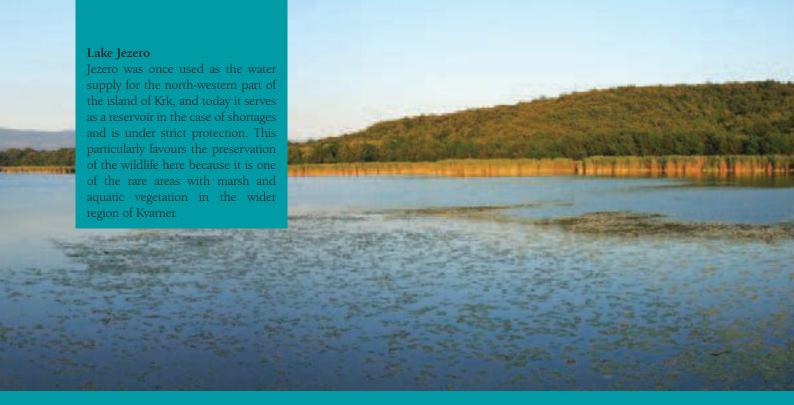


Near the village of Njivice, there is a lake called Jezero. It is special because it is a crypto-depression, which means that its bottom lies below sea level and its surface above. It is also only one kilometre away from the sea. The lake base is salty but freshwater hydrostatic pressure prevents salt water from entering from under the ground. It is primarily fed by the surface inflow from the flysch area of Veli Lug and Mali Lug, and is replenished by springs on its southern edge, the most important being the Vrutak spring. During the largest inflows of water, the lake becomes a flow lake, as the water runs off through a channel to the sea.

Lake Jezero is inhabited by very rich bird fauna. It is a nesting area for several marsh species rarely found on islands, such as the purple heron (*Ardea purpurea*), little bittern (*Ixobrychus minutus*), great crested grebe (*Podiceps cristatus*), common moorhen (*Gallinula chloropus*), and Cetti's warbler (*Cettia cetti*). The western marsh harrier (*Circus aeruginosus*) can also be seen flying over the area. There are also several endangered reptile and amphibian species, such as the European pond turtle (*Emys orbicularis*), dice snake (*Natrix tessellata*), and European tree frog (*Hyla arborea*).

Natura 2000 site		
Site code	Site name	
HR2000891	Lake Jezero near Njivice on the island of Krk	
Target species		
Bladetail (Lindenia tetraphylla)		
Ornate bluet (Coenagrion ornatum)		
European pond turtle (Emys orbicularis)		
Lesser horseshoe bat (Rhinolophus hipposideros)		
Target habitats		
Sub-Mediterranean Molinio-Horedion secalini damp grassland		

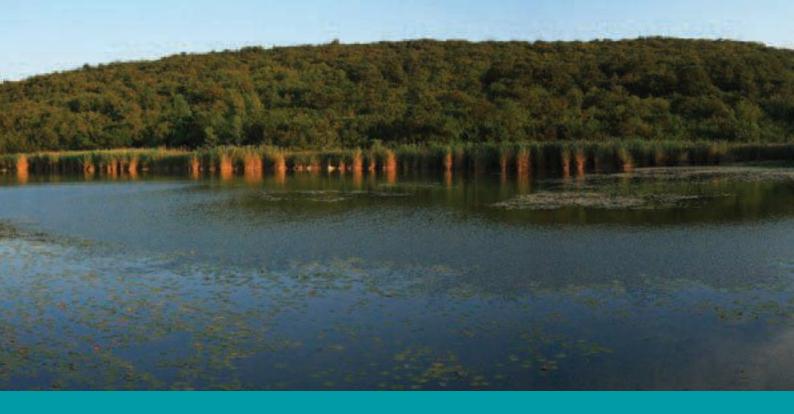
LAKE JEZERO NEAR NJIVICE





European pond turtle

The European pond turtle (*Emys orbicularis*) is one of three species of freshwater turtle in Europe. Today, due to the fragmentation of its habitats and death on the roads, it is considered an endangered species. Besides this, it is also endangered by the both invasive and aggressive red-eared slider terrapin (*Trachemys scripta elegans*), a common pet which is often found in nature and by its way of life pushes out the European pond turtle and so disturbs the biological diversity of the area.









The area of Lake Jezero is also an important resting area for migrating birds, a place where birds rest during bad and windy weather to build up strength to fly over the peaks of Gorski Kotar. More than 40 different bird species can be seen during the summer months at Lake Jezero. This was the reason for the establishment of a bird ringing station on the lake. Ringing was launched in 2008 by the Jezero Association, and has been carried out since then every summer. Since 2009, ringing has been carried out in conjunction with the Priroda Public Institution.

There is a belt of reed and peat along the shore of Lake Jezero. Apart from marsh plants and white willow (*Salix alba*), there are also sub-Mediterranean forests that are important habitats for numerous birds and other animals, such as amphibians, reptiles and insects. Botanically speaking, the surrounding forests are distinctive for the presence of pedunculate oak trees (*Quercus robur*), which are the last relics of flooded Mediterranean forests.



Eurasian scops owl

The Eurasian scops owl (*Otus scops*) is the smallest member of the owl family. This nocturnal bird of prey is characterised by its silent flight and superb sight, capabilities which very few prey can escape. It can often be seen and heard on the island as it 'watches and stands guard', which is why its image can be found on the official coat of arms of the Town of Krk. One of the historical names of the town of Krk was Veglia, which comes from the Latin word 'viglia' meaning *vigil* or *vigilance*.



In the central part of the island of Krk, there is a deep karst dale called Ponikve which in its narrowest part contains an artificial lake of the same name. Before the construction of the dam, this area was periodically flooded during the rainy season, which resulted in the creation of a natural intermittent lake. It was dry in periods without rain, but the soil remained damp due to the high groundwater level. This distinguishes Ponikve from the surrounding area, as it is a rare wetland oasis in the karst of the island of Krk. This has enabled the development of wetland communities and species. In 1986, a dam was constructed which prevented the draining of water from the karst lake. This reservoir is used today as a water supply for part of the island.

Even before the construction of the dam, the area of Ponikve was recognised as an area of great biological importance, and has remained so up to the present. The existence of a permanent lake is particularly convenient for the large numbers of birds, particularly during the spring and autumn migrations. The bird fauna here is thus numerous and very interesting. During their migration, several species of heron can be found here: the grey heron (*Ardea cinerea*), great egret (*Egretta alba*), and little egret (*Egretta garzetta*). The following are also frequent visitors: the northern lapwing (*Vanellus vanellus*), waders (*Tringa totanus* and *Tringa glareola*), and various species of calidris (*Calidris minuta* and *Calidris alpina*). There are also several species of duck: the wild duck (*Anas pla-*

Natura 2000 site		
Site code	Site name	
HR2000893	Lake Ponikve on the island of Krk	
Target species		
Bladetail (Lindenia tetraphylla)		
Target habitats		
Natural eutrophic lakes with Magnopotamion or Hydrocharition-type vegetation		
Caves not open to the public		

LAKE PONIKVE



Eye to eye with a dragonfly

Dragonflies are extraordinary hunters. Their large compound eyes cover much of their head which allow them an almost 360 degree field of vision. They also have two pairs of wings which they can move independently, and this gives them remarkable flying abilities. They can manoeuvre rapidly in all directions or even just hover. Their excellent vision and agile and fast flight are abilities which make them one of the best insect hunters-predators.



tyrhynchos), Eurasian teal (Anas crecca), Eurasian wigeon (Anas penelope), and common pochard (Aythya ferina), as well as many other species.

Lake Ponikve is surrounded by damp meadows and forest. The forest surrounding the lake is an important nesting site for songbirds. The frequent inhabitants here are the Eurasian blackcap (*Sylvia atricapilla*), common nightingale (*Luscinia megarhynchos*), spotted flycatcher (*Muscicarpa striata*), and numerous other species. The colonies of bee-eaters (*Merops apiaster*) and cranes (*Grus grus*) flying over the area are particularly impressive, as are the birds of prey like the golden eagle (*Aquila chrysaetos*) and short-toed snake eagle (*Circaetus gallicus*).

One of the interesting sites in this area is the Vela Fontana karst spring, which is close to the lake. The spring is part of the ecological network because of its interesting subterranean fauna. Biospeleological research here has found endemic species of underground amphipod (Niphargus rejici jadranko and Niphargus steueri liburnicus). Niphargus rejici jadranko is considered a critically endangered amphipod species.



Empty dragonfly exoskeleton

Before a larva matures into an adult dragonfly, it passes through a process of growth and transformation. In this period it changes 9 to 16 times. Right before the final change it leaves the watery environment where it grew, leaving only the empty exoskeleton on a nearby plant behind to show the end of its life as a larva.



Bladetail

The bladetail dragonfly (*Lindenia tetraphylla*) is linked to lakes by its lifecycle and due to the change of the water regime of habitats and pollution it has become endangered throughout Europe. It is the largest species of the dragonfly family (*Gomphidae*), recognisable by the distinctive widening of the end of the abdomen, which can also be seen in the photograph. As with all dragonflies it is an excellent predator in both larval and adult phases. It feeds on other species of insects and so it is a more than welcome ally when it comes to the control of populations of mosquitoes and flies.



Southern bladderwort

The ecological network at Lake Ponikve also protects a special habitat – a community of frogbit (*Hydrocharis morsus-ranae*). Besides this free-floating aquatic plant, numerous other interesting plants species can be found here. One of them (in the photograph) is the carnivorous southern bladderwort (*Utricularia australis*). It has no roots, as the bulk of the plant consists of a submerged stalk with leaves like branching filaments. Individual filaments turn into small bladder-like formations that help the plant to trap small aquatic insects and little crustaceans. The 'catch' lasts less than a millisecond, which places the bladderworts amongst some of the fastest predator plants.



Soline Bay

The area of the coastal salt marshes – Meline, located in the southwestern corner of the wide shallow cove of Soline on the island of Krk, has been recognised at the level of the Primorje-Gorski Kotar County, Croatia and European Union as an exceptionally valuable region of natural importance. The Meline marshland is the most important salt marsh on the island of Krk and one of the rare still remaining marshlands of similar characteristics of the whole Kvarner region. This very rare and well-preserved Natura 2000 habitat is home to Mediterranean and thermo-Atlantic vegetation of halophilous scrubs (*Sarcocornetea fruticosi*) and is one of the reasons why Soline Bay has been included in the Natura 2000 ecological network.

The low relief of the indented and spacious Soline Cove and the mudflat shores of Melin is completely different from the prevailing mountainous relief and reef coasts of the rest of the island of Krk. The shores of Melin are covered in halophilous plants which retain tiny particles of mud, thus contributing to the accumulation of peloid, which is mud used for therapeutic purposes.

The halophytic vegetation is exceptionally rich. On the flat muddy and sandy coast, terophytic (annual) vegetation thrives, the prevalent species being *Salicornia herbacea*. Besides the annual *Salicornia* community, there is the *Puccinellio festucaeformis — Sarcocornietum fruticosae* community, and then the sea-lavender and *Artemisia* (*Limonio-Artemisietum coerulescentis*) community. Further towards the land, the last of the halophilous communities is the rush community (*Juncetum maritimo-acuti*).

In the mud of Soline Cove, there are numerous holes and tunnels used by worms, molluscs and crustaceans that attract different types of marsh bird. Hence, during the spring and autumn migration, mixed flocks of different species of heron (*Ardeidae*) can be seen in Soline Cove. It is not uncommon to see the great egret (*Casmerodius albus*), which is a very endangered species and is becoming increasingly rare everywhere. There are also different species of sandpiper (*Scolopacidae*), such as the calidris (*Calidris* sp. div.), curlew (*Numenius* sp.), godwit (*Limosa* sp. div.), and wader (*Tringa* sp. div.).

Natura 2000 site		
Site code	Site name	
HR4000029	Soline Cove – island of Krk	
Target habitats		
Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi)		

SOLINE COVE



'Wall carpet' of common bent-wing bats

It is typical for a colony of common bent-wing bats (*Miniopterus schreibersii*) to form a 'wall carpet', when individuals press themselves together. Sometimes they arrange themselves in layers and so there could be several thousand individuals hiding in a seemingly small colony.

The plain of Vrbničko Polje in the hinterland of the town of Vrbnik, together with the Bašćanska Valley, is the most fertile area of the island of Krk. The intermittent Vretenica stream (also called Potok) flows through the field and is used for irrigation. In order to regulate the flooding of the field, the Vrbnik irrigation tunnel was built in the mid-20th century.

This long tunnel, which rarely sees water today, has become an important shelter for bats, which have inhabited it for years. The Vrbnik tunnel has therefore been listed as an internationally important underground shelter for bats. So far, six species of bat, five of which are Natura 2000 species, have been found to inhabit the tunnel. The area between the town of Vrbnik and the villages of Risika and Garica has therefore been included in the Natura 2000 ecological network. This area includes the plain of Vrbničko Polje, the surrounding smaller cultivated areas, and also the forest vegetation. Along with the adjacent karst ponds, these are the sources of different species of insect on which the bats feed.

The area around Vrbnik is widely known for its fields, vineyards and, of course, *žlahtina* wine. A single bat in just one hour at night can eat 500 to 1,000 insects. If their numbers were left unchecked, these insects could cause significant damage to the vineyards. It can therefore be said that the bats are actually good friends of the farmers in Vrbnik.

Natura 2000 site	
Site code	Site name
HR2001275	Vrbnik
Target species	
Greater horseshoe bat (Rhinolophus ferrumequinum)	
Mediterranean horseshoe bat (Rhinolophus euryale)	
Common bent-wing bat (Miniopterus schreibersii)	
Long-fingered bat (Myotis capaccinii)	
Geoffroy's bat (Myotis emarginatus)	

VRBNIK



Kuntrep Ornithological Reserve, which was proclaimed in 1969, is located on the northwest coast of the island of Krk, in the area of the Municipality of Baška. It stretches along the coast from Cape Glavine to Mala Luka Cove, and comprises a coastal belt which is one kilometre wide and ten kilometres long.

When the reserve was proclaimed, there were as many as 50 griffon vulture (*Gyps fulvus*) nests. Unfortunately, in the 1990s there was a sudden decrease in the number of griffon vultures due to poisoning. This was because people tried to poison the bears and wild dogs which attacked their sheep. Following an educational campaign and the cessation of poisoning, the population of griffon vultures started recovering slowly, and in 2013 there were 35 nesting pairs in the reserve.

However, griffon vultures are not the only ornithologically important species in this reserve. It is also the nesting area of other species of bird endangered in Europe, such as the short-toed snake eagle (*Circaetus gallicus*), peregrine falcon (*Falco peregrinus*), common kestrel (*Falco tinnunculus*), European shag (*Phalacrocorax aristotelis desmarestii*), Eurasian eagle owl (*Bubo bubo*), blue rock thrush (*Monticola solitarius*), common rock thrush (*Monticola saxatilis*), and other rare birds found on coastal cliffs.

Another ornithologically interesting and important aspect of this area is that the nesting area of the endangered Eurasian stone-curlew (*Burhinus oedicnemus*) is located on the plateau that stretches from the edge of the cliffs towards the Bašćanska Valley, and which also includes the peak of

Category of protection: Special ornithological reserve	
Year proclaimed	1969
Area	1,000 ha
Location	Municipality of Baška
Altitude	0-475 m

KUNTREP (GLAVINE-MALA LUKA)



Red-backed shrike

The best known feature of the red-backed shrike (*Lanius collurio*) is its black-eye 'mask', which makes it resemble a burglar. It is most commonly seen on prominent positions such as the tops of bushes from where it watches for prey. The name of the genus *Lanius* comes from the Latin word for 'butcher', because of these little predators' habit of impaling their prey on thorns or barbed wire. They do this because their talons are too small for them to hold their prey the way that other birds of prey generally do.

Diviška. The reserve is also used as a hunting area by the golden eagle (*Aquila chrysaetos*), which nests in close proximity to the reserve.

The reserve is only accessible on foot or by boat. The steep cliffs fall sharply down to the sea and continue deep underwater. When visiting the area, it is very important to maintain a suitable distance from the cliffs where the vultures nest in order not to disturb them. Making loud noises during the nesting season or climbing the cliffs can result in young birds being drowned. It is therefore important to note that it is prohibited to sail and anchor all types of vessels within a distance of 200 metres of the vultures' coastal nesting sites, and feeding and resting areas.

The landscape of the reserve is very impressive. A chain of picturesque cliffs and rocky canyons stretches along the northwest side of the island of Krk, from Cape Glavina to Mala Luka Cove. The largest rocks can be found in the area of Butinj and Kuntrep, between which there lies the magnificent Jasenova canyon, which is about one kilometre long and only about twenty metres wide. There are grand cliffs all around, reaching 300 or even 400 metres in height, with scree underneath. However bleak and barren they may seem, the cliffs and scree are full of endemic rock and scree flora and vegetation. A particularly beautiful sight is provided by certain endemic plant species in their habitat in full bloom, for example the blue flower of the Istrian bellflower (Campanula fenestrellata ssp. istriaca), the purple flower heads of the Dalmatian knapweed (Centaurea dalmatica) on the rocks, the prickly and bristly Jacquin's drypis (Drypis spinosa ssp. jacquiniana), the thorny flower heads of the Rijeka carline (Carlina fiumensis), and other species inaccessible even to sheep.

In contrast to the wild and steep terrain of the cliffs, the landscape of the area's upper border consists of more sedate and flat, but also bare, pasture. This is important for the whole mountainous plateau of the southern part of the island of Krk. People have even named some parts of the plateau "the Moon's surface" because of the bare terrain.



Diviška pond

The landscape is criss-crossed with long dry stone walls, shepherd boundaries that seem to stretch on endlessly. The unusually picturesque pond of Diviška is located at one of these wall intersections. It is significant for the local wildlife because of its rare fauna, and it also plays an important role in the preservation of life and biodiversity in this arid karst region.



Blue rock thrush

The blue rock thrush (*Monticola solitarius*) is linked to the habitats of cliffs and rocks. Females are of a speckled brownish colour, whilst the males are adorned with a recognisable blue plumage. In the bird world it is the males who most frequently have a splendid appearance and attract the attention and looks of the females. The plain appearance of the females merges well with the environment and enables them to hide from predators.





The islet of Košljun with sunken stone wall

Legend says that the sunken stone wall, clearly visible in aerial photographs, once connected Košljun to the island of Krk. Due to the slow rise of the sea level, the coast in ancient times was about two metres lower than it is today. Further investigation is required in order to find out whether this wall, now located underwater, in the past really served as a bridge, or if it was only used for fishing, which was also one of the purposes of sunken underwater structures along the coast of the islet.

The islet of Košljun is situated in Puntarska Draga Cove. It is the result of the sinking of the Adriatic coast after the ice ages, and is the unsubmerged peak of a former elevation. This configuration of the coast and sea bottom was the inspiration for an interesting legend. The legend says that there was a valley, today's Puntarska Draga Cove, which used to be the property of two brothers, one of whom was blind. The brothers were farmers, but the one who was able to see deceived his brother when dividing the wheat harvest. The blind brother found out about the deception and called upon God for help. God answered his call and created the Buka Strait. The sea entered the strait and submerged the property of the dishonest brother, while the house and the property of the blind brother remained on dry land. This is how the islet of Košljun was created.

The islet of Košljun has been inhabited since antique times, when a fortified villa was built after which the islet was named: *castellum* – Košljun. In the 9th century, the Benedictine abbey of St. Mary was to be found on the islet, the foundations of which were found underneath the present-day church. In the 15th century, after the death of the last Benedictine abbot, the abandoned monastery became home to the Franciscans. This Franciscan monastery is still on the islet of Košljun.

Košljun is covered in a rich mixed forest of holm oak and manna ash (Orno-Quercetum ilicis), which is otherwise found only sporadi-

Category of protection: Special forest vegetation reserve	
Year proclaimed	1969
Area	6 ha
Location	Town of Krk
Altitude	0-6 m

KOŠLJUN



Statue of Saint Francis on Košljun

People come to the islet of Košljun primarily because of the special atmosphere which the Franciscan monks breathe into it, as well as its cultural heritage. The Košljun monastery is a famous sanctuary and a rich cultural treasure chest of this part of the island of Krk. In the little harbour there is a statue of Saint Francis of Assisi with a tamed wolf. The statue symbolically shows that wild nature can become man's friend, and that is how it is here with nature on Košljun. A centuries-old holm oak forest shelters and protects the monastery and safeguards the fertile soil which would otherwise be blown away by the wind or washed away by the rain, leaving Košljun bleak, bare and uninhabitable, like many of the desolate little rocky islands in the Adriatic.



Trooping funnel mushroom

The wooded habitats of the islet are rich with fungi, which like the other flora and vegetation were painstakingly researched by the Franciscan Berard Barčić. On the basis of his research Brother Berard named Košljun the island of fungi. Some of the interesting amongst the many species are the trooping funnel (*Clitocybe geotropa*), cauliflower fungus (*Sparassis laminosa*), chestnut bolete (*Gyroporus castaneus*), latticed stinkhorn (*Clathrus ruber*) and the poisonous species – Satan's bolete (*Boletus satanas*), Jack o'lantern (*Omphalotus olearius*), livid entoloma (*Entoloma sinuatum*), plus the Panther Cap (*Amanita pantherina*).

cally on the island of Krk. The centuries-old holm oak trees are one of the reasons this islet is protected as a special forest vegetation reserve. An interesting fact about the forest on the islet is the frequent presence of bay laurel (*Laurus nobilis*), which can sometimes have the shape of a real tree. Apart from evergreen holm oak, there is also deciduous downy oak (*Quercus pubescens*), field maple (*Acer campestre*), and Montpelier maple (*Acer monspessulanum*). These deciduous trees suggest that the forest on the islet of Košljun may have looked rather different in the past. It is interesting to note that in the northeast of the islet the vegetation is significantly less developed compared to the rest of the islet because of the strong gusts of the *bura* wind.



Salt pan at Peškera

The area of Peškera, enclosed by a circular dry stone wall, once served as a place for the catching and holding of live fish. Today, on the low muddy shore, there is a tiny specific habitat overgrown with plants that can live in an environment with the large amount of sea salt in the soil. The plants that manage to thrive in these difficult conditions are called halophytes. The species of halophytes that can be found on Košljun are glasswort (*Salicornia* sp.), sea lavender (*Limonium narbonense*), golden samphire (*Inula crithmoides*) plus several others.



Different vegetation types can be found in a small area in Glavotok, the western part of the island of Krk. Between the campsite and well-known Franciscan monastery of St. Mary, there is an evergreen holm oak forest (*Quercus ilex*), which is closely connected to a deciduous forest of ancient downy oak (*Quercus pubescens*). The protected holm oak forest occupies an area of 1.5 hectares, and is separated from the surrounding area by a dry stone wall. It looks like a small isolated island of evergreen vegetation. The monks have contributed to the preservation and beauty of this evergreen forest, and it can be considered a kind of a "holy grove" of the kind found frequently near monasteries.

The explanation for the presence of both evergreen and deciduous vegetation in such a small area is rather simple. The holm oak forest was planted, and so is not wild-growing, as uninformed visitors might think. The average age of the forest is today about 130 years and the average height of the holm oak trees is about 12 metres. It has been confirmed that the forest belongs to the northernmost areal variant of the community of holm oak and manna ash (*Orno-Quercetum ilicis*), which lacks numerous elements of the typical community. The layer of trees in the forest in Glavotok also contains, apart from holm oak trees, a few manna ash trees (*Fraxinus ornus*), which are more frequently found in the shrub layer. This layer also contains laurel shrubs (*Laurus nobilis*), while the undergrowth is especially rich in butcher's broom (*Ruscus aculeatus*), which grows abundantly beneath the trees in the forest.

Category of protection: Special forest vegetation reserve	
Year proclaimed	1969
Area	1.5 ha
Location	Town of Krk
Altitude	0-18 m

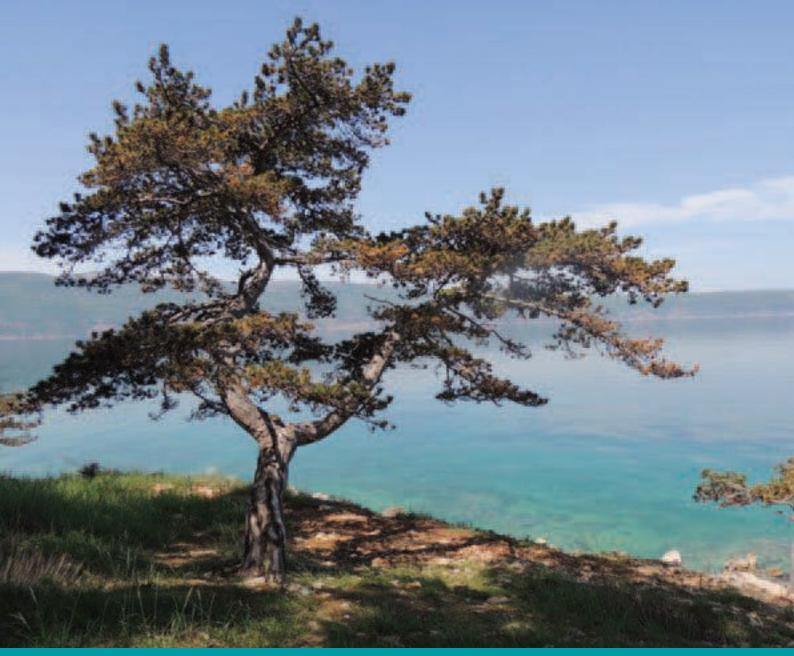
HOLM OAK FOREST IN GLAVOTOK





There are also several groups of common smilax (*Smilax aspera*). The wild madder (*Rubia peregrina*), Italian arum (*Arum italicum*), spring sowbread (*Cyclamen repandum*), and other plants are also frequently found in the ground layer.

Towards the coast, a few black pine trees (*Pinus nigra*) have been planted, which contribute to the diversity of the forest vegetation. In the southern and southeastern parts of this stand, there are picturesque gardens and olive groves belonging to the Franciscan monastery, while on the eastern side the terrain is covered in deciduous forest of oriental hornbeam and downy oak (*Querco-Carpinetum orientalis*). Oriental hornbeam and downy oak communities are common in this part of the island of Krk. The deciduous forest on the opposite side of the protected reserve is also very attractive because of its very old downy oak trees (*Quercus pubescens*) with unusually shaped treetops. The treetops trimmed by man are the result of a special management regime.



Black pine

The picturesque black pine canopy in the shape of a lyre, is an impressive motif of the coastal region of the forest reserve. The black pine species in this part of the island was planted by man and there are only a few specimens that were brought here naturally by the wind – mostly from nearby cultivated groves.



Milkvetch

It is believed that in the not too distant past the island of Prvić was largely covered with forest, which now can only be seen by the scant remnants of holm oak, black pine, wild fig and low-lying scrub. On Prvić, due to the frequent and persistent storm force winds, at the lowest altitude, in comparison with other Adriatic islands, there also grow some mountain and sub-Alpine species, which are otherwise found on the high ridges of the Dinaric Alps, such as the narrow-leaved moor grass (Sesleria juncifolia), Alpine daphne (Daphne alpina) and hawksbeard (Crepis chondriloides). The island is home to 351 species of flowers and ferns, and particularly abundant and often dominant are some Kvarner endemic species such as the milkvetch (Astragalus sp.) which is shown in the photograph.

After the small island of Jabuka in the southern Adriatic, the island of Prvić is the rockiest and most inaccessible island in the Adriatic. Its very steep coastline and vertical rocks rising up to 300 metres high make this island very inaccessible. Access is, however, possible by means of the western, milder slopes of the island, where shepherds' paths located in gullies lead to the plateau.

Because of the island of Prvić's rare flora and fauna, unusual barren appearance, ornithological importance, and interesting underwater world, in 1972 the island, together with its surrounding waters and the cliffs of the islands of Goli Otok and Sveti Grgur, was proclaimed a special botanical and zoological reserve. Due to its difficult accessibility, unfavourable maritime conditions (the Senj *bura*), steep coast and difficult anchoring, it has managed to preserve up to the present day a specific and rare flora and fauna, as well as the primordial appearance of its landscape.

The mammals present include the European rabbit (*Oryctolagus cuniculus*) and a large number of sheep kept by the people of Baška. The important amphibians and reptiles include the European green toad (*Pseudoepidalea viridis*), blue-throated keeled lizard (*Algyroides nigropunctatus*), Dalmatian wall lizard (*Podarcis melisellensis fiumana*), European cat snake (*Telescopus fallax*), and other species.

Common sage (Salvia officinalis) provides valuable forage for the bees, while during the warm part of the year grasshoppers jump among the

Category of protection: Special botanical-zoological reserve		
Year proclaimed	1972	
Area	7,000 ha (part of the area includes the surrounding waters)	
Location	Municipality of Baška	
Altitude	0-357 m	

ISLAND OF PRVIĆ AND GRGUR CHANNEL





Eurasian eagle-owl

One of the special values of the island is the fact that some rare species of birds nest here, such as the Eurasian eagle-owl (Bubo bubo), golden eagle (Aquila chrysaetos), peregrine falcon (Falco peregrinus), short-toed snake eagle (Circaetus gallicus) and the griffon vulture (Gyps fulvus). The Eurasian eagle-owl is one of the largest owls in this area and amongst the largest in the world, with a wingspan of up to 180 centimetres. This skilled nocturnal hunter, famous for the tufts on its head that look like ears, mals, although sometimes it can even surprise a larger animal such as a young deer. It nests on cliffs and rocks and so it is well adapted to life on the Kvarner islands.



sparse grass. The invertebrate fauna on the islands of Prvić, Goli Otok and Sveti Grgur is at present somewhat unresearched.

The waters off the islands of Prvić, Sveti Grgur and Goli Otok abound in submerged or partly submerged sea caves, semi-caves, indents, passages and tunnels. The shadowy ceilings and walls of the speleological features and formations abound in rich colours, with sponges leading the way in terms of diversity. The steep, impressive cliffs of the island of Prvić continue deep under the sea, frequently reaching depths of 90 metres, while those on the southeast headland of Cape Šilo descend more than 100 metres. The northern parts of the islands of Sveti Grgur and Goli Otok share similar features. The sea currents are very strong here, which has resulted in the development of a rich coralligenous community.

Unlike the major part of the coastal reserve, where underwater cliffs with depths of more than 50 metres are frequent, the west and southwest coasts of the island of Prvić, from Cape Stražica to Cape Zvonik, are the only parts of the reserve with a more gently inclined coast and sporadic pebbly and sandy shores. Such a seabed has favoured the development of a community of organisms different from those that have developed on the steep rocky bottoms of the rest of the island's coast. Here, there is a mosaic of sandy seabeds, rocky bottoms with infralittoral algae, and small meadows of Neptune grass (*Posidonia oceanica*).

There is also an interesting and rare geological phenomenon in the underwater world off the island of Prvić. This is a tombolo: a triangular piece of land forming a barrier that connects the island to Njivice Rock near Prvić's southwest coast. This phenomenon is even more interesting under the sea. The erosion caused by the waves has created sandstone outcrops, the vertical position and almost linear direction of which resemble man-made walls.



Coralligen

Calcareous algae form the base of a coralligenous community. In their cells they accumulate limestone forming large or small clusters with shady cavities which become the habitats of numerous invertebrates. Due to their great biodiversity and colourfulness, coralligenous communities are amongst the most attractive sites for diving.



The island of Sveti Grgur is located north of the island of Rab and northwest of the much more famous island of Goli Otok. It has a relatively milder climate than the neighbouring islands of Prvić and Goli Otok, because the higher and longer reef of Prvić protects it from the strongest gusts of the *bura* wind blowing from Mount Velebit.

It is uninhabited today, but was periodically inhabited throughout history, mostly because of bauxite excavation. In recent history, it was the location of a women's camp, i.e. a detention and rehabilitation centre.

Until the 17th century, the island was called Drivenik because of the abundant forest growing on it (*drvo* is the Croatian word for 'wood'). After that, it became known as Šagargur, as it is sometimes still called today by the local population of nearby Lopar and Baška.

The northeast coast of Sveti Grgur, exposed to the strong gusts of the *bura* wind, is characterised by a steep karst relief with rugged cliffs, indents and semi-caves. The vegetation on the calcareous rocks is scarce, though there are some mountainous and sub-alpine species which tolerate the harsh climate.

The endemic flora and vegetation are most developed on the cliffs and rocky habitats of the northwest coast. The endemic and stenoendemic (having a restricted distribution) Kvarner species are especially interesting, such as Horvat's onion (*Allium horvatii*),

Natura 2000 site	
Site code	Site name
HR2000898	Holm oak forest on the island of Sveti Grgur
Target habitats	
Calcareous rocky slopes with chasmophytic vegetation	
Quercus ilex and Quercus rotundifolia forests	

ISLAND OF SVETI GRGUR



Jacquin's drypis (*Drypis spinosa* ssp. *jacquiniana*), and Kvarner spleenwort (*Asplenium hybridum*).

Whereas Horvat's onion chooses the cliffs that are most exposed to the *bura* wind, Kvarner spleenwort grows in shaded semi-caves, while Jacquin's drypis inhabits rocky landslides or the scree beneath cliffs. Each of these three habitats has its own endemic community: the Istrian bellflower and Dalmatian knapweed community (*Campanulo-Centaureetum dalmaticae*) on the cliffs, the moss and Kvarner spleenwort (*Eucladio-Phyllitetum*) community in the semicaves, and the Jacquin's drypis (*Drypis spinosa* ssp. *jacquiniana*) community on the screes.

The south coast, which faces the Lopar peninsula, has a milder terrain. Its largest beach is located in the northwest part of the island. Here, there is a stand of evergreen holm oak (*Quercus ilex*), which is predominantly in the form of macchia. The most well-preserved forests are found in the Smokovo Valley.

A large part of the open pastures is covered by sage, immortelle and other aromatic flowering species, which means that the island is suitable for beekeeping and sheep farming. There is a small population of fallow deer on the island, a non-native game species which is so accustomed to people that it has become a tourist attraction.

The wealth of natural heritage on the island of Sveti Grgur has required several levels of protection. The northeast cliffs are a part of the special Prvić reserve, while the rest of the island is part of the Natura 2000 ecological network.





Salt deposit on the leaves of Mediterranean spurge ($Euphorbia\ characias$)

Unlike the 'jugo' wind which blows from the south-easterly direction along the Adriatic coast, and whose waves can reach up to several metres on the open sea, the 'bura' wind descends from the coastal mountains and, although it blows significantly faster than the 'jugo', it creates significantly smaller waves. However, the force of the 'bura' lifts up sea spray from the foaming waves which the wind then carries off to the islands depositing it on the vegetation, soil and buildings. In this way, a thin deposit layer of crystal sea salt is created. This salt deposit has a negative effect on the vegetation as it damages the leaves and flowers, and it impedes the plants water supply increasing the osmotic value of the soil.

Observing the island of Rab from an aircraft or the vantage point on Kamenjak Hill, it is noticeable that the island has two completely different landscapes. One is bare, bleached and washed out to its rocky base, while the other is pronouncedly green and covered in rich vegetation.

The island of Rab, as well as the whole Rab island group (consisting of rocks, islets, and small and large islands, such as Sveti Grgur, Goli Otok and Dolin), is under the strong influence of the *bura* wind. Combined with its unique geological structure, this has resulted in a tremendous landscape and biological diversity. This is why the whole island is part of the Natura 2000 ecological network, the aim of which is to preserve its valuable species and habitats.

The forests on Rab are particularity noteworthy. They cover one third of its surface, which means that, in comparison with other Adriatic islands, only Mljet has more green areas. The major part of the forest vegetation belongs to the holm oak and manna ash community (*Fraxino orni — Quercetum ilicis*), while the planted forests of Aleppo pine are usually found in the coastal areas and around settlements. The island also has a large number of rocky pastures which are still well preserved, thanks to the large number of sheep that graze there.

ISLAND OF RAB



Natura 2000 site	
Site code	Site name
HR2001359	Island of Rab

Target species

Great capricorn beetle (Cerambyx cerdo)

Mediterranean killifish (Aphanius fasciatus)

Four-lined snake (Elaphe quatuorlineata)

Blasius's horseshoe bat (Rhinolophus blasii)

Greater horseshoe bat (Rhinolophus ferrumequinum)

Mediterranean horseshoe bat (Rhinolophus euryale)

Lesser mouse-eared bat (Myotis blythii)

Common bentwing bat (Miniopterus schreibersii)

Geoffroy's bat (Myotis emarginatus)

Greater mouse-eared bat (Myotis myotis)

Target habitats

Vegetated sea cliffs of the Mediterranean coasts with endemic Limonium spp.

Mediterranean salt meadows (Juncetalia maritimi)

Mediterranean and thermo-Atlantic halophilous scrubs (Sarcocornetea fruticosi)

Eastern Mediterranean screes

Embryonic shifting dunes

Quercus ilex and Quercus rotundifolia forests

Calcareous rocky slopes with chasmophytic vegetation

Caves not open to the public

Submerged or partly submerged sea caves

Annual vegetation of drift lines

Mediterranean temporary ponds

Eastern sub-Mediterranean dry grasslands (Scorzoneretalia villosae)

Mediterranean tall humid grasslands of Molinio-Holoschoenion



Sea holly

One of the rarest habitats, which on the island of Rab is included in the Natura 2000 ecological network, are the embryonic coastal dunes, sandy habitats which today mainly due to the landscaping of natural sandy beaches, are slowly disappearing. This type of habitat is home to many almost entirely extinct species. A rare plant that inhabits only sandy beaches is the sea holly (*Eryngium maritimum*).

Four-lined snake

The four-lined snake (*Elaphe quatuorlineata*) is considered the longest European species of snake. It is nonvenomous, slow-moving and doesn't like to attack. The adult snake has four distinctive stripes down its body from which this species gets its name. However, when they are young they have a similar appearance to the European cat snake (with black patches on a light background) and so they are often mistaken for one another. The largest and most beautiful specimens of this species are often seen in the forest firebreaks of the Kalifront area on Rab.



Latticed stinkhorn

The Latticed stinkhom (*Clathrus ruber*) is a fungus of a distinctive unsightly appearance (because of which it is also called the red cage), which likes the warm regions of the Mediterranean, including the island of Rab. It grows in anthropogenic habitats, such as gardens and olive groves, the edges of roads, as well as holm oak forests. It isn't edible and it is distinguished by the unpleasant smell of rotten meat that attracts flies and other insects that help it spread its spores.





Water lilies on Fruga plateau

The Fruga plateau is an exceptionally valuable area of the island of Rab, primarily due to its landscape diversity. The whole area is a mosaic of old holm oak forests, pastures and ravines plus pyramidal forms which have been created by the erosion of the several metre deep clay soil. The area is rich in ponds: the largest among them, the eponymous Fruga pond, doesn't dry out even during the longest of summer droughts. The pond is teeming with life, particularly various species of invertebrates, the most interesting among them being the crabs of the *Triops* genus. Dragonfly larvae, leeches, shellfish and snails also live in the pond.



The forested Kalifront peninsula in the southwestern part of the island of Rab is the location of Dundo Forest, sometimes called Dundovo Forest by the local population. This forest reserve is often mentioned as one of the most beautiful and best-preserved holm oak forests in the Mediterranean. It stretches from the coast at Kristofor Cove up to 80 metres above sea level.

Dundo Forest has an interesting and rich history in terms of forestry and protection. According to historical records, the forest was first under church ownership and then came under state control. Its importance to the development of tourism was recognised at an early stage. After World War I, Dundo Forest was considered a nature park and was protected in 1949 as a natural rarity. It was also the first natural area to be given protected status in the territory of what is today Primorje-Gorski Kotar County.

Until World War II, the impressive holm oak trees (*Quercus ilex*) formed thick canopies in this forest. Sadly, the most beautiful trees, some of which were 200 years old, were cut down. Today, only the occasional old tree that still grows near the forester's house shows how this forest used to look. The forest nevertheless remains distinctive and beautiful.

The forest consists of a holm oak and manna ash (*Fraxinus ornus*) community. The following can also be found here: the green olive tree (*Phillyrea latifolia*), tree heath (*Erica arborea*), lentisk (*Pistacia lentiscus*), strawberry tree (*Arbutus unedo*), common myrtle (*Myrtus*)

Category of protection: Special forest vegetation reserve		
Year proclaimed	1949	
Area	106 ha	
Location	Town of Rab	
Altitude	0-80 m	

DUNDO FOREST



Italian wall lizard

The Italian wall lizard (*Podarcis sicula*) is endemic to the Mediterranean. Of all the species of little lizards that live on the Adriatic coast, this one is best adapted to cohabiting with humans. The gardens and walls of the littoral villages sometimes literally swarm with these attractive reptiles of which there could be as many as 16,000 in a single hectare. Their appearance is very similar to that of the Dalmatian wall lizard (*Podarcis melisellensis*). Considering that they live in similar habitats, it often happens that the Italian species completely ousts the Dalmatian species. Such cases are frequent, particularly on the islands, so for example the Dalmatian wall lizard no longer lives on Rab today.



communis), laurustinus (Viburnum tinus), and many climbing plants such as the Mediterranean smilax (Smilax aspera), evergreen rose (Rosa sempervirens), wild asparagus (Asparagus acutifolius), and black bryony (Tamus communis).

The soil in Dundovo Forest is deeper in certain parts, consisting of red and, to a lesser extent, eutric brown soil. In other parts, it is rather shallow, and calcareous rocks emerge on the surface, which is one of the reasons for the small variations in the composition and appearance of the forest. The eutric brown soil is especially good for tree heath (*Erica arborea*), and there are also some downy oak trees (*Quercus pubescens*) which, according to certain sources, were planted here.

One of the branches of the Premužić Trail leads through Dundo Forest. It was based on the model of the trail on Mount Velebit designed by the engineer Ante Premužić, who encouraged the construction of several such trails on the island of Rab. The trail was built using the dry stone wall technique, and is a valuable piece of cultural and historical heritage.







Strawberry tree

The strawberry tree (*Arbutus unedo*) is an evergreen bush that grows in the sunny spots of the Dundo forest. The tasty red fruit ripens a year after flowering from October to December so both the fruit and the blossoms can be seen on the plant at the same time. They are rich in vitamin C and sugar, however it has been known since ancient times that it is not advisable to eat too many of them (the Latin name of the species *unedo* means 'only eat one') because with the ripening of the fruit the harmful alcohol mannitol is released.



The Lopar peninsula in the northeastern part of the island of Rab is one of a few examples of the protected geological heritage in the county. It is built of Eocene marlstone and sandstone created in the estuary of an ancient river approximately 40-50 million years ago.

Throughout the millennia, the strong *bura* wind and waves of the sea have shaped the relief of the Lopar peninsula, which, with its numerous coves with sandy shores, resembles outstretched fingers. These shores are home to live stromatolites, very rare layered structures of cyanobacteria which have been developing on Earth for millions of years in shallow seas with muddy and sandy shores.

Along the coast and in the interior of the peninsula, the erosion has created interesting sandy pyramid forms, and the whole area abounds in the remains of shells of prehistoric organisms – foraminifera, gastropods and bivalves which lived in the Eocene, at the time the rocks of Lopar were created. Because of its numerous fossils and unusual geological formation, sites of interest on the Lopar peninsula have been included in the Rab Geo-Park project. The aim of the project is to protect, promote and utilise geological heritage in a sustainable manner.

The geological bedrock contributes to the weathering of rocks into sand, which then accumulates on the sea shores where small embryonic sand dunes are created. These are a Natura 2000 habitat – embryonic shifting dunes, which are very important for the conservation of rare life forms, mainly sand plants (psammophytes). The

Category of protection: Protected landscape		
Year proclaimed	1969	
Area	about 100 ha	
Location	Town of Rab	
Altitude	0-87 m	

LOPAR



Nummulites

Amongst the fossils in the rocks of Lopar particularly numerous are the nummulites. The name nummulites comes from the Latin word *nummulus* meaning 'little coin'. These are the fossil remains of protozoa forams (*foraminifera*), single-cell organisms that build a mineral skeleton – a shell, around themselves. Individual groups of forams still survive today.



establishment of the island of Rab ecological network site seeks to preserve this rare habitat.

The whole area of Lopar is characterised by evergreen sclerophyllous Mediterranean vegetation with an abundance of plant species, and there is a strong scent of fragrant essential oils. A special charm of this site is provided by the numerous flowering plant species which in different seasons colour the rather uniformly coloured landscape with completely new tones, such as pink rockrose plants (*Cistus* sp.) in late spring or the autumn crocus (*Colchicum* sp.) in autumn.

The fauna of the area consists mostly of different species of butterfly, hymenoptera, and other insects. The snouted grasshopper (*Acrida ungarica*) is especially interesting. Its appearance, shape and colour are specially adapted to hiding in grassland vegetation so that it is very difficult to spot. As far as sea invertebrates are concerned, there are several species of bivalve, arthropod and annelid specially adapted to living in shifting sands.





The sandy pyramids of Lopar

The pyramids of Lopar are still today subject to the processes of wind and sea erosion. If one looks at some of the archive photographs of this area, such as this one of Miroslav Maroević, from the private collection of Josip Andrić, taken in 1939, it becomes obvious that these sandy pyramids were once much larger.



Myrtle bushes on a sandy pyramid

Due to the geological structure and tough environmental conditions, the vegetation of Lopar is very interesting. Right along the shoreline bushes of common myrtle (*Myrtus communis*) lie flush with the soil. Their appearance is shaped by the strong 'bura' wind, which also brings salt deposits. It is because of this that halophyte vegetation has also developed on the cliffs and coast, whilst the sandy areas are also home to special sandy soil species of grass and other psammophytic (sandy soil) plants.



Reaching right up to the walls of the old town of Rab, and stretching towards the northwest, there is Komrčar Forest Park, the "green pearl of Rab". Its name may have originated from the Latin name *Comercarius* or *Campus Martius* (Field of Mars): the area of ancient Rome where soldiers used to exercise. Why Komrčar should be named after the Field of Mars remains unknown. The air in the forest park is filled with the pleasant scent of conifers and evergreen plants. This is even more intense in May when the Spanish broom (*Spartium junceum*) and Australian laurel (*Pittosporum tobira*) are in bloom. The floral abundance of Komrčar is more noticeable on its sunny slope, along the Fra Odorik Badurina Promenade, where the habitats are more diverse than in the forest. The century plant (*Agave americana*) also grows here, thus contributing to the exotic atmosphere of this part of the forest park.

The common wild madder (*Rubia peregrina*) is frequently found in the pine undergrowth. Its many tiny, plain, yellow-green flowers bloom in May. The highest parts of the ridge and the part of the forest park not facing the sun are in the shade because of the fully canopied holm oak forest (*Quercus ilex*). The sunny side is a resting place for the wall brown butterfly (*Lasiommata megera*), which flies off every now and then when it senses walkers on the path. The shady spots are also inhabited by the speckled wood butterfly (*Pararge aegeria*), which can be found resting in the shade or in a ray of sunshine on a leaf, or twirling in couples in the air. Another interesting butterfly is the Cleopatra butterfly (*Gonepteryx cleopatra*), a typical representative of Mediterranean fauna.

Category of protection: Forest park		
Year proclaimed	1965	
Area	10 ha	
Location	Town of Rab	
Altitude	0-40 m	

KOMRČAR



Bust of Pravdoje Belia

The most meritorious person for today's appearance of Komrčar is the head forester Pravdoje Belia, an enthusiast of Slovenian origin. He led the project of the afforestation of the barren Komrčar area from 1890 to 1905, which included the planting of Aleppo pine (Pinus halepensis) and maritime pine (Pinus pinaster). Later on, the afforestation project also included the planting of indigenous evergreen species. In the forest park there can still be found exceptional specimens of Aleppo pines with diameters of more than 90 centimetres and about 30 meareas and parks on the islands of Rab and Pag, of which Komrčar is without doubt the most impressive, as a sign of appreciation the people of Rab erected a bronze tre of the forest park in 1974.



Common toad

While walking through Komrčar one might come across the common toad (*Bufo bufo*). Contrary to many popular beliefs, the warts on the surface of its skin are not contagious. The two distinct glands, located of the back of its neck, serve as protection from predators. A bufotoxin substance is secreted from them which makes the frog unpalatable. Nevertheless, some animals, such as grass snakes and hedgehogs, have developed resistance to the bufotoxin and so the common toad is their frequent prey.

In the upper part of the forest park, spiders stretch their webs from one holm oak to another, while little reddish or greenish caterpillars descend periodically from the trees on their silk threads. They descend for cocooning, after having chewed on the young holm oak leaves, like live rain falling from the trees to the ground where they are met and pecked at by common blackbirds (*Turdus merula*).

The few grass clearings of Komrčar are adorned in May with the large, sulphur-yellow flower heads of the smooth golden fleece (*Urospermum dalechampii*), a species of the *Astraceae* family which makes a special impression on visitors not accustomed to eumediterranean flora.

Visitors to the island of Rab in May must not miss the sight offered by the blooming blue Istrian bellflowers (*Campanula fenestrellata* ssp. *istriaca*) which grow on the walls of the old parts of Rab. Lucky visitors might even spot a rare fern called the Kvarner spleenwort (*Asplenium hybridum*), which also has its habitat here.



Rest area in Komrčar

A stone-edged trail, 6.5 kilometre long, winds through Komrčar. The dark and damp northern part of the forest park is criss-crossed with a labyrinth of twisting trails which in several places link to the central transversal trail – a long tunnel-like path with a canopy of dense vegetation. From the southern longitudinal trail, views of the islands of Pag, Lošinj and Cres open up at individual spots.



The island of Dolin stretches along the southwest coast of the island of Rab, forming the Barbat Channel, the average width of which is about 500 metres. Dolin is a natural barrier protecting the island of Rab from the gusts of the *jugo* wind. Its northernmost point is called Dolnja Punta (the Lower Cape) by the local population, and its southernmost Gornja Punta (the Upper Cape). Today, these toponyms may seem somewhat illogical, since the south is always lower on geographical maps. However, they probably originate from old seafarers who named places in relation to the Equator and North Pole, with places closer to the Equator being given the name "upper".

The coast of the island of Dolin is mostly low and rocky, and only in the southeastern part are there smaller cliffs and coves. In terms of vegetation, it consists of two completely different parts divided by an almost straight line.

The northern part of the island was forested after World War II with Aleppo pines (*Pinus halepensis*), while in the southern part, there are sub-Mediterranean dry grasslands kept in a relatively good state by flocks of sheep.

This seemingly barren, southern part of the island of Dolin is part of the Natura 2000 ecological network because of its exceptional biological importance. Apart from its grassland community, the southern part of Dolin is an important nesting site for the only population of the lesser kestrel (*Falco naumanni*) in Croatia.

Natura 2000 site		
Site code	Site name	
HR2001419	Island of Dolin – south	
Target habitats		
Eastern sub-Mediterranean dry grasslands (Scorzoneretalia villosae)		

ISLAND OF DOLIN



Lesser kestrel fledgling

In July 2010 a colony of twenty or so nesting pairs of Croatia's smallest bird of prey, the lesser kestrel (*Falco naumanni*), was discovered on the island of Dolin. This species was common in Croatia in the first half of the 20th century, however after that its numbers began to fall dramatically. In the 1960s it was thought that this species had become extinct here. It cannot be determined accurately when the lesser kestrel began to nest again on Dolin, however regular flights across the Barbat Channel were being observed back in 2003. Although the kestrel nests on Dolin, it uses the nearby rocky pastures of the southeastern plateau of the island of Rab as its main feeding ground.





Stag beetle

The stag beetle (*Lucanus cervus*) is one of the Natura 2000 species found in the County. It is also one of Europe's largest insects. The male of this species is distinguished by its developed jaws which look a little like a stag's antlers which is how this species got its name. It most frequently lives in warm deciduous forests.

It is estimated that the island of Cres, together with other islands in the waters off Cres and Lošinj, was inhabited as early as the end of the Palaeolithic period. One of the oldest settlements is certainly the village of Lubenice, located at the top of a cliff 378 metres above the western shore of the island. Because of its strategic position, which enabled maritime routes to be monitored, Lubenice was a fort in the Middle Ages which was expanded several times throughout history. The ruins of the walls and two town gates have been preserved, and today bear witness to this period.

This hilly island resembles a natural bridge between the Istrian coast and the eastern chain of Kvarner islands. It is connected to the neighbouring island of Lošinj by a bridge in the small town of Osor. Due to its length and orientation (it stretches in a north-to-south direction), the island of Cres is influenced by both a sub-Mediterranean and Mediterranean climate, resulting in exceptional biodiversity. The long well-indented coastline is lower on the western and southern sides, and abounds in numerous coves and beaches, whereas high and steep rocks prevail on the northern and eastern sides. As is the case with other Kvarner islands, the island of Cres also has a diverse landscape. The northern and southern parts of the island, Tramuntana and Punta Križa, are completely forested, whereas bare pastures and thick macchia prevail in the central part.

The northern part of the island of Cres, known as Tramuntana, is the most forested part of the island. The influence of the sub-Mediterranean climate favours the development of forest vegetation, which covers about 5,500 hectares of the area of Tramuntana. There are several indigenous forest communities here, of which the most widespread is downy oak with Oriental and European hop hornbeam (*Querco-Carpinetum orientalis* and *Ostryo-Quercetum pubescentis*) and, to a lesser extent, Turkey oak with chestnut. These are predominantly old

ISLAND OF CRES



forests, sometimes more than 130 years old. Hence, there are occasional gigantic trees, such as oaks which can be up to 30 metres high and which have trunks up to 6 metres wide. In the area of Tramuntana, the most interesting specimens are the chestnut trees in Poje near Paiske pond, the largest of which has an eight-metre-wide trunk. The forest vegetation of Tramuntana is characterised by exceptional diversity in terms of its tree species, especially indigenous ones. So far, 56 such species have been recorded. Such old forests with this kind of vegetation diversity are rarely found in Europe, and those in the area of Tramuntana constitute important natural heritage.

The southern part of the island, called Punta Križa, is also forested, but the distinct influence of the eumediterranean climate has favoured the development of different vegetation compared to the northern part of the island. Most of Punta Križa is covered by vegetation consisting of eumediterranean evergreen tree and shrub species, among which the holm oak (Quercus ilex) prevails. In these forests, however, as well as on the neighbouring islands of Krk and Rab, there are also some deciduous species, such as the manna ash (Fraxinus ornus). Hence, in the area of Punta Križa, there is a community of manna ash and holm oak (Orno-Quercetum ilicis). Apart from macchia, there are also some beautiful low and medium-sized forest stands that have been planted. The trunks of some trees have a diameter of more than 30 centimetres and are about 15 metres tall. Another distinctive feature of Punta Križa is its unusual well-indented coastline. There is a succession of picturesque coves with shallow muddy seabeds cutting deep into the land, each more beautiful than the one before, with protruding, often curved headlands between them. These coves attract many tourist yachts and vessels in summer. The most impressive cove which cuts furthest into the land, Jadriješćica Cove, has at its end a small wetland area with communities ranging from those found





Hermit beetle

The hermit beetle (Osmoderma eremita), stag beetle (Lucanus cervus) and great capricorn beetle (Cerambyx cerdo) are Natura 2000 species of saproxylic beetles that live on the island of Cres. This is a group of insects with a lifecycle linked to old and rotten tree trunks whose larvae feed on the decomposing wood. The reduced number of saproxylic beetles throughout Europe is a consequence of the long-term practice of removing old and rotten trees from forests, which has ultimately led to the significant depletion of the overall biodiversity of forest ecosystems.

Natura 2000 site		
Site code	Site name	
HR2001358	Island of Cres	

Target species

Narrow-mouthed whorl snail (Vertigo angustior)

Stag beetle (Lucanus cervus)

Great Capricorn beetle (Cerambyx cerdo)

Long-horned beetle (Morimus funereus)

White-clawed crayfish (Austropotamobius pallipes)

Hermann's tortoise (Testudo hermanni)

Four-lined snake (Elaphe quatuorlineata)

European rat snake (Zamenis situla)

Blasius's horseshoe bat (Rhinolophus blasii)

Greater horseshoe bat (Rhinolophus ferrumequinum)

Lesser horseshoe bat (Rhinolophus hipposideros)

Adriatic lizard orchid (Himantoglossum adriaticum)

Hermit beetle (Osmoderma eremita)

Jersey tiger (Euplagia quadripunctaria)

Target habitats

Calcareous rocky slopes with chasmophytic vegetation

Eastern sub-Mediterranean dry grasslands (Scorzoneretalia villosae)

Castanea sativa woods

Quercus ilex and Quercus rotundifolia forests

Mediterranean salt meadows (Juncetalia maritimi)

Mediterranean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*)

Annual vegetation of drift lines

Vegetated sea cliffs of the Mediterranean coasts with endemic Limonium spp.

Mediterranean temporary ponds

Salicornia and other annuals colonising mud and sand

Caves not open to the public



Hermann's tortoise

The preserved natural areas of the island of Cres abound in habitats that are home to Hermann's tortoise (*Testudo hermanni*). It feeds exclusively on plants, and when there is a lack of food it can survive for several weeks. It leads quite a solitary life, except during the mating season. It grows very slowly; in the wild it generally lives for more than 20 years. Hermann's tortoise is the common prey of the golden eagle (*Aquila chrysaetos*) which nests on the cliffs of Cres. This is a critically endangered species in the Republic of Croatia, and the only remaining island population lives in Primorje-Gorski Kotar County. Furthermore, the area of the County is particularly significant for the preservation of the golden eagle because it serves as a corridor during the movement and migration of individuals from the surrounding regions and countries. Hermann's tortoise and the golden eagle are Natura 2000 species.







Corydalis Acaulis on ancient walls

On the ancient walls of Osor there grows the endemic plant species of *Corydalis acaulis*. It belongs to the group of Illyrian-Adriatic endemic species and in Osor it has a habitat which is somewhat separate from the majority of its known habitats. This is also the only known site of this plant in the County. Therefore it is very important when repairing the old walls in Osor to leave parts of this habitat in a suitable condition for the revival of the plant. It is interesting that the island of Cres is home to some plants which grow only on this island – for example, the Lubenice knapweed (*Centaurea dalmatica* ssp. *lubenicensis*) grows on the cliffs of the ancient little hilltop village of Lubenice in the central part of the island.



Sharp-snouted rock lizard

On the island of Cres the sharp-snouted rock lizard (*Dalmatolacerta oxycephala*) is found in only one location, in the village of Osor. Considering that the island of Cres is situated almost 100 kilometres north of the natural border of its distribution, it is assumed that the first several individuals (from which the small Osor population descended) were introduced accidently or intentionally. It is interesting that in the same location the Dalmatian wall lizard (*Podarcis melisellensis*) also lives. This kind of co-existence between two lizard species is not common and contributes to the distinctiveness of the habitat of Osor's lizards.

in completely salty maritime habitats, to purely freshwater habitats with wetland vegetation. One such area is covered by a community of lesser bulrush (*Typha angustifolia*), which is rarely found on islands.

Cres is an island of great biodiversity and particular botanical importance. More than 1,350 different plant species grow on the island. Because of the richness of its vegetation, the island of Cres stands out from all other Adriatic islands. For the purpose of comparison, "only" 782 plant species grow on the island of Rab. As far as the flora of the island of Cres is concerned, there are 43 species of orchid and 6 species of oak. More than 200 bird species inhabit the island, including endangered ones such as the griffon vulture (*Gyps fulvus*), golden eagle (*Aquila chrysaetos*), and short-toed snake eagle (*Circaetus gallicus*). Cres is home to more nesting birds than any other Adriatic island, as many as 99 species. The herpetofauna of the island of Cres is also exceptionally rich. So far, 29 reptile and amphibian species have been recorded on the island.



Lake Vrana

Lake Vrana is a natural phenomenon of the island of Cres and the richest reservoir of clean drinking water in the Adriatic islands and Croatia in general. It is located in a karst depression in the central part of the island between the villages of Valun and Vrana. This lake is the largest cryptodepression in Croatia. The average water level is about 13 metres above sea level, whilst the maximum depth is 74.5 metres, which means that the deepest part of the lake lies about 61.5 metres below sea level. Fresh water can flow out from the lake, but seawater cannot penetrate into the lake because the pressure of the lake's water is higher than that of the surrounding sea. The lake is about 5.8 kilometres long and 1.6 kilometres wide at the point where the water surface is 13 metres above sea level. It stretches in a north-northwest to south-southeast direction just like the island of Cres. The lake contains about 200,000,000 m³ of fresh water of exceptional quality and purity. The lake supplies water to the Cres-Lošinj island area and is under strict protection. This ultimately helps the conservation of nature of the lake and its immediate surroundings.



In 1986, two special ornithological reserves were proclaimed on the island of Cres. These cover the coast between Fojiška Cove and Pod Predošćica Cove in the northern part of the island, and the coast between Mali Bok Cove and Koromačna Cove in the middle part. The special ornithological reserves on the island of Cres were established on the basis of ornithological research conducted in the 1980s. This created the prerequisites for the conservation of the largest remaining population of griffon vultures in Croatia.

As a result of the efforts invested into protecting griffon vultures, their number on the island of Cres has started increasing again after being drastically reduced in this part of Europe in the 1970s and 1980s. The griffon vulture (*Gyps fulvus*) is one of four species of vulture living in Europe, and the only one living in Croatia.

The other three species: the cinereous vulture (*Aegypius monachus*), bearded vulture (*Gypaetus barbatus*), and Egyptian vulture (*Neophron percnopterus*) have disappeared from Croatian territory in the last few decades.

Vultures only feed on dead animals, and never on live prey. For the population of Kvarner vultures, this mainly means sheep carcasses. The carcasses are a source of disease for people and animals, especially if they are on inaccessible terrain from which they cannot be removed. Thus, the diet of griffon vultures has turned them into natural cleaners.

Category of protection: Special ornithological reserve		
Year proclaimed	1986	
Area	Fojiška-Pod Predošćica 550 ha, and Mali Bok-Koromačna 900 ha	
Location	Town of Cres	
Altitude	0-370 m	

ORNITHOLOGI-CAL RESERVES ON THE ISLAND OF CRES

North: the area between Fojiška Cove and Pod Predošćica Cove (Kruna)

South: the area between Mali Bok Cove and Koromačna Cove (Pod Okladi)



A female griffon vulture lays one egg annually at the beginning of winter. Both male and female vultures take regular shifts in sitting on the egg. After they hatch, young griffon vultures grow in their nests for about four months before starting to search for food independently. They spend the first two months under the supervision of one of their parents. When they become independent, the young leave the colony and start a journey, colloquially known as "wandering", to the north across Slovenia and Italy up to Austria and Germany; to the south down to Bulgaria, Greece, Turkey, Israel and Africa; and to the west across France and up to Spain. After they mature, they find a partner and return to make a nest, frequently on the same cliff where they were hatched.

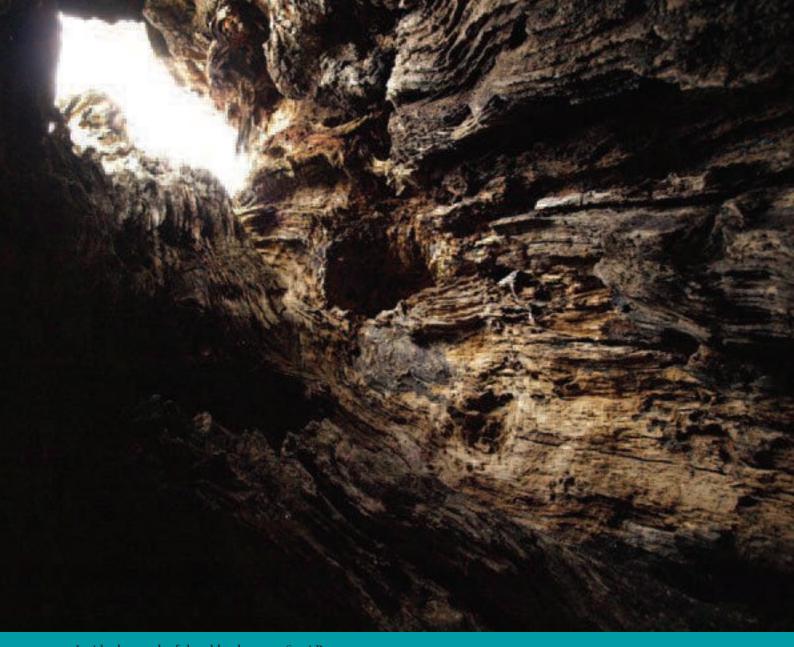
The extinction of griffon vultures has almost been halted on the island of Cres as the result of the efforts of the scientists of the Ornithological Institute of the Croatian Academy of Sciences and Arts (HAZU) and numerous volunteers gathered by what was the Caput Insulae-Beli Association Eco Centre. An interesting fact is that the increase in the number of vultures has led to an expansion of their nesting area onto the cliffs of the eastern coast of the island, which are not in the reserve. A consequence of this is that a larger number of nests can now be found outside the northern reserve than within it.

The recovery of the population of griffon vultures is a slow process because one pair successfully broods a young bird only every two years, and it takes 5 to 6 years for a young vulture to reach maturity. While growing up, the mortality rate of young birds that fly long distances is as high as 90 percent. Every additional disturbance can therefore have negative consequences for the further recovery of the Kvarner population.



The steep cliffs on the eastern coast of the island of Cres

The population of griffon vultures that live on the Kvarner islands is unique in the world because it is here that the griffons nest on the vertical cliffs just above the sea — sometimes just 10 metres above the surface of the water. A similar situation only occurs on Sardinia and Cyprus, where griffons build nests up high, a hundred or more metres above the surface of the sea.



Inside the trunk of the old oak tree at Sveti Petar

There are legends entwined with the old oak tree at Sveti Petar. In his book *Apsyrtides* Branko Fučić, a scientist and historian, describes the oak like this: ... In the village (Sveti Petar) you enter under the canopy of a huge oak tree, centuries old, ancient. A flock of sheep could squeeze into the hollows of this trunk. It is said that in the hollow of the oak there also crouches a dribbling, toothless old woman. In all of our old villages someone who visits the place for the first time must first of all kiss an old woman. This should also be done in Sveti Petar...

Several old trees contribute to the archaic rural atmosphere and conservation of nature in the village of Sveti Petar in the northern part of the island of Cres. The sub-Mediterranean deciduous downy oaks (*Quercus pubescens* ssp. *pubescens*) here are particularly distinctive.

One such old downy oak tree, growing next to the path leading from the local Križić-Beli road towards the village of Sveti Petar, has been the inspiration for stories and legends. It is a distinctive specimen, the age of which is estimated to be more than 400 years old. Its trunk diameter is 565 centimetres, its height about 15 metres, its crown diameter 22 metres, and the diameter of individual branches 25 to 55 centimetres. There is a hole in the bottom of the trunk large enough for a person to fit into.

Since 1997, it has had the status of an individual tree protected as a natural monument. About ten years after it was given this status, several storms destroyed a large part of its crown. Three large branches broke because of their weight and weather conditions. In addition, the tree lacks a genuine top, so its crown now consists of a cluster of branches. The shape of the tree is probably the result of a previous forest management method known as 'pollarding'.

The botanical classification of the oak was researched by the forestry expert Dr Zvonimir Pelcer. According to him, it is an indigenous downy oak, forests of which are important for the sub-Mediterranean

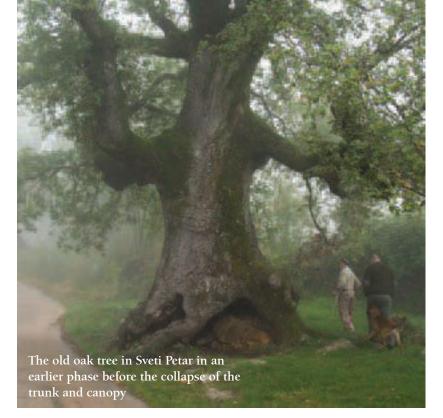
Individual tree protected as a natural monument		
Year proclaimed	1997	
Tree species	Downy oak (Quercus pubescens)	
Tree age	Estimated to be more than 400 years old	
Location	Town of Cres (Tramontana)	
Altitude	250 m	

OLD OAK AT SVETI PETAR



Great capricorn beetle

Today the great capricom beetle (*Cerambix cerdo*) is a very endangered and rare beetle species. Its larvae feed on the damaged parts of oak tree trunks where they lay their eggs from which the plump whitish larvae develop. With their powerful jaws they bore tunnels and channels in the wood. In the tree trunk the larvae pupate and from the pupa they develop into handsome, sturdy insects of a dark brown colour with particularly long antennae. On Cres this rare species is found in the area of Tramuntana due to the specific method of forest management, that is, the existence of many old and rotten trees which are left in the forest and become home to the numerous protected and endangered species.



deciduous vegetation zone that also covers the northern part of the island of Cres.

Despite its ruined crown, the old oak still looks magnificent, and its scars bear witness to times past. Experts on the protection of old trees have treated the damage to the tree by using certain well-established procedures. They have cut and thinned the remaining branches in order to restore the tree's stability and stimulate the recovery of the treetop with young shoots.

Old trees represent unusually diverse and rich biological microcosms in which there are numerous organisms: longhorn beetles, stag beetles, chestnut gall wasps, butterfly caterpillars, and fungi. The dead parts of the trunk of the old oak at Sveti Petar are home to numerous "tenants", including the endangered great capricorn beetle.





The island of Lošinj naturally follows the same direction as the southern part of the island of Cres. The two islands were once one island. They were separated in Roman times when a 10-metre-wide channel was dug in the small town of Osor to shorten the voyage of commercial vessels. Because of their historic connection, both islands differ from other Kvarner islands with their elongated forms, and karst and hilly landscapes.

Dominated by the miniature island mountain of Osoršćica in the north, the island of Lošinj is characterised by large ecological contrasts, and rich and diverse flora, fauna and vegetation. Its southern part is the only place on the Kvarner islands with evergreen holm oak forests in which there are no deciduous trees or shrubs, which are regularly found in similar forests on most Kvarner islands. The forests here, however, are exclusively evergreen forests, consisting primarily of myrtle and holm oak (Myrto-Quercetum ilicis), with corresponding types of macchia and garrigue. On Kvarner's islands, this community appears only on the islands of Lošinj and Cres. In the latter case, it occurs only in certain warm and dry micro-sites, such as those on the slopes of Toveršćica Cove on the Punta Križa peninsula. In the area of Punta Križa, this distinctly eumediterranean community is conditioned by the local microclimate, whereas on the island of Lošinj, this type of forest, consisting only of holm oak, is conditioned by the overall climate of the area, and the community is considered to be climatogenic.

Osoršćica, as a prominent elevation, has an altitudinal zonation of plants and animals, and the ravines on the eastern side of the mountain and around its peak provide the habitats for deciduous species. The deciduous trees here include the Montpellier maple (*Acer monspessulanum*), which grows in the highest parts around the peak of Televrin, and the deciduous downy oak (*Quercus pubescens*),

ISLAND OF LOŠINJ



The transformation of a cicada

The chirping of cicadas in the summer months is a familiar element of the sound landscape of the island of Lošinj. Larvae of cicadas (Cicadidae) spend the greater part of their life burrowing tunnels in the ground and sucking from the roots of plants, sometimes for several years. When a cicada larva comes to the surface, it finds a suitable place to sunbathe – a high branch or stalk. Gradually, the dry cuticle (the outer protective layer of the cicada) cracks, and the adult cicada appears in the final stage of this interesting transformation.

which inhabits the damp dales under Mount Osoršćica. The herbaceous plants include certain mountain and endemic species, such as narrow-leaved moor grass (*Sesleria juncifolia*) and sea bittercress (*Cardamine maritima*), whose origins on this island mountain presumably date back to the ice ages, when the relief of Kvarner was different and the climate harsher. In the Pleistocene (ice ages), Mount Osoršćica on the island of Lošinj, the Sis-Gorice ridge on the island of Cres, Mount Obzova on the island of Krk, and Mount Kamenjak on the island of Rab formed a chain of mountain peaks connected by means of land links to Mount Učka, Velebit and other mountains in the interior of Kvarner Bay. The special flora and vegetation of Mount Osoršćica are the reason why it was proclaimed an Important Plant Area (IPA) in Croatia.

Mount Osoršćica provides one of the most beautiful views of the well-indented coast of Lošinj. The mountain stretches for a total length of about ten kilometres, and its highest peak, Televrin, reaches 588 metres above sea level. The tremendous plant diversity and well-preserved nature of Mount Orošćica represent one of the most well-known important natural features of the island of Lošinj.

Almost half of the island of Lošinj is covered by the Natura 2000 ecological network, as part of the Kvarner Islands site, an area important for the conservation of birds. The ecological network includes the whole northern and central parts of the island of Lošinj, all the way to Privlaka and part of Čikat Cove.



Kermes oak

The kermes oak (*Quercus coccifera*) is relatively rare in the Northern Adriatic, however its most northern stands are found in the area of Liski near Ćunski. The oak is characterised by its low bushy growth and leathery, comparatively small leaves, the edges of which are spiked.



Stone steps inside the Pod Javori forest park

The stone steps right next to a former mansion house, the present day Veli Lošinj Sanatorium, are located at the entrance to the forest park. They represent a picturesque entrance to this, already slightly wild, beautiful overgrown place. The forest park can be walked through by the footpaths that lead towards the ridge of the island and the little Church of St John, from where there extends a unique view of the surrounding sea and the islands of Ilovik, Sv. Petar, Vele Orjule and Male Orjule.

One of the attractions of Veli Lošinj and the whole island is certainly the thick Pod Javori Forest where Veli Lošinj Sanatorium is situated. The forest stretches from the town of Veli Lošinj across the slopes of Kalvarija, and up to the road at the top of the hill.

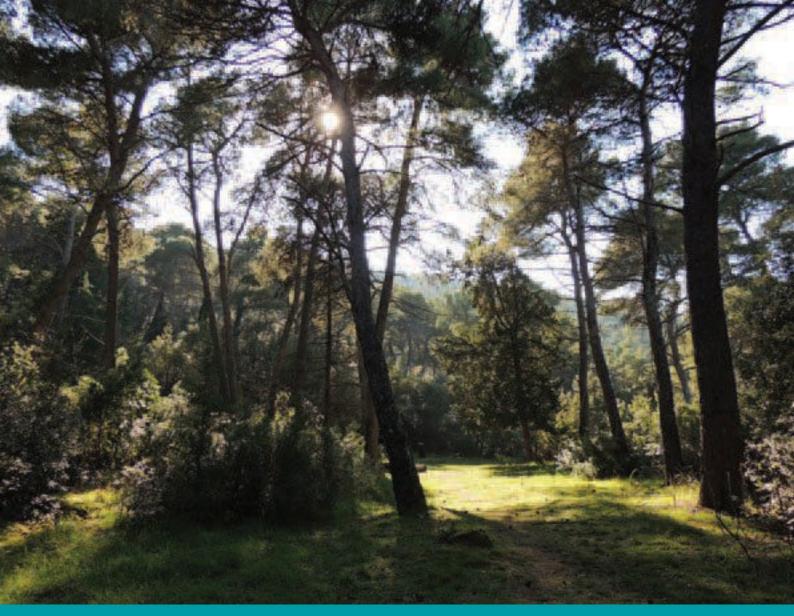
Until the 1890s, the slopes of Kalvarija were somewhat bare and covered by macchia. The forest owes its present-day appearance to Archduke Charles Stephen of Austria, who created a park here next to his manor. He chose this location as being particularly advantageous partly as the result of climate research conducted on the island of Lošinj by Professor Ambroz Haračić.

The park was designed by gardening experts from Vienna, who took advantage of the terraced slopes of Kalvarija Hill. During this process, the macchia was partly cut back, and a large number of evergreen and different exotic trees were planted. The park was designed as a landscape with open grasslands, tree groups, huge individual trees, and thick forest canopies. The great aesthetic quality of the park's composition has been preserved, even though many trees have been uprooted by the wind or simply withered. Today, natural vegetation covers much of the park and has somewhat disturbed the original design, although the trees planted at the end of the 19th century still dominate the composition of the park.

One of the dominant tree species in the forest park today is the Aleppo pine (*Pinus halepensis*), the most frequently planted species in the

Category of protection: Forest park	
Year proclaimed	1993
Area	39 ha
Location	Town of Mali Lošinj
Altitude	25-210 m

POD JAVORI



Scene from the Pod Javori forest park

While walking in the forest it is possible to see many large trees more than a hundred years old. As in many gardens of the 19th century, when there was a trend for wide dendrological diversity, this park too has a multitude of species gathered together in a relatively small area. Back then, this botanical collection of the archduke's garden included an impressive number of 200 species! Other parks that also included a great number of species in this region were the parks in Opatija and the park of Archduke Joseph Habsburg, today known as the Nikola Host Park in Rijeka.

wider area of Veli Lošinj. The forest park also contains the black pine (*Pinus nigra*), maritime pine (*Pinus pinaster*), stone pine (*Pinus pinea*), and several species of cypress (*Cupressus* sp. div.). These species, along with the usual natural evergreen macchia, are mostly present in the upper, wooded part of the forest park, which is located on a slope with winding trails cutting through the vegetation. In the lower part of the park, located on the descent from the manor towards the entrance, the prevailing species are cedar (*Cedrus* sp.), cypress, coast redwood (*Sequoia sempervirens*), lime trees, plane trees, and magnolia, while in front of the manor there are interesting palm trees, such as the sago palm (*Cycas revoluta*), and various shrubs.

Since their construction, the manor and forest park have changed owners and use, but today their original purpose has been restored: recreation and the treatment of pulmonary disorders and allergies. The former manor is today Veli Lošinj Health Sanatorium.

The forest park has multiple therapeutic benefits that combine with the positive, often happy, and sometimes even enthusiastic mood stimulated by a stay in beautiful nature that has been "improved upon" by man. Nature in the forest park stimulates the senses in many ways. The clean air and influence of the sea, together with the scents of the evergreen vegetation, from whose leaves many types of volatile essential oils are obtained, primarily offer visitors olfactory (smell-related) sensations, and in the case of convalescents are reputed to accelerate recovery and strengthen the immune system. One such horticulturally important fragrant Mediterranean plant is the laurel (*Laurus nobilis*). The area of the forest park below the Church of St. John (Sveti Ivan) gets its name from *javor*, the name for laurel in the local dialect. The laurel tree has remained an important part of the local indigenous decorative flora which contributes to the beauty and therapeutic properties of this area.



Lichens

A common sight, which can be encountered during a walk of the upper part of the forest park, are the seemingly uninteresting, slightly unattractive lichens on the trunks of trees. One should note that lichen is in fact composed of two completely different organisms: fungi and algae that live in symbiosis. The role of the algae in this symbiotic relationship is to produce carbohydrates by the process of photosynthesis, whilst the role of the fungi is to give the algae a haven and protection, sufficient water and mineral elements. Lichens grow very slowly, and some species can even live for several millennia. Lichens are important as bio-indicators because their presence points to a clean and healthy



Čikat Forest Park on the island of Lošinj is known as the island's green oasis. The area around the cove of the same name was bleak and bare until the end of the 19th century. The year 1886 was an important one in the creation of Čikat Forest Park, as this was the year the Society for the Afforestation and Embellishment of Mali Lošinj was founded. One of the aims of the society was to afforest the bleak and bare areas around Mali Lošinj. Under the supervision of the renowned naturalist, Professor Ambroz Haračić, Čikat and the surrounding areas were afforested over several years with numerous Aleppo pine (*Pinus halepensis*) and black pine (*Pinus nigra*) trees. In just six years, about 50 hectares were forested with pines, and about 300 evergreen trees were planted.

Haračić encouraged the local population to afforest the land, claiming that the forest would serve as "a natural wall protecting the town and harbour from the *bura* wind". Simultaneously with his efforts, the development of tourism on the island also started. In 1892, the towns of Veli Lošinj and Mali Lošinj were proclaimed climatic health resorts.

After a period of adaptation, the Aleppo pines spread naturally and rather quickly to the vineyards that had been abandoned due to the phylloxera outbreak. Even though the pines spread quickly and appear to be an indigenous species on the island, it should be noted that they are in fact outside the territory of their natural distribution.

Category of protection: Forest park	
Year proclaimed	1992
Area	236 ha
Location	Town of Mali Lošinj
Altitude	0-62 m

ČIKAT



The activities of the Society for the Afforestation and Embellishment of Mali Lošinj were successful. The later, sudden development of tourism in Čikat led to the construction of villas and summer resorts. Around these buildings, parks were created, a network of promenades constructed, beaches established, and small sports facilities opened, all of which additionally stimulated the development of tourism in Čikat.

Apart from Aleppo pine trees, the forest park today also contains stone pines (*Pinus pinea*), and on the rocky terrain along the coast, there are black pines. The exotic plants present include the deodar cedar (*Cedrus deodara*) and cypress (*Cupressus sempervirens*).

From Čikat Cove to Sunčana Uvala Cove, the inner part of the Aleppo pine forest comprises macchia, which consists of a large number of eumediterranean evergreen woody species, such as the lentisk (*Pistacia lentiscus*), myrtle (*Myrtus communis*), strawberry tree (*Arbutus unedo*), wayfaring tree (*Viburnum lantana*), Mediterranean honeysuckle (*Lonicera implexa*), and others. The holm oak (*Quercus ilex*) is rather rare on Čikat and does not form forests, but can be found as a smaller tree in pine forests, either individually or in groups.

As far as evergreen trees and shrubs are concerned, important species include the laurel (*Laurus nobilis*), green olive tree (*Phillyrea latifolia*), tree heath (*Erica arborea*), and prickly juniper (*Juniperus oxycedrus*). The occasional olive trees (*Olea europaea*) give a special charm to this area with their silvery treetops. Along the coast, shrubs of sage-leaved rock-rose (*Cistus salvifolius*) and rosemary (*Rosmarinus officinalis*) can be found, which additionally enrich the floral wealth of the forest park.



Monument to Ambroz Haračić

The monument to Ambroz Haračić (1855-1916), located in the cove of Čikat, is the work of sculptor Ante Starčević. Ambroz Haračić was a famous Croatian naturalist and patriot, the founder of the meteorological station in Mali Lošinj in 1879, where he carried out long term observations. His most important piece of work is The island of Lošinj, its climate and vegetation (Ľisola di Lussin, il suo clima e la sua vegetazione) from 1906.



The islet of Veli Osir is situated only 100 metres off the coast of the island of Lošinj, east of the village of Ćunski, near Za Osirom Cove. It has a regular conical shape, and in its central part has an altitude of about 54 metres.

Its area of some 5 hectares has rather interesting flora. The vegetation of the islet consists mostly of junipers (*Juniperus* sp.), which was the reason why the whole islet was included in the Natura 2000 ecological network. The islet is also important for the conservation of the Mediterranean macchia.

Ambroz Haračić, who conducted research on the flora of the island of Lošinj and published his findings in 1905, found 67 plant species on Veli Osir, including the Kvarner spleenwort (*Asplenium hybridum*), a rare endemic ferm.

The most important woody species are the wild olive (*Olea europaea* var. *sylvestris*) and carob tree (*Ceratonia siliqua*), while the herbaceous vegetation of the islet consists mostly of the branched asphodel (*Asphodelus ramosus*) and Mediterranean spurge (*Euphorbia characias* ssp. *wulfenii*).

Natura 2000 site	
Site code	Site name
HR2001036	Islet of Veli Osir
Target habitats	
Calcareous rocky slopes with chasmophytic vegetation	
Arborescent matorral with Juniperus spp.	

ISLET OF VELI OSIR



A young European shag

On the steep rocky coast of Veli Osir along with gulls there also nests a Natura 2000 species – a subspecies of European Shag (*Phalacrocorax aristotelis desmarestii*), endemic to the Mediterranean and the Black Sea. Observing them for the shore as they swim on the surface of the sea, at the moment when they dive, people often don't realise that the European shags are amazing hunters. They feed on little fish that they hunt whilst diving, and in doing so they can dive down to as much as 60 metres.



Yellow hornpoppy

The saline gravel sandbanks and gravel-sandy beaches with sufficient nitrogen compounds are the habitats of the yellow hompoppy (*Glaucium flavum*). The splashing waves of the sea and shifting ground make these two habitats inhospitable, so only a small number of species has adapted to such conditions. The yellow hompoppy has a fleshy structure and an attractive flower, however a thick sticky white sap that contains several toxic compounds, flows down its conductive veins. The ancient Greeks cooked and made a drink from the seeds of the yellow hompoppy which they then used to remedy parasites in the digestive system.



The islet of Zabodarski is situated opposite the cove of the same name on the island of Lošinj. The islet has the most beautiful, intact, natural pebbly shores. It has an altitude of only about 16 metres, and an area of about one hectare. It was probably created by the rising of the sea after the last ice age in the Pleistocene period.

A better insight into the structure of the islet is obtained by taking a panoramic flight from nearby Lošinj airport. An aerial view of the islet shows that it has a more or less circular shape with prominent semi-circular limestone layers, sparse low and dark shrubs on light grassland, and white rings of bare, flat and, in places, winding and wrinkled layered rocks washed by waves blown in from the open sea by the strong winds.

There is no tall vegetation on the islet, and the most important is that found in rock crevices (chasmophytic vegetation), because of which the islet of Zabodarski has been included in the Natura 2000 ecological network. Among the recorded 24 species, the most notable are mitnan (*Thymelaea hirsuta*) and swallow-wort (*Vincetoxicum fuscatum*). It is interesting to note that the islet is home to an abundant plant called the southern shepherd's needle (*Scandix australis*), which is rather rare in surrounding sites.

On the northern side of the islet, in a little cove by the sea, there is a rich deposit of petrified bones which have been fused by a ferrous mass into bone gravel.

Natura 2000 site	
Site code	Site name
HR2001035	Islet of Zabodarski
Target habitats	
Calcareous rocky slopes with chasmophytic vegetation	

ISLET OF ZABODARSKI



The island of Zeča is located west of the island of Cres, and is part of the Cres-Lošinj archipelago. Very close to the island, to the west, there is Pregaznik Rock and Seka Reef, while to the east there is Mišar Rock. The island is not inhabited but has a lighthouse warning seafarers of these rocks. The northernmost point of the island is Cape Tanki, and the southernmost is Cape Debeli.

The island of Zeča has spacious pebbly shores, where in the colder part of the year large clusters of dead Neptune grass (*Posidonia oceanica*) accumulate. There is also very developed and well-preserved distinctive halophytic vegetation on the pebbles on these shores. This vegetation has been destroyed along most of the Adriatic coast because it grows on pebbly beaches which are very attractive bathing sites.

The pebble deposits on Zeča have built a natural bank dividing the sea on the one side from salty lagoons on the other. The salty lagoons are muddy areas filled with tiny insects, crustaceans and serpulid worms, which are a very important food source for many birds. As a result, there is a large number of migrating birds on the island in spring and autumn.

Natura 2000 site	
Site code	Site name
HR4000031	Island of Zeča
Target habitats	
Posidonia beds (<i>Posidonion oceanicae</i>)	
Coastal lagoons	
Annual vegetation of drift lines	
Salicornia and other annuals colonising mud and sand	

ISLAND OF ZEČA



Vele Srakane and Male Srakane are geologically a part of the same reef that stretches from the island of Unije towards the south. These narrow, elongated islets are separated by the Žaplić Strait, which is just over 150 metres wide. Their highest point, Vela Straža, is 60 metres above sea level, and is located in the northwest of Vele Srakane. When sailing along the coasts of Vele Srakane and Male Srakane, the most impressive view is that of the erosion scars in the thick sandy soil covering the coastal calcareous rocks.

The islands of Vele Srakane and Male Srakane are a Natura 2000 site important for the conservation of Mediterranean grasslands of seaside bent (*Agrostietum maritimae*), which grows in sandy soils. On the islands of Vele Srakane and Male Srakane, the plant vegetation, besides creeping bentgrass (*Agrostis stolonifera*), is made of plant species such as narrow-leaf bird's-foot trefoil (*Lotus glaber*), annual fescue (*Vulpia myuros*), spiny restharrow (*Ononis antiquorum*), and others.

This community is predominantly characterised by annual plants, the life cycle of which usually ends before the summer droughts. Therefore, in summer, one gets the impression that the vegetation is rather poor. It should be pointed out that this exceptionally rare community in Croatia has only been studied in detail on the Srakane islands. Because of the summer droughts, the richness of the vegetation of the Srakane islands is best experienced in spring.

Natura 2000 site	
Site code	Site name
HR2001380	Vele Srakane and Male Srakane – land
Target habitats	
Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea	

VELE SRAKANE AND MALE SRAKANE



European bee-eater

The ornithofauna of the island is extraordinarily interesting. A total of 16 bird species nest on Susak, of which special attention is drawn to the endangered peregrine falcon (*Falco peregrinus*) and the European bee-eater (*Merops apiaster*), one of the most colourful and beautiful birds that can be found on the Croatian coast. The bee-eater feeds on insects which it hunts during flight, and its most common prey are wasps, bees and bumblebees. Considering that sometimes its prey also includes honey bees, it is no surprise that it is not a welcome sight amongst beekeepers. Several decades ago the island of Susak was the only known habitat of the bee-eater among the Adriatic islands, from there it gradually spread to some other Adriatic islands, such as Krk, where today there are birds permanently nesting in at least three separate locations.

Susak, a unique sandy island in the Adriatic Sea, stands out among all other Kvarner islands because of its natural features. It is different because of its almost complete lack of forest. It is characterised by terraces, vineyards, and protective belts of giant cane (*Arundo donax*) plantations, a tall and resilient reed-like plant. In addition, the people on this island have distinctive customs, genetics, and traditions. All these distinctive features can best be ascribed to the isolation of the island of Susak, which is the Kvarner island located farthest out to sea, some 3.5 nautical miles from the island of Lošinj.

Just as every naturalist's dream is to visit Darwin's Galapagos Islands, the isolated island group in the Pacific and the cradle of the theory of evolution, so the island of Susak, together with the distant islands of Jabuka and Palagruža, also attracts Croatian naturalists like a magnet. Since the first attempts of Albert Fortis in 1777, a lot of ink has been used describing its distinctive features and trying to interpret the origin of the sand on the island. As early as 1914, there was a detailed report on the spring flora of the island of Susak (and Unije) written by the renowned Croatian naturalist and travel writer Dragutin Hirc. Numerous other pieces of research on the island were conducted and published afterwards.

The presence of the thick layers of sand is explained by the aeolic theory, i.e. that the sand was deposited on the island by strong and frequent winds blowing across what was once the Po Valley. During the ice ages (the Pleistocene geological period), this plain was land

Natura 2000 site	
Site code Site name	
HR2000888	Island of Susak
Target habitats	
Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea	

ISLAND OF SUSAK



Grassy vegetation in abandoned vineyards

Tall Ravenna grass grows over the sand and protects the soil from erosion.

and covered with sand deposited by the large River Po and its numerous tributaries from the Alpine river basin system.

The phenomenon of the sandy or "loess islands" of Kvarner Bay (Susak, Vele Srakane, Male Srakane, Unije), has captured the imagination and curiosity of numerous scientists from the 18th century up to the present. There have been many different theories concerning their origin. However, this aeolic theory (Aeolus being the Greek god of the winds) is, for the time being, the scientifically accepted account.

The only settlement on the island of Susak is located in the eastern part of the island above the expanse of Dragočaj Cove and its beautiful sandy beach. It is divided into the older village of Gornje Selo (Upper Village) and the more recent one of Donje Selo (Lower Village), which is located by the sea. Despite emigration and the pressures of modern society, the population has kept many of its old traditions, as well as its folk costume and local dialect.

In the 1960s, the difficult economic situation on the island forced many people to emigrate from Susak to America. The population of the island was then at its peak of 1,800 inhabitants, and today it is predominantly an older population that still lives on the island. Emigration also led to the neglect of the vineyards which at the beginning of the 20th century covered as much as 96 percent of the island. There is almost no indigenous forest on the island any more, especially not holm oak, the presence of which might be expected considering the climate. According to certain data, in 1900 a small culture of black pine was planted in Bok Cove, as well as smaller plantations of black locust (*Robinia pseudoacacia*) in various parts of the island. There are also groves in the steep inaccessible sandy ravines. Most of the abandoned vineyards are covered by grass and blackberry (*Rubus* sp.), which protect the soil from erosion.







The vineyards have been restored lately, which provides reassurance that old indigenous grape species, such as *trojšćina*, will not become extinct. Due to the great sensitivity of the sandy soil, large livestock was never used for labour purposes here. Today, mechanisation has made managing the vineyards easier for the population of Susak, but this might result in a possible threat to the delicate ecological balance of the island.

The natural indigenous vegetation has been preserved only in the steep sandy parts on the edges of the island. These are home to the scientifically interesting pioneer grassland community of blady grass and fescue (Festuco-Imperateum cylindricae) with blady grass (Imperata cylindrica), ravenngrass (Saccharum ravennae) and fescue (Festuca sp.), as well as other botanically rare plants, such as the bug orchid (Orchis coriophora) and mallow bindweed (Convolvulus althaeosides ssp. tenuissimus). Susak is the only site where this community can be found in the county. Because of the vegetation of the dry eumediterranean grasslands, to which the abovementioned communities belong, the island of Susak has been listed in the Natura 2000 ecological network.



Do you know the most beautiful part of the Croatian Littoral? Oh it is the wonderful, magic Vinodol, where the towns have blossomed since ancient times, where in Antiquity the Roman marched and picked the fruits.. How these silver streams and brooks babble, how quietly they crawl over these beautiful lands; they stop in many places, as though it is difficult for them to bid you farewell. Golden valley!

Dragutin Hirc, Hrvatsko primorje (The Croatian Littoral), (1891)





Park architecture in Opatija began to develop in the second half of the 19th century. It was particularly strong at the end of the 19th century and at the start of the 20th. All the basic elements from which the town today derives a large part of its recognisable appearance can be dated back to this period. Opatija has nine town parks and park squares, including Angiolina Park, Margarita Park and Sveti Jakov Park, which are protected as monuments of park architecture by the Nature Protection Act.

The origins of the largest and most important park in Opatija, Angiolina Park, go back to 1844, when Higinio Scarpa, a patrician from Rijeka, built a holiday home here: the Villa Angiolina. The very next year, he started laying out a garden around the villa, which was to provide the basis for the present park. Continuously maintained for more than 170 years, in terms of age, this is the most important park in Opatija.

Angiolina Park is also Opatija's largest park, and derives its importance from its historical, botanical, town-planning and environmental significance. Scarpa's seafaring friends brought back numerous exotic species from distant parts of the world, including ones that can still be seen today, such as the two southern magnolia trees (Magnolia grandiflora) that were planted in front of the villa. The incredible wealth of plant species in Angiolina Park is one of its defining characteristics, and one which allows it to be considered a kind of botanical garden. According to the most recent research, there are more than 120 different plant species present in the park.

Category of protection: Park architecture monument	
Year proclaimed	1968
Location	Town of Opatija
Area	2.7 ha
Altitude	10-20 m

ANGIOLINA PARK



Camellia

Botanically speaking, the most interesting part of the park is the enclosed section with Japanese camellia bushes (*Camellia japonica*) that remain outdoors even in winter, and because of which Opatija and its mild climate have become renowned. In fact, the camellia has become a kind of trademark of Opatija. It belongs to the *Theaceae* family, and blooms in the colder part of the year in winter and early spring. Its flowers are a beautiful red but there are also white and pink ones.

One of the most popular parts of the park is situated to the east of the Villa Angiolina and contains camellias: the symbol of Opatija. Not far from the camellias, there are some old coast redwood trees (*Sequoia sempervirens*), while towards the Open Air Theatre there is an attractive group of Californian incense cedars (*Calocedrus decurrens*).

The park is known for its distinctive circular flower bed surrounded by trimmed ornamental boxwood in front of the Villa Angiolina, inside which seasonal flowers are planted. The fact that the park is located in a karst area is indicated by the picturesque solitary stones and groups of limestone rock in the laurel grove (*Laurus nobilis*), some of which have been turned into benches where you can rest.

The larger vegetation complex in the north of the park is characterised by a wood of old pine and holm oak. As far as shrubs are concerned, the Japanese aucuba (*Aucuba japonica*) here is worth noting. The southern part of the park contains impressive large trees and groups of trees, circular flower beds, and lawns.

By the wall of the coastal promenade, near the circular flower bed in front of the Villa Angiolina, there are several large downy oaks (*Quercus pubescens*) that bear witness to the deciduous sub-Mediterranean forests that once covered the eastern slopes of Mount Učka. Such oaks can be found in many places along the coastal promenade and elsewhere in Opatija.

The groups of golden bamboo (*Phyllostachys aurea*) give the park a somewhat exotic look. A less striking but nonetheless interesting detail in this section of the park is the group of stalagmites that were placed in the area east of the Villa Angiolina, and which today give the park a certain romantic aspect. In recent times, stonecrops (*Sedum* sp.), sedges (*Carex* sp.), creeping fig (*Ficus repens*), and other perennials have been planted in the crevices of the stalagmites.



Statue of Friedrich Julius Schüler Next to the statue of F. J. Schüler, the general director of Austrian Southern Railways, who played a significant role not only in the development of Opatija's parks but also tourism in the town, a group of exotic Japanese banana trees (*Musa bajsoo*) has been planted.



Margarita Park is located in the northwestern part of Opatija on the slope above Slatina. When it was established, it largely kept its existing vegetation: its natural laurel and downy oak forest. The park has retained its original form in terms of its shape, area, design, plant species, park architecture structures, facilities and urban surroundings. The trees preserved in the park are significant from a biological standpoint, as they indicate what kind of downy oak forest once existed in this area and how it was able to develop, and at the same time indicate the potential of the forest karst area.

In 1889, Opatija had been declared the first climatic health resort on the eastern Adriatic coast. The health and recreational benefits of Margarita Park, together with its importance for tourism, were recognised and the park was included in treatment programmes from the time of its establishment in the form of therapeutic tours, a feature which has continued up to the present. The park, which was created at the start of the 20th century, is also important for the fact that it is the only romantic landscape garden in Opatija.

The park is conceived as a place oriented away from the surrounding area of the town and towards the paths and trails that wind their way around the park, directing walkers to the peace of the gardens and the abundance of plant species here. It is situated on a slight incline, and the gravel paths are combined with stairs in places.

Category of protection: Park architecture monument	
Year proclaimed	1968
Location	Town of Opatija
Area	1.8 ha
Altitude	30-40 m

MARGARITA PARK



Judas Tree

In Margarita Park, there is a Judas tree (*Cercis siliquastrum*), an ornamental tree of the leguminous family. Its deep pink flowers bloom at the end of April. Beautiful clumps of blossom cover the branches and trunk, which give the tree its somewhat unusual and distinctive appearance. It is an interesting fact that the Judas tree is a living fossil, which means that the species has not changed in evolutionary terms for at least 100 million years, which is how far back the oldest fossilised remains of the plant have been dated to. In autumn, the flowers produce seed pods that can survive on the tree throughout the winter. They provide welcome food for the various species of bird that reside in the park.

The park also contains resting places with benches, such as the *Adelheid-Ruhe* repose area, which is enclosed by natural stones and offers a view of the central area of the park.

The mild climate, especially the protection from strong winds, has provided the conditions for luxuriant vegetation to grow in all of Opatija's parks, including this one. As already mentioned, the basis for Margarita Park was provided by its natural laurel and downy oak forest. However, numerous other species important to Opatija's gardens have been planted here, thus contributing to their biodiversity, including holm oak and various types of pine, cedar, cypress, palm and magnolia. The undergrowth is dominated by laurel, pittosporum, laurestine, cherry laurel and butcher's broom. The basic colour and mood in the park is provided throughout the year by the evergreen species that predominate here. Research has confirmed that there are about 50 plant species in Margarita Park.

The central part of the park consists of a large, well-tended grassy plateau, on the edge of which there are particularly striking giant Aleppo pines (*Pinus halepensis*), holm oaks with lush crowns, and a small group of palm trees. There is also a strawberry tree (*Arbutus unedo*) that stands out because of its size and age. It is situated by a path not far from the grassy plateau. It was presumably planted in the early days of the park. Parts of the park are also covered in dense laurel groves.

As far as birds are concerned, several species of woodpecker, jays (Garrulus glandarius), blue tits (Parus caeruleus), great tits (Parus major), and numerous other birds can often be seen in Margarita Park. These fly into the park from the nearby forested areas in the foothills of Ćićarija and Učka. Blackbirds (Turdus merula) are unmistakable inhabitants of the park, and can often be seen searching for food among the dry leaves on the ground.



Downy oak twig

The indigenous, centuries-old downy oak trees (Quercus pubescens) are a particularly important biological feature of this park. The greatest numbers are found in the eastern part of the park, where they combine interestingly with the Californian incense-cedar trees (Calocedrus decurrens). The undergrowth features abundant laurel, and in places bamboo (Phyllostachis sp.), both of which are important species in Opatija's parks. The indigenous plants that grow in this part of the park also include western black spleenwort (Asplenium onopteris), a Mediterranean forest species that is relatively rare on the Liburnian coast.



View of St. James' Church

Sveti Jakov Park is located between St. James' Church, the Juraj Šporer Arts Pavilion, and Ulica Maršala Tita Street. The park gets its name from St. James' Church, which was mentioned for the first time in 1449. The park surrounds the small church, which is of great historical importance, as it was built on the site of a Benedictine monastery that was the oldest building in the coastal area of Opatija.

Sveti Jakov Park was created in 1886. It is situated in the centre of Opatija, and is surrounded by historic buildings: the Hotels Imperial, Milenij and Kvarner, the Juraj Šporer Arts Pavilion, and St. James' Church. The park offers a view of the sea and surrounding buildings. It has an irregular shape, and is divided into two parts by the coastal promenade.

The upper part is known for its Neo-Baroque fountain of 1889. Besides the fountain, the upper part of the park is also interesting for the numerous plant species that it contains. Some of today's specimens were planted back when the park was founded. The park is now home to 59 different species.

The central part of the park consists of a lawn with a row of windmill palms (*Trachycarpus fortunei*). At the end of the park, in the western part, there is an attractive tall cedar tree (*Cedrus* sp.), while on the southern side, next to St. James' Church and the Juraj Šporer Arts Pavilion, there are some tall old stone pines (*Pinus pinea*).

Opatija's parks are home to a veritable collection of exotic woody plants, and various trees and shrubs, including magnolias, palms, banana trees, bamboo, camellias, cordyline, various conifers, and broad-leaved trees. Many of these species come from warmer, subtropical climes.

Because of this, Opatija came to be known for its mild climate at a time when tourism in Liburnia was starting to develop and just as

Category of protection: Park architecture monument	
Year proclaimed	2010
Location	Town of Opatija
Area	0.5 ha
Altitude	10-20 m

SVETI JAKOV PARK



parks were being opened and rich and diverse collections of trees and shrubs were starting to form in them.

Opatija's parks contain some very interesting herbaceous perennials. One such interesting example is the New Zealand flax (*Phormium tenax*), a striking monocot plant with long blade-like leaves. It was once classified as belonging to the Agave genus (*Agavaceae*), interesting examples of which can be found in Opatija's gardens, such *Agave* sp. div. Today, as a result of genetic research, it has a different classification, as it has no botanical relationship with flax from the Old Continent other than the fact that textile fibres can be obtained from it. It has always been important to the indigenous Maori population of New Zealand, who use it in various ways and call it *harakeke*.

Back in New Zealand, the rich nectar of its flowers is enjoyed by korimako birds, bats and members of the gecko family, as well as numerous endemic insects. In Opatija's gardens, in the absence of such exotic pollinators, its sweet and energy-rich nectar is collected by that most industrious and ordinary of European honeybees: *Apis mellifera*.

Today, Sveti Jakov Park functions as a town centre, meeting place, and a location that offers wonderful views while connecting historical secular and sacral buildings. It also regulates pedestrian traffic between the main street and the sea. The park has been important in terms of health, recreation and tourism ever since it was first opened, and is one of the most significant and instantly recognisable parts of the town, as a result of which it is a frequent image on postcards and tourist guides.



New Zealand flax

If you see the unusual flowers of the New Zealand flax (*Phormium tenax*) in Sveti Jakov Park, they will probably remind you of something exotic, which indeed they are, for this species is endemic to New Zealand.



The canyon and valley of the River Rječina form an interesting area of natural and scientific importance in the immediate hinterland of the city of Rijeka. The area has a particularly diverse flora with a great wealth of forms. The results of both earlier and more recent research indicate that the greatest plant diversity occurs in the steep canyon carbonate part of the valley rather than in the lowland flysch part of the Rječina. Continental species (beech, sessile oak and common hornbeam) descend the damp flysch gullies and colder valley to a lower altitude, down to Lopača and Pašac, while the dry and warm rocky canyon sides are home to evergreen holm oak, mock privet and other Mediterranean species.

As a result of the mixture of mountain, continental and sub-Mediterranean flora, and a pronounced "canyon effect", the numerous pieces of research carried out on the flora of the Rječina Valley, as well as the efforts of the Priroda Public Institution over the years, have so far revealed 1,190 plant species (ferns and seed plants), which is a tremendous number in such a relatively small area.

Because of its aquatic fauna and the vegetation on its limestone rocks, this area has been included in the Natura 2000 ecological network. The canyon vegetation is not directly threatened at present. However, the water habitats and the life they contain, as well as the distinctive species of damp gallery (riparian, river bank)

Natura 2000 site		
Site code	Site name	
HR2000658	Rječina	
Target species		
White-clawed crayfish (Austropotamobius pallipes)		
Target habitats		
Calcareous rocky slopes with chasmophytic vegetation		

CANYON AND VALLEY OF THE RIVER RJEČINA



forests where, mainly in the coastal area, the rare black alder (*Alnus glutinosa*) grows, are today at risk. The reasons for this can be found in the regulation of the river bed and in the water regime of the coastal streams, which often dry up in summer. In such conditions, life in these water habitats has had to adapt to large fluctuations in water level. In adverse dry periods, it survives in small residual water bodies that are permanently present in hollows in the riverbeds and banks.

The Rječina, in a number of ways, connects the surrounding world of Mount Obruč with the green forested valley and the coast in Rijeka Bay. The rich nature of the mountainous hinterland mixes with the urban fabric of the city of Rijeka by means of a kind of "biocorridor" formed by the valley and narrow canyon, down which the lively stream makes its way from the mountain range to the sea. Nature in the city, in the Delta area, where the river forks near its mouth, and where there were once wetlands and the Rječina met the sea, has largely had to retreat in the face of man, though deep in the hinterland it remains relatively well preserved.

In just an hour or so, a recently renovated and attractive path will take you from the city centre to the lush nature of the canyon, from where you can reach the romantic ruins of mills and a valley full of contrasts. A hiking trail leads from the canyon to Zvir, a karst spring that is another natural phenomenon well worth visiting, and which is located about 19 kilometres from the mouth of the river in the Delta area of the city. This karst spring is particularly attractive, because it emerges from the underground darkness beneath striking vertical limestone cliffs.

Written sources exist that testify to the fact that the Rječina was once rich in aquatic fauna. For example, the marble trout (*Salmo marmoratus*), a relict species endemic to the Adriatic basin, used to live in its clear waters. The wetlands at the river's mouth have long

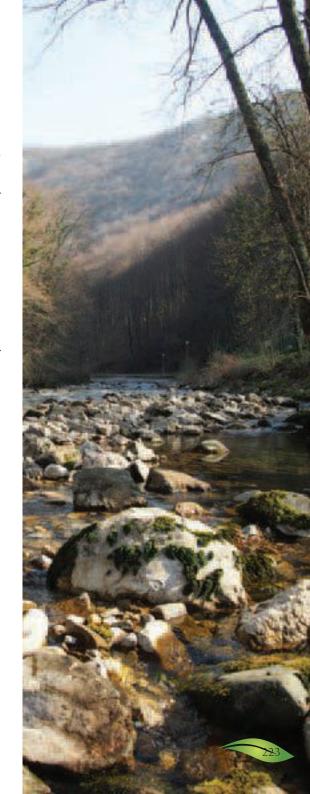
gone, and with them numerous plants and animals found in wetland and aquatic habitats, and which now exist only in the scant records of naturalists of the past.

Since the Rječina today is really a torrential stream and in summer often dries up even at its source, its freshwater world has been significantly impoverished. However, thanks to a small number of springs and side streams which in times of drought continue to hold water, the Rječina is still home to the white-clawed crayfish (Austropotamobius pallipes) and also the brown trout (Salmo trutta), which anglers occasionally stock the river with.

A number of invertebrates typical of coastal rivers have survived here. The indigenous white-clawed crayfish is under threat throughout Europe, and has been placed on the European list of endangered species that need to be protected and preserved. Because of this, the Rječina has been included as a Natura 2000 ecological network site. The specific canyon vegetation on the rocks that tower over parts of the valley is another reason why the area has been included in the ecological network.

Biologically, the Rječina Valley serves as a link between Mount Obruč, one of the most important and richest oases of highland flora and fauna in the wider Rijeka region, and the narrower sub-Mediterranean coastal area. It plays a particularly important role in winter when snow falls in the mountains. At this time, animals move to their winter grounds closer to the warm sea.

One such place is the upper part of the Rječina Valley, or to be more precise: the area around its spring. Together with other wildlife, large numbers of red deer (*Cervus elaphus*), and sometimes roe deer (*Capreolus capreolus*), descend from the higher ground on Mount Obruč to winter in the warmer Rječina Valley. The red deer stay in





the not easily accessible slopes beneath Kičej Rock, where they can find sufficient food and remain undisturbed.

Roe deer can be found in the woodlands along the entire course of the Rječina, right up to the canyon section near the city of Rijeka. Here, individual deer can be found throughout the entire year. When winter conditions pass, red deer leave the valley and return to higher ground. Game species are sometimes preyed upon by the rare and endangered predators from the wide expanses of forest in the Obruč range, such as the lynx (*Lynx lynx*). However, as you would expect from the biggest but most secretive cat in the region, the lynx always remains hidden and only the occasional lucky person will catch a glimpse of one.

The "biocorridor" in the Rječina Valley almost certainly played a special connecting role in earlier geological periods. In the canyon of the Rječina at Strmica (in the Trsat area), interesting sediment remains have been found that could be interpreted as evidence of the movement of glaciers in the past. The sediment undoubtedly needs to be analysed in more detail, and could help us understand certain specific features of today's vegetation distribution.

Narrow-leaved moor grass (*Sesleria juncifolia*) descends from the heights of the Obruč range along the canyon almost down to the sea. The last of this vegetation grows on the edges of the canyon around the Veli Vrh peak and the area of Trsat. This particular mountain grass is probably able to survive at such low altitudes because of the influence of the *bura* wind, and during colder periods is much more widespread.





On the northern side of Kotor Hill, in the immediate vicinity of Crikvenica, at the edge of the picturesque Guljanov Dolac dell, there are two magnificent downy oaks (*Quercus pubescens*) that are centuries old. Their importance has been demonstrated by members of the Društvo Crikveničana Association, which, among other things, cares for the natural heritage of the area. As a result of their tremendous efforts to protect the oaks, at the beginning of 2002 the Primorje-Gorski Kotar County Assembly decided to declare them individual trees protected as natural monuments.

The trees are estimated to be around 350 and 400 years old respectively, but this is only a rough estimate, and it is possible that they are even older.

The two oaks testify to a past when lush sub-Mediterranean forests of downy oak and common hornbeam grew here. Over time, people cleared the forests and converted them into pasture, which was the case with Guljanov Dolac, which is today sadly abandoned, like the rest of Kotor Hill. Numerous archaeological finds and the picturesque abandoned village of Kotor bear witness to an interesting and rich past that gives the entire area a cultural-historical importance, which, like those natural monuments – the old oaks, for now is not appreciated enough.

The two old oaks have a role in ensuring juveniles for the new forest that is growing in this grassy area, as they produce the seeds from which new oaks will grow.

Individual trees protected as natural monuments	
Year proclaimed	2002
Tree species	downy oak (Quercus pubescens)
Age of trees	about 350 and 400 years old
Location	Town of Crikvenica (Kotor)
Altitude	134 m

THE OLD OAKS AT GULJANOV DOLAC



Panther cap

The sub-Mediterranean forests of downy oak and oriental hornbeam are places of great biological diversity and contain a wealth of mushrooms. Many of these are found in communities (mycorrhizae) with oak roots. This type of coexistence is mutually beneficial, and is known as symbiosis. The mushrooms obtain organic compounds for food from the trees, and in return the oaks secure water and minerals, which are extracted from mycelium over a wide area. Some mushrooms which grow in such communities are edible, while others, like this panther cap (Amanita pantherina), are extremely poisonous. Croatia's most deadly mushroom species, the death cap, is often found together with downy oaks.



Golden eye jumping spider

Jumping spiders (*Salticidae*) are a large group of small spiders that are characterised by attractive colours and the ability to jump suddenly. They do not use webs to hunt their prey but rather surprise it and jump upon it. When they succeed in doing this, they kill their prey by administering a poisonous bite. They do not pose a danger to people because their toxic chelicerae cannot puncture human skin. They like sunny places and are often seen on stone walls, rocks and on the less covered edges of grasslands. The male of the golden eye jumping spider (*Philaeus chrysops*), like this one on a rock at the foot of some old oak trees, stands out on limestone rocks with its deep red or orange abdomen which contrasts sharply with its black longitudinal stripe.

Pastures and dry grasslands becoming overgrown is a process that occurs everywhere in the Croatian Littoral these days. Common sage (Salvia officinalis), European feather grass (Stipa pennata), Chrysopogon gryllus bunchgrass, and other diverse plants found in pastures and dry grasslands have withdrawn to rocky slopes with poor soil, and are gradually being replaced on the grassland by wild asparagus, prickly juniper (Juniperus oxycedrus), scorpion senna (Coronilla emerus ssp. emeroides), and various forest shrubs and trees.

Dells, including Guljanov Dolac, are typical karst relief forms. These are funnel or bowl-shaped hollows in karst or limestone areas whose origins are caused by the dissolution of carbonate rock. In Guljanov Dolac, that means limestone, which can be seen at the nearby quarry in Podbadanj.





Grasslands and young pine forest

Below Mali Platak, there are grasslands and a young planted pine forest. On the left-hand side, Jasvina Ridge can be seen, while in the background there is the rocky peak of Kamenjak.

Spacious grassy slopes spread like fans across Podplanina beneath the peak of Obruč, and continue eastwards towards Kobila and Črna Stena, across the large spaces of Burnjak and Mudna Dol towards Nebesa, where this grassy belt narrows because of the forest. A grassy slope also spreads out beneath Mali Platak towards the high ground of Pliš, which rises at an important road pass on Gornje Jelenje. The flora, fauna and vegetation of these distinctive habitats are unusually rich and diverse. Because of the distinctiveness of these well-developed dry grassland habitats, this area has been included in the Natura 2000 ecological network.

These spacious grasslands were once important pastures for sheep, but today they only occasionally see small flocks of sheep or herds of semi-wild horses. Livestock, but also game, at least for a period of time, have slowed down the inevitable natural process of the grassland becoming overgrown with forest vegetation.

The rare flora, unusually numerous and diverse butterfly and insect fauna, and panoramic views of the sea are just some of the main features of the grassy slopes upon which visitors will inevitably find something that inspires them and awakens their enthusiasm for the natural world. The wide grassy spaces also attract rare birds of prey, such as the golden eagle (*Aquila chrysaetos*), short-toed snake eagle

Natura 2000 site	
Site code	Site name
HR2000707	Gornje Jelenje towards Platak
Target habitats	
Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (important orchid sites)	
Eastern sub-Mediterranean dry grasslands (Scorzoneretalia villosae)	

GORNJE JELENJE TOWARDS PLATAK







Scree broom

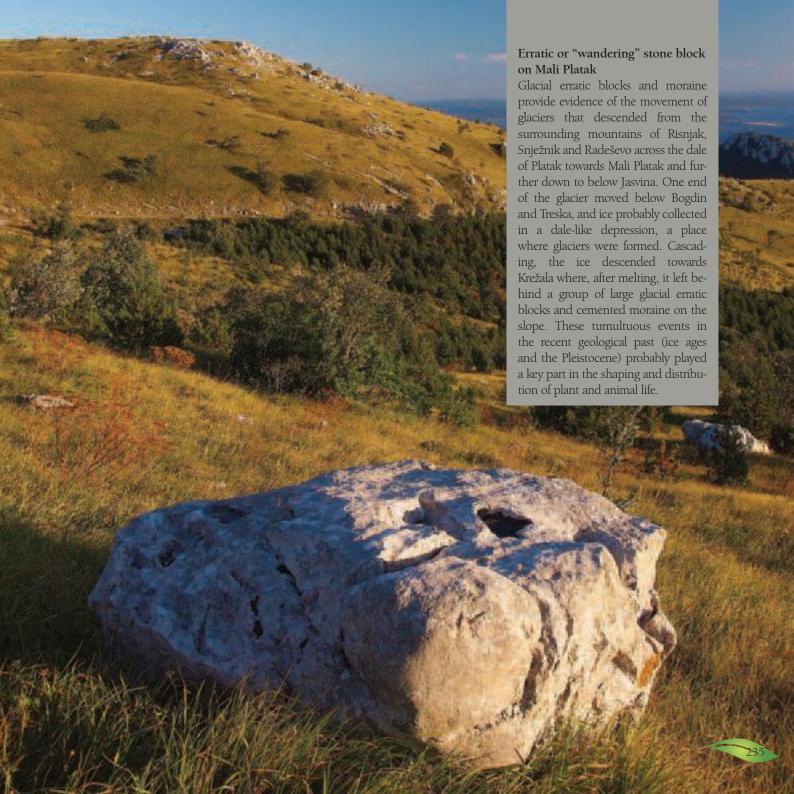
The endemic karst or whole-leaved broom (Genista holopetala) is one of the important Natura 2000 plants that grow in this grassland complex. The other rare species for whose protection this Natura 2000 area has been established is the stemless lousewort (Pedicularis acaulis), which still exists in small numbers but is threatened by grassland areas becoming overgrown. Grasslands with stemless lousewort and dwarf sedge (Pediculari-Caricetum humilis) were once very common, which can be seen on the vegetation map of Professor Ivo Horvat. Today, however, they have sadly nearly all been overgrown with scrub.

(Circaetus gallicus), and common buzzard (Buteo buteo), which find some of their favourite hunting grounds here.

Below Mali Platak, the remains of glaciers have been deposited: moraine material (Pleistocene till) and individual glacial erratics, very large pieces of fragmented rock which a glacier has carried and left somewhere. Today, they are often found in flat areas where they do not seem to fit into the landscape. These glacial remains are visible here and there on the slopes, and moraine (loose glacial sediment) is particularly pronounced at the bottom of the slope at the vantage point on Mali Platak and also around Jasvina.

Distinctive Mediterranean-montane grasslands have developed on both loose and firm carbonate bases. The main role here is played by narrow-leaved moor grass (*Sesleria juncifolia*), which is resistant to the strong gusts of the *bura* wind. The strength of the *bura* can be seen in the shapes of trees that have been bent over towards the ground by its force. The old white road which ascends from Kamenjak towards Platak winds its way along the foot of Jasvina and then passes along the edge of the moraine before coming out onto what is now the asphalted road to the Mali Platak vantage point. It was designed so that along its entire route it would avoid areas where snowdrifts occur, and so would always be passable in winter.

The grasslands of narrow-leaved moor grass in areas exposed to the *bura* wind, and also those in more sheltered areas, which generally belong to the *Carici-Centaureetum rupestris* pasture community, are rich in diverse and rare flora. In more recent times, parts of these grasslands have been covered in black pine (*Pinus nigra*), which protects the new asphalt road from the *bura* wind. However, such artificially created forests to a certain extent result in the loss of the biological wealth of grasslands.









Above the steep slopes of Bakar Bay, there is a belt of fertile soil which has been used for housing and development by a row of picturesque coastal villages: Krasica, Praputnjak, Meja, Gaj and Hreljin.

Once, this rich soil was an area for vineyards and other agricultural activities, but nowadays only a fraction of the area is used. One of these fertile areas is the spacious Dolčina karst doline. However, even here agriculture is largely neglected.

On the eastern edge of Dolčina, there is a small karst ridge known as Glavičina, which is 252 metres high. East of Dolčina, Glavičina is covered with sub-Mediterranean thickets and woods of oriental hornbeam and neglected dry grasslands. On the top of the ridge, there are the ruins of a Second World War bunker. In all likelihood, this probably had an impact on the quality of the soil of these dry grasslands, as it can be assumed that small pieces of carbonaceous material that were dug up when building the bunker were scattered over the area where today lizard orchids grow. A special soil quality was thus created which seems to favour the conservation of the habitat of the rare Adriatic lizard orchid (Himantoglossum adriaticum).

This grassland with Adriatic lizard orchids on the slope of Glavičina is in a succession phase with various species of shrub growing here. The reason for this is that traditional livestock and agricultural activities, such as grazing and mowing, have been abandoned, and

Natura 2000 site		
Site code	Site name	
HR2001487	Bakar-Meja	
Target species		
Adriatic lizard orchid (Himantoglossum adriaticum)		

BAKAR-MEJA



A grasshoppers feeds on the fruit of an Adriatic lizard orchid

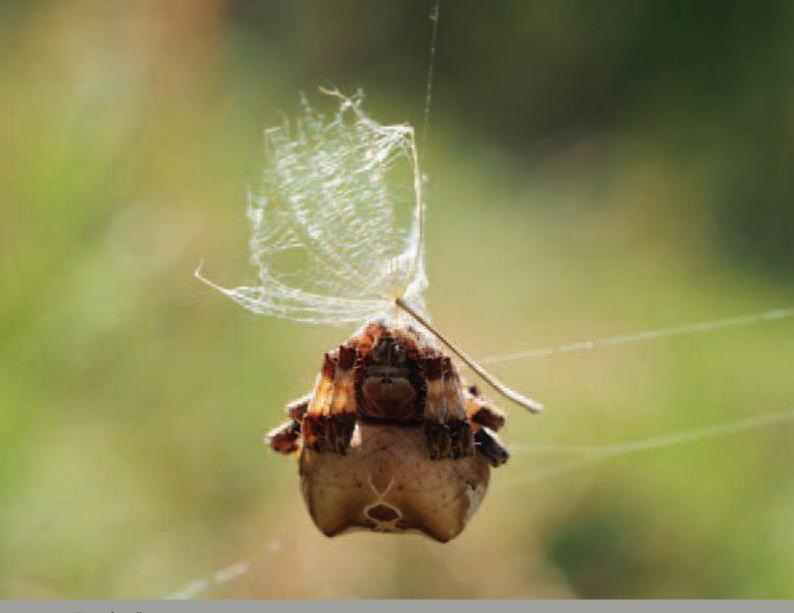
In the summer of 2014, another threat to the Adriatic lizard orchid population at this site appeared. This year saw unusually large numbers of big grasshoppers, which were everywhere on the vegetation, and even certain species of shrub and tree, feeding on the greenery. The same happened to the Adriatic lizard orchids, and their unripened, still green, fruit was completely consumed by the grasshoppers. When one bears in mind that a single orchid fruit produces thousands of tiny seeds, it can be seen that such an invasion causes serious damage to orchid populations.

the botanical composition of the grassland has changed with the appearance of woody vegetation. Because of succession, grassland species are gradually disappearing and the biodiversity of the area is diminishing. This could pose a threat to the survival of Adriatic lizard orchids on Glavičina, because such species retreat when their grassland habitats become overgrown.

Although lizard orchid seeds are unusually numerous and tiny like dust, so that the wind disperses them over great distances, it has been confirmed that orchid seedlings, including those of the Adriatic lizard orchid, sprout most frequently near the parent plant. In part, this can be attributed to the fact that the germination of seeds and the growth of seedlings require symbiosis with particular species of fungi that are not distributed evenly in the soil.

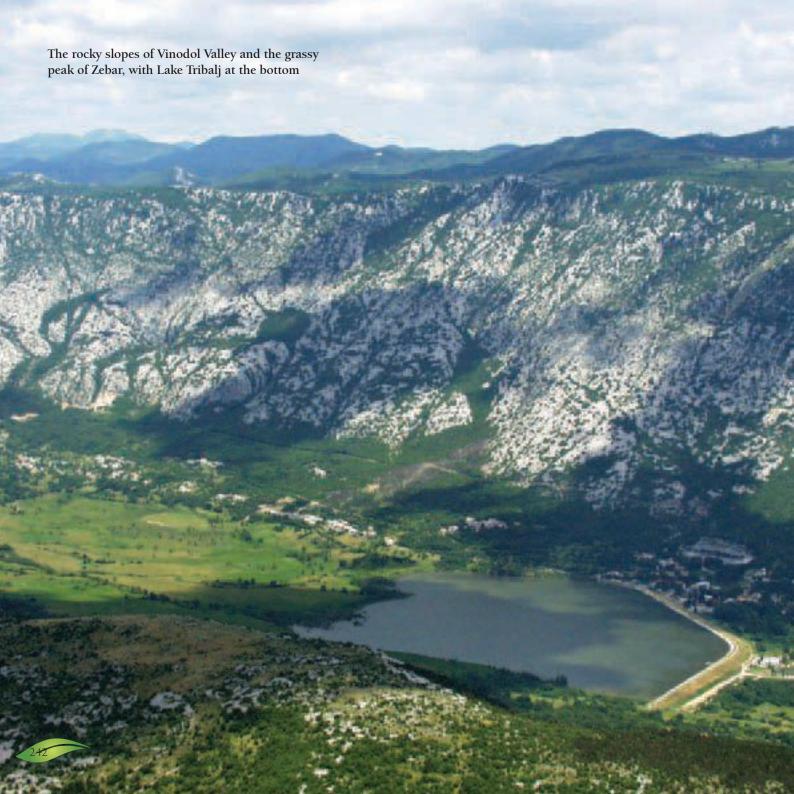
Other species of orchid grow on the overgrown grasslands of Glavičina and its surrounding slopes, as well as other rare and interesting plants. Unfortunately, the populations of some of the more interesting plants, such as the delicate oriental fritillary (*Fritillaria orientalis*) or Provence orchid (*Orchis provincialis*), have been largely destroyed or their numbers significantly reduced during the building of the motorway from Bakar to Križišće, especially at the edge of the coastal ridge above Bakar Bay.

The fact is that when grasslands become overgrown, in the stage when they pass from grassland into scrub or forest, they no longer favour the maintenance and conservation of rare plants like orchids. However, such succession stages are marked by their own natural characteristics. In particular, on the overgrown grassland of Glavičina, there are numerous and varied insects, such as grasshoppers, butterflies and flies, which use the multi-layered structure of the vegetation to hide, feed and breed. These insects attract spiders, which hunt them with webs and in other ways.



"Parachute"

The large *Araneus* spider of the orb-weaver (*Araneidae*) family bends its legs, folds itself up and looks like a small dried up piece of leaf or twig. It is capable of remaining completely still on its web while waiting for its prey. Its web is strung between blades of grass on overgrown grassland. Given the spider is so well disguised, we could ask ourselves whether the parachute-like part of the fruit of the goat's beard plant (*Tragopogon pratensis*) serves it as additional camouflage. Is it possible that this part of the goat's beard's fruit accidentally became entangled in the web after being carried on air currents, and the spider does not wish to or cannot manage to remove it from its web?



The edge of Vinodol Valley in the area of the Zebar heights is one of the most beautiful vantage points in the Croatian Littoral. The cliffs and steep rocky slopes rise directly above green and fertile Vinodol, from the bottom of which there reflects the surface of a lake. Lake Tribalj significantly enhances the dynamic of the relief, as it is surrounded by steep cliffs, and lush woods and fields.

This is an area chosen by birds of prey for both nesting, because of the inaccessible cliffs, and also hunting grounds. They are joined in the skies by other flyers: hang-gliders and paragliders. However, flying permits can only be obtained outside the season when rare and endangered bird species nest here. The take-off ramp for hang-gliders and paragliders is at the edge of the steep grasslands that descend from the ridge of Zebar.

The grasslands are also known for their rich and diverse mountain-Mediterranean (Mediterranean-montane) flora and vegetation, because of which the entire area has been included in the Natura 2000 European ecological network. It is here, among the first spring flowers, as early as the beginning of April, when the slopes are still marked in places by snow, that the beautiful greater pasque flower (*Pulsatilla vulgaris* ssp. *grandis*) blooms. Its small population has survived for centuries on the wind-exposed grasslands, from Kamenjak and Škrebutnjak near Gornje Jelenje, across Zebar to the grassy areas above

Natura 2000 site	
Site code	Site name
HR2001300	Zebar
Target species	
Greater pasque flower (Pulsatilla vulgaris ssp. grandis)	
Target habitats	
Eastern sub-Mediterranean dry grasslands (Scorzoneretalia villosae)	

ZEBAR



Pasque flower

The flowers of the pasque flower, protected by their silky hairs, shyly peak out from among the thick clumps of narrow-leaved moor grass on the slopes of Zebar as the *bura* wind blows all around. However, the March sun is already warm enough to heat up the lower layers of air.

Novi Vinodolski. It appears again, with occasional interruptions, in both the northern and southern parts of the Velebit range.

It is interesting that the plant, an important Natura 2000 species, also grows on certain continental types of grassland, such as on Mount Ivanščica and Mount Papuk. The greater pasque flower population on Zebar and elsewhere in the northwest Dinaric mountains demonstrates an exceptional adaptation to its environment, which is exposed to the strong gusts of the *bura* wind. Ecologically speaking, it is known that the *bura* dries out soil and has the greatest impact on plant life of all the winds that blow in the Croatian Littoral.

The flowers, stems and young leaves of the greater pasque flower are densely covered with silky hairs that protect the plant from sudden late coldness and the gusts of the *bura*. Its flowers close during unfavourable, rainy or cold weather. In the highlands of the hinterland of Kvarner Bay, the greater pasque flower usually occurs together with the highly resilient narrow-leaved moor grass (*Sesleria juncifolia*), which has also adapted exceptionally well to the *bura*. This is the case on the slopes of Zebar, where narrow-leaved moor grass, together with part of the greater pasque flower population, covers the highest parts of Zebar and also the ridges and slopes facing the *bura*.

More sheltered, south-facing, sunnier slopes are covered with the *Carici-Centaureetum rupestris* pasture community, where the greater pasque flower also grows well, though in slightly more favourable microclimatic conditions. The stands of *Carici-Centaureetum rupestris* on Zebar are home to a wealth of diverse, endemic, rare and colourful flowers.



Pasque flower habitat on the slopes of Zebar during the flowering period

In early spring, when the pasque flower blooms, and there can still be leftover snow on the surrounding slopes of Zebar, only a few plants are in bloom. The numerous other species do not flower until the sun shines more strongly. In areas exposed to the sun, an unusually floristically rich *Carici-Centaureetum rupestris* pasture community has developed.



Kestrels in flight

Groups of common kestrels (*Falco tinnunculus*) can often be seen in flight over the hills and karts pastures of Pleteno. These quick and agile birds of prey are easily recognisable in flight by the way in which they hover over a place, waiting for their prey.

Pleteno is a karst dale which the Novi Vinodolski-Breze-Ogulin road passes through. It is located near Breze at about 640 metres above sea level, and is surrounded by mainly grassland hills that reach 700 to 800 metres in height. Here the road splits in two. The western asphalted road heads towards Lukovo, Lič and Fužine, while the recently made non-asphalted track leads east through the forest to Luka Krmpotska.

The fertile soil that has accumulated over the millennia at the bottom of the dale was once worked, but today this is the case with only a few patches here and there. Most of Pleteno is overgrown with scrub and grassland used for grazing horses. Part is used as hayfields, while part is abandoned pasture rich in flora. On certain neglected slopes, tall *Molinia* sp. moor grass can be found, which in autumn has a distinctive yellow-brown colour. On some of the steeper slopes, there are numerous large members of the Apiaceae family, which are spread over significant areas. Large numbers of molehills caused by moles (*Talpa europaea*) can be seen in these grassy areas.

Populations of the greater pasque flower (*Pulsatilla vulgaris* ssp. *grandis*) also flourish on the grasslands of Pleteno. Because of this, Pleteno has been included in the Natura 2000 ecological network. Because of the specific way in which its grasslands are managed, Pleteno is a zoologically important site. A colony of one of the rarest

Natura 2000 site		
Site name		
Pleteno above Novi Vinodolski		
Target species		
Greater pasque flower (Pulsatilla vulgaris ssp. grandis)		
Target habitats		
Eastern sub-Mediterranean dry grasslands (Scorzoneretalia villosae)		
Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (important orchid sites)		

PLETENO ABOVE NOVI VINODOLSKI



and most endangered species of ants has been found here. These are ants of the *Myrmica* genus, which is on the IUCN (International Union for Conservation of Nature and Natural Resources) red list of threatened species in the world. This type of ant is connected with another species of insect that is endangered at the global level. This is the mountain alcon blue butterfly (*Maculinea rebeli*), which interacts in an interesting way with the ants in a relationship known in zoology as myrmecophily.

The caterpillar of the mountain alcon blue lives with the ants in a parasitic-symbiotic relationship, which means that although both species benefit from the relationship (symbiosis), the caterpillar nevertheless causes damage to its host (like a parasite). The caterpillar spends more than eight months in the ants' nest feeding on their larvae, but at the same time secretes a sweetish substance which the ants feed on. In June, the butterflies fly out of the anthill, and after mating lay their eggs on a particular plant, which in this case is the star gentian (*Gentiana cruciata*). Caterpillars which have just hatched feed on the plant's seeds and flowers for the first four weeks of their lives, after which they drop to the ground, where they are collected by the ants and taken to their nest.

The way in which Pleteno's grasslands have been managed means that the populations of these plants, the mountain alcon blue butterfly, and its host ant species are maintained at satisfactory levels. All three species involved in this complex interrelationship are of great natural importance, as everywhere in Europe their numbers have experienced a significant decline. The abovementioned species of ant and butterfly are among the most precious Croatian and world fauna, and the rarity of such habitats as the Pleteno grasslands, not only in Croatia but in Europe as a whole, means that it is necessary to protect them with special care.





In the diverse karst relief of the Krmpotsko area, relatively spacious areas of grassland (rocky pasture and smaller areas of dry sub-Mediterranean grassland) alternate with thermophilic woods, scrub and also young black pine (*Pinus nigra*) woods planted by man.

The diversity of the vegetation and terrain allows plant communities of various botanical composition and ecologies to alternate in a small area. The amount of light and warmth from the sun on the slopes, and the slopes' exposure to the cold gusts of the *bura* wind, have allowed some small areas to be inhabited by grassland communities in which one of the target species of the ecological network feels at home: the greater pasque flower (*Pulsatilla vulgaris* ssp. *grandis*).

The horses that freely wander and graze in these grasslands prevent them from becoming overgrown with woody vegetation, and so protect the greater pasque flower and other plants which love plenty of sunlight and which would not be able to thrive in the shade of shrubs and trees.

Greater pasque flowers on the Krmpotsko site can be found in clusters of several specimens or in smaller groups. These are generally places exposed to the *bura* wind. Such places are usually located at the top of exposed ridges or on the upper part of shady slopes. Apart from the greater pasque flower, narrow-leaved moor grass (*Sesleria juncifolia*) also grows here. In early spring, its dense tufts are adorned with numerous yellow-white stamens.

Natura 2000 site		
Site code	Site name	
HR2001302	Krmpotsko	
Target species		
Greater pasque flower (Pulsatilla vulgaris ssp. grandis)		

KRMPOTSKO



Greater pasque flower after rain

The large and attractive flowers of the greater pasque flower (*Pulsatilla vulgaris* ssp. *grandis*) appear in the early spring on pastures exposed to the *bura* wind. A thick blanket of hairs protects their seemingly delicate flowers, young stems and incompletely developed leaves from the *bura*, cold, strong sun, and rain.



Tommasini cinquefoil

The yellow and blue of the first spring plants predominate on the rocky pastures of Krmpotsko during the blooming period of the greater pasque flower. Yellow is the colour of the large clumps of Tommasini cinquefoil (*Potentilla cinerea*), whose unusually numerous flowers quickly close and droop towards the ground during unpleasant and rainy weather. Unlike the greater pasque flower, this hardy species chooses more sheltered parts of the pasture and south-facing slopes which in summer get bright sunlight. The cinquefoil has adapted to such extreme conditions with grey-green leaves with tiny thick hairs that protect the plant from the strongest rays of the sun.



Velebit degenia (*Degenia velebitica*) is the rarest species of both Velebit and Croatian flora. It was discovered about 100 years ago by the Hungarian naturalist Árpád von Degen, after whom it is named. It is one of the first spring plants to bloom after the snow melts. It is a relict species, and only grows on mountain scree facing south and in rocky crevices.

Tomišina Draga is the most beautiful torrential ravine in a series of such features on the coast. The series begins in the environs of Povile near Novi Vinodolski with the Derašnica stream, which flows into Tepli Porat Cove. This is followed in the direction of Senj by the Žrnovnica ravine, and then near the border with Lika-Senj County there is a series of three more ravines: Tomišina Draga, Vodna Draga, and Bukova Draga. The border between the two counties passes along the bottom of Tomišina Draga. It is interesting that the first two ravines (Tepli Porat and Žrnovnica) have been submerged by the sea. In Primorje-Gorski Kotar County, such ravines submerged by the sea are rare. Zavratnica Cove near Jablanac at the foot of Mount Velebit in Lika-Senj County is a far better known example.

In addition to the landscape and geomorphological features that make Tomišina Draga stand out, this ravine, with its pronounced relief, is also distinguished by the flora found here, especially its petrophile communities, i.e. rock and scree communities. The slopes of Veli Vrh above Tomišina Draga are the only location outside Velebit Nature

	Natura 2000 site
Site code	Site name
HR2000856	The slopes of Veli Vrh above Tomišina Draga
	Target species
Velebit degenia (Degenia	a velebitica)

THE SLOPES OF VELI VRH ABOVE TOMIŠINA DRAGA



Park where the rare and endemic Velebit degenia grows. For this reason, this area has been included in the Natura 2000 ecological network.

The Velebit degenia on the slopes of Veli Vrh grows in very difficult conditions due to its exposure to the sun and strong *bura* wind. Here, the rocks are mainly covered in narrow-leaved moor grass (*Sesleria juncifolia*), which in places forms dense stands that make a soft carpet that is pleasant for walking on, as opposed to the bare harsh karst where sharp stones and rocks have to be carefully negotiated.

The rocks are inhabited by the endemic Istrian bellflower (*Campanula fenestrellata* ssp. *istriaca*), chimney bellflower (*Campanula pyramidalis*), Guan's moon carrot (*Seseli elatum* ssp. *gouanii*), alpine daphne (*Daphne alpina*) and rock buckthorn (*Frangula rupestris*). In terms of its floral composition, this community corresponds to the endemic *Scorzonero-Seslerietum juncifoliae* grassland community that covers the rocks of the highest part of the island of Krk.

While various Mediterranean-mountain species can be found in the narrow-leaved moor grass, the bare karst is home to scree flora and vegetation, such as large clumps of prickly Jacquen's drypis (*Drypis spinosa ssp. jacquiniana*), French sorrel (*Rumex scutatus*) and candytuft (*Iberis sp.*).

Sub-Mediterranean thermophilic floral elements like common sage (*Salvia officinalis*), white wormwood (*Artemisia alba*), and winter savory (*Satureja montana*) extend from the lower parts of Tomišina Draga all the way to its edge.



...up and up climb the highlands right to the top.
The dark greenery of the conifers covers
the gentle slopes on the sides of these giants,
and from the lush green carpet, towards the sky, rise
grey rocks and cliffs, their bare heads lost in the dark clouds...

Dragutin Hirc, A Natural Geography (1905)





Učka and the southeastern part of Ćićarija were proclaimed a nature park in 1999, and today this is the only nature park in Primorje-Gorski Kotar County. It covers an area of 146 km² and includes the Učka ridge, which stretches from Bukovo (771 m) and Sisol (835 m) in the south, across grassy Brgud/Bodaj (907 m), rocky-wooded Suhi Vrh (1,333 m) and Vojak (1,401 m) to Poklon pass (922 m), where it reaches the Ćićarija mountain range with the peaks of Crikveni Vrh (1,101 m), Brložnik (1,093 m), Planik (1,272 m), the highest peak of Ćićarija, and Kadički Vrh (1,104 m). In its northernmost part, the park borders the Lisina protected landscape.

The most distinctive feature of the park is the fact that Ćićarija, and Učka in particular, are Mediterranean mountains whose beech forests stand out as separate 'islands' above the sub-Mediterranean vegetation zone. Učka's highest peak, Vojak, offers unforgettable views of Rijeka Bay and its hinterland, and also beyond the islands all the way to Velebit. On the other side, Istria can be clearly seen, and when the weather is fine, one can even see the peaks of the Alps in the distance. Although the largest part of Učka Nature Park is covered in forest, its diversity is enhanced by the area's numerous rocky pastures, lush meadows, rocks, screes, torrential streams, karst sinkholes, and caves.

Učka -	- Category of protection: Nature park
Year proclaimed	1999
Area	16,051 ha (including 8,026 ha in Istria County)
Location	The park encompasses part of the Učka and Ćićarija (in Istria) mountain ranges, and includes areas of the Town of Opatija and the municipalities of Lovran, Matulji and Mošćenička Draga in Primorje-Gorski Kotar County, and areas of the municipalities of Kršan, Lanišće and Lupoglav in Istria County
Altitude	60-1,401 m
Main peaks	Učka: Vojak 1,401 m, Suhi Vrh 1,333 m, Sisol 835 m; Ćićarija: Planik 1,272 m (highest peak of Ćićarija), Brložnik 1,093 m

UČKA AND ĆIĆARIJA





The geological structure of Mount Učka is quite complex and interesting. There is a water impermeable flysch zone around its peak ridge in the form of a half ring. Next to this, there are numerous springs that are supplied with water from the loose rock material of the carbonate hinterland. This accumulates at the foot of the steeper slopes.

It seems that the peak areas of Učka, and maybe also Ćićarija, were frozen during the Pleistocene. This is suggested by the widespread, partially redeposited moraine material and glacial erratic blocks scattered across the area between the villages of Mala Učka and Vela Učka, all the way to Vela Ravna, and then around Učka in the area of

Na	atura 2000 site
Site code	Site name
HR1000018	Učka and Ćićarija
Tar	get bird species
Rock partridge (Alectoris graeca)	
Tawny pipit (Anthus campestris)	
Golden eagle (Aquila chrysaetos)	
Eurasian eagle-owl (Bubo bubo)	
European nightjar (Caprimulgus	
Short-toed snake eagle (Circaetu	s gallicus)
Corn crake (Crex crex)	
Black woodpecker (Dryocopus m	
Ortolan bunting (Emberiza hortu	
Peregrine falcon (Falco peregrinus	
Eurasian pygmy owl (Glaucidium	ı passerinum)
Griffon vulture (Gyps fulvus)	
Red-backed shrike (Lanius collur	io)
Woodlark (Lullula arborea)	
European honey buzzard (Pernis	1
Grey-headed woodpecke (Picus	canus)
Ural owl (Strix uralensis)	
Barred warbler (Sylvia nisoria)	
Western Bonelli's warbler (Phyllo	oscopus bonelli)





Natura 2000 site	
Site code Site name	
HR2000601 Učka Nature Park	
Target species	
Marsh fritillary (Euphydryas aurinia)	
Stag beetle (Lucanus cervus)	
Rosalia longicom (Rosalia alpina)	
Great capricorn beetle (Cerambyx cerdo)	
Four-spotted longhorn beetle (Morimus funereus)	
Italian crested newt (Triturus carnifex)	
Yellow-bellied toad (Bombina variegata)	
Bechstein's bat (Myotis bechsteinii)	
Lesser horseshoe bat (Rhinolophus hipposideros)	
Slender-necked cave beetle (Leptodirus hochenwarti)	
Nodular ground beetle (Carabus nodulosus)	
Hermit beetle (Osmoderma eremita)	
Jersey tiger (Euplagia quadripunctaria)	
Scopoli's rockcress (Arabis scopoliana)	
Target habitats	
Juniperus communis formations on heaths or calcareous grasslands	
Illyrian Fagus sylvatica forests (Aremonio-Fagion)	
Eastern sub-mediterranean dry grasslands (Scorzoneratalia villosae)	
Calcareous rocky slopes with chasmophytic vegetation	
Castanea sativa woods	
Caves not open to the public	
Eastern Mediterranean screes	
_ , , , , , , , , , , , , , , , , , , ,	

Rupicolous calcareous or basophilic grasslands of the *Alysso-Sedion albi* Semi-natural dry grasslands and scrubland facies on calcareous substrates

Species-rich Nardus grasslands, on siliceous substrates in mountain areas

(Festuco Brometalia) (important orchid sites)

(and submountain areas, in Continental Europe)



Učka (Tommasini) bellflower

One of the distinctive features of the flora and vegetation of Učka is the Učka or Tommasini bellflower (*Campanula tommasiniana*), whose existence is most likely linked with events at the time of glaciation. It is endemic (a species of narrow distribution) to Učka, and does not grow anywhere in the world except on this mountain.





Littoral beech forest in the valley of Trebišća

Učka Nature Park has been included in the Natura 2000 ecological network as an area important for the conservation of species and habitats. In the Park there are 10 types of Natura 2000 habitats, such as Illyrian beech forests (*Aremonio-Fagion*), forests of sweet chestnut (*Castanea sativa*), and Eastern Mediterranean dry grasslands.

Babin Grob, and also above the Rečina stream. Some of the springs that emerge on the surface occur in these areas with presumably loose (probably glacial) material. The glaciation of Učka has not been fully researched yet, and there is almost no relevant data in the literature. However, once the extent of possible former glaciers has been determined, it could shed new light on our understanding of the former and present distribution and migration corridors of plants and animals in this biogeographically important mountainous area.

The heights of Učka and Ćićarija are located in a specific area of the Liburnian coast of Istria. The fact that they are found in the immediate vicinity of the sea has encouraged the development of lush forest vegetation distributed over several altitudinal belts from the sea to the peaks. The isolated beech forests mainly belong to the littoral beech forest community (*Seslerio autumnalis-Fagetum sylvaticae*), which on littoral mountains is usually found in the border areas between Mediterranean and continental regions. It is home to many thermophile species, the most prominent being autumn moor grass (*Sesleria autumnalis*), which in places covers the ground in the forest undergrowth. The forests that grow in the karst sinkholes and valleys are more of a continental type with an abundance of spring flowers, while subalpine beech forest is present only in the highest areas of Učka: on the peak of Vojak and in the Plas area.

In terms of forest vegetation, we should mention sub-Mediterranean downy oak forests (*Querco-Carpinetum orientalis*), which occasionally include other oak species, Turkey oak (*Quercus cerris*) being the most common, followed by maple (*Acer* sp. div.), manna ash (*Fraxinus ornus*), oriental hornbeam (*Carpinus orientalis*), and hop hornbeam (*Ostrya carpinifolia*) in higher parts, as well as other trees and shrubs. A large part of the park is covered in hop hornbeam forest. Moist forests with 'continental' common hornbeam (*Carpinus betulus*) that occur in gullies, and also xerophile evergreen groves with Mediterranean holm



Sweet chestnut forests develop on particularly deep soils

Right by the village of Lovranska Draga there is an old sweet chestnut forest, one of the few of its kind in Učka Nature Park, and characterised by an abundance of mushrooms.





Peony flower

The unusually diverse community that developed on the edge of the forest is adorned with the flowers of the protected common peony (*Paeonia officinalis*), wild rose (*Rosa* sp.), cowslip primrose (*Primula veris* spp. *columnae*), lilies (*Lilium* sp. div.), and other attractive plants with brightly coloured flowers.



oak (*Quercus ilex*) on rock are particularly interesting rarities. Forests with sweet chestnut (*Castanea sativa*) are also important. These mostly develop in deep red soil. The park is also home to Croatia's rarest and most endangered tree species, the yew (*Taxus baccata*), which can be found mainly on inaccessible cliffs. The herbaceous layer of plants in the forests is very diverse. As with the littoral beech forest, the species that stands out in most other types of forest community is autumn moor grass (*Sesleria autumnalis*), as well as numerous spring flowers.

The peak areas of Učka are distinguished by their specific non-forest habitats, such as rocks and grasslands with subalpine vegetation. The most frequent is the narrow-leaved moor grass (*Sesleria juncifolia*) that thrives in several habitat types. On the peak of Vojak, we encounter dwarf mountain pine, although this species, according to the records of certain botanists of the past, was planted here. The list of rare plants that grow on Učka includes, in addition to the endemic Učka bellflower, the mountain cowslip (*Primula auricula*) – a glacial relict, Scopoli's rockcress (*Arabis scopoliana*), Justin's bellflower (*Campanula justiniana*), and the Istrian bellflower (*Campanula fenestrellata* ssp. *istriaca*), which are also all endemic species. In addition, we can find the protected frittilary (*Fritillaria* sp. div.) and Croatian barberry (*Berberis croatica*) here. Many interesting and rare species can also be found on the colourful grasslands of hairy viper's grass and spotted hawkweed (*Scorzonero* – *Hypochoeretum maculatae*).

It is important to point out that the park is an area where alpine, karst and sub-Mediterranean wildlife elements meet. Unfortunately, due to reduced agricultural activity, the grasslands and non-forested areas have become overgrown with forest vegetation. Nevertheless, non-forested land contributes significantly to the landscape diversity of Učka Nature Park. For this reason, these mountainous areas are very popular with tourists, excursionists and hikers. The abundance of rare and endangered plant species with colourful blooms lends a vivid



Four-spotted longhorn beetle

Učka Nature Park is home to nine Natura 2000 insect species whose preservation is of great importance. These include the stag beetle (*Lucanus cervus*), the marsh fritillary (*Euphydryas aurinia*), the great capricorn beetle (*Cerambyx cerdo*) and the nodular ground beetle (*Carabus nodulosus*). Invertebrate fauna is also very numerous. There is a multitude of dead, rotting trees in the Park, which are important for the development of many insect larvae, and are inhabited by interesting and rare longhorn beetle species, such as the four-spotted longhorn beetle (*Morimus funereus*).





appearance to the mountain meadows on the flysch layer below the Učka ridge. The flysch grasslands around the peak of Učka are today partially overgrown with thicket. The areas around the villages of Vela Učka and Mala Učka are rich in flora. Hoermann's lousewort (Pedicularis hoermanniana), the Carniolan lily (Lilium carniolicum), orange lily (Lilium bulbiferum), Illyrian gladiolus (Gladiolus illyricus), and yellow gentian (Gentiana lutea ssp. symphyandra) are just some of the floral rarities in these areas.

As it is a mountain barrier between Istria and the littoral zone (Primorje), and because of the immediate vicinity of the sea, and also as a result of its vegetation, Učka is very distinctive in terms of its altitudinal zonation and the characteristics of its fauna. It should be pointed out that Učka is an enclave of the relict Horvath's rock lizard (Iberolacerta horvathi), a species with an Alpine-Dinaric distribution. Most of the rare animal species inhabit the grassy areas, rocks and screes, while the tree hollows in the forests are home to certain rare bat species. These forests are also occasionally visited by large mammals that are present elsewhere in Gorski Kotar, such as the bear (Ursus arctos), lynx (Lynx lynx) and wolf (Canis lupus). Small herds of deer can also be seen at times. The chamois (Rupicapra rupicapra) and golden eagle (Aquila chrysaetos) have permanent habitats on the cliffs and inaccessible rocky slopes. The rocks in the peak areas of Učka are occasionally flown over and used as resting places by griffon vultures (Gyps fulvus). It is as if they enjoy the magnificent views of the surrounding areas.

The numerous springs in the flysch layer are today mostly utilised for water-supply purposes, while the remaining natural springs and their streams are important plant and animal habitats. One of the most striking water habitats is the Banina stream, which has not been thoroughly researched yet. Another interesting habitat is the torrential Potok stream in the valley of Potoška Vala (Mošćenička Draga) near the picturesque abandoned hamlet of Trebišća. The torrential Medveja stream flows





through the Lovranska Draga gully during times of high water, cascading over a series of waterfalls. As with the other torrential streams in the park, the gully it flows through provides a kind of ecological corridor between the mountain and the sea. It is through such gullies that the endemic Učka bellflower descends from the inaccessible cliffs in the higher areas of Učka all the way down to the sea. Similarly, elements of Mediterranean flora and vegetation also thrive high in mountain areas.

In the areas of Učka and Ćićarija, there are also some interesting caves. In an underground cavity, which was discovered during the construction of the Učka Tunnel, important subterranean fauna, including an endemic beetle species, has been found.

In the northern part of the park, there is the interesting peak of Brložnik, which until recently was the last beech primeval forest on this part of the mountain. Here, the terrain is almost inaccessible due to the numerous forest rocks, dolines, fissures and the general karst relief. The grassy valleys of Vela Sapca and Mala Sapca are particularly interesting in terms of their scenic beauty. The rare Illyrian iris (*Iris illyrica*) and also daffodils (*Narcissus radiiflorus*) grow here.

Učka Nature Park includes certain interesting areas that are actually inside Istria County. A true jewel among these is the Vela Draga geomorphological reserve, situated above the village of Vranja. With its rocky barriers and vertical towers, it is a true Mecca for climbers.

Not only has Učka Nature Park been included in the Natura 2000 ecological network as a special area of conservation of natural habitats and wild fauna (part of the larger Učka and Ćićarija Natura 2000 site), but it has also been included in the network as a special protection area for the conservation of 19 bird species, including the nightjar (Caprimulgus europaeus), rock partridge (Alectoris graeca), Eurasian eagle owl (Bubo bubo), grey-headed woodpecker (Picus canus), short-toed snake eagle (Circaetus gallicus), and griffon vulture (Gyps fulvus).



Nightjar

At the forest edges of Učka, in open and airy areas with some trees, another Natura 2000 species can be seen with a little effort: the nightjar (*Caprimulgus europaeus*). It is an interesting nocturnal bird that feeds on different types of insects. Even more interesting to note is that nightjars do not stand on a branch like other birds but instead perch lengthwise in order to better merge with the branch. The streaked appearance of their brownish feathers provides camouflage on the ground where they mainly reside during the day.



The protected landscape of Lisina is a spacious wooded area in the mountain areas of Ćićarija that borders Učka Nature Park. One of the most interesting peaks in this wooded mountainous landscape is Crni Vrh (1,037 m). A hiking trail that starts southwest of the Lisina mountain lodge leads across its picturesque ridge. The ridge is rather rocky and has several small forest rocks, among which, even at this elevation, species typical of thermophile forests grow. These include the hop hornbeam (*Ostrya carpinifolia*), manna ash (*Fraxinus ornus*), and others. As far as rare plants are concerned, the protected Turk's cap lily (*Lilium martagon*) can be found here.

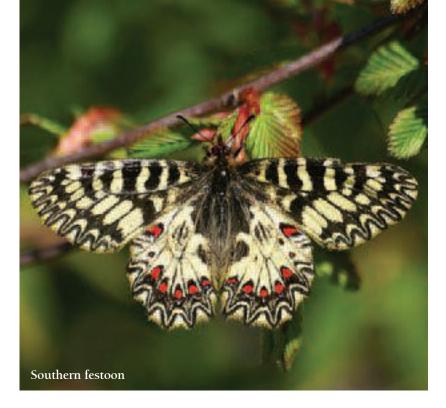
The nearby peak of Kadički Vrh (1,104 m) is surrounded by karst terrain covered with beech forest, and is characterised by numerous forest sinkholes, small forest rocks, and deep depressions in which snow remains until late spring. The area around Vodička Griža (1,143 m), with the well-known Vodica spring at its foot, provides pleasant refreshment in the summer heat with its cool spring water. The peak of Vodička Griža is only ten minutes on foot from here. The spring and its streams are a small freshwater habitat in the wooded karst, one of the few such places in this part of Ćićarija, and therefore particularly significant for the preservation of biodiversity. The peaks of Lisina (1,183 m) and Gomila (1,241 m) are probably the most visited mountain destinations inside the protected landscape area.

Categ	ory of protection: Protected landscape
Year proclaimed	1997
Area	1,394 ha
Location	Municipality of Matulji (Ćićarija)
Altitude	600-1,241 m

LISINA







Further north, there is the peak of Lepi (1,014 m), which has been afforested with coniferous trees. The planted spruce and fir forest on its slopes is particularly striking. Despite the fact that it was planted, it provides a lasting aesthetic impression, as it blends perfectly with the rather uniform expanses of natural beech forest.

The best time to visit this area is in early spring when the snow is melting and the beech trees do not have any leaves. At this time, we can often find the fruiting bodies of the spruce-cone cap mushroom (*Strobilurus esculentus*) on the spruce cones that have fallen and that remain half-buried in the ground.

The most southeasterly part of the protected landscape is the peak of Beljač (787 m), which is partially covered with planted black pine forest. While other parts of Lisina are mainly covered in beech forest, the area of Beljač is within the thermophile hop hornbeam





forest zone, which is why the flora here is somewhat different to that in other parts of Lisina. On the northern part of Beljač ridge, there are picturesque forest rocks.

Grasslands are particularly important for the conservation of biodiversity in this area, but they are rather scarce here. The most significant ones are the meadows close to the Lisina mountain lodge, but these are largely neglected and are overgrown with shrubs. Some of the rare plants that grow in these areas can be spotted in early spring. These include the Tertiary relict stemless lousewort (*Pedicularis acaulis*) and the narrow-leaved lungwort (*Pulmonaria angustifolia*), which also grow on the grasslands of Učka. Other rare plants include the blue-flowered Trieste gentian (*Gentiana tergestina*) and the yellow-flowered cowslip primrose (*Primula veris* ssp. *columnae*). As far as orchids are concerned, we can see the black-reddish burnt orchid (*Orchis ustulata*) in June.

An interesting beetle species is the green tortoise beetle (*Cassida viridis*), whose flat body and colour are perfectly adapted to the leaves that they feed on.

The forests of Lisina are known as the habitat of the edible dormouse (*Glis glis*). Here, we can also spot roe deer, and occasionally wild boar and red deer. The area is home to foxes, badgers, rabbits and martens, as well as many bird species that live in forest habitats. East of the mountain lodge, there is a wooded dale with a series of small dolines. In the autumn, many mushrooms grow here, including some unusual species and rare boletes (*Boletaceae*).



Dormouse

The dormouse (*Glis glis*) lives all over Croatia in the hollows of old trees. However, it can be most frequently seen in the karst areas, such as Primorje-Gorski Kotar County, as it uses the underground karst for hibernation, and sometimes as a dwelling. Although the dormouse is not a threatened species in Croatia, certain populations are under pressure due to the removal of old trees that abound in hollows. This loss of habitat explains why dormice dwell in attics and various cavities in houses. Interestingly, the English name "edible dormouse" comes from the habits of the ancient Romans who bred dormice as a culinary treat.





Gorski Kotar, the mountainous part of Primorje-Gorski Kotar County, rises steeply in the hinterland of Kvarner Bay. It comprises highlands, small plains and valleys, high mountain areas and karst fields, and also the county's highest mountain peaks. The highest peaks in the western part of Gorski Kotar are Risnjak (1,528 m) and Snježnik (1,506 m), and in the southeastern part the peaks of Kula on Mount Bjelolasica (1,534 m) and Viševica (1,428 m). The river valleys of the Dobra and Kupa stretch between these mountains.

The nature in Gorski Kotar differs significantly from that on the islands and along the coast. Its diversity and unusual contrasts give Primorje-Gorski Kotar County a special significance in the wider European context.

	Natura 2000 site
Site code	Site name
HR5000019	Gorski Kotar and northern Lika
	Target species
Barbastelle (Barbastella barb	bastellus)
Lesser horseshoe bat (Rhin	olophus hipposideros)
Gray wolf (Canis lupus)	
Brown bear (Ursus arctos)	
Eurasian lynx (Lynx lynx)	
Ladybells (Adenophora liliif	olia)
Scree broom (Genista holop	etala)
Ornate Bluet (Coenagrion o	rnatum)
Balkan goldenring (Cordule	gaster heros)
Four-spotted longhorn bee	tle (Morimus funereus)
Stone crayfish (Austropotan	nobius torrentium)
	Target habitats
(Sub-)Mediterranean pine	forest with endemic black pine

GORSKI KOTAR

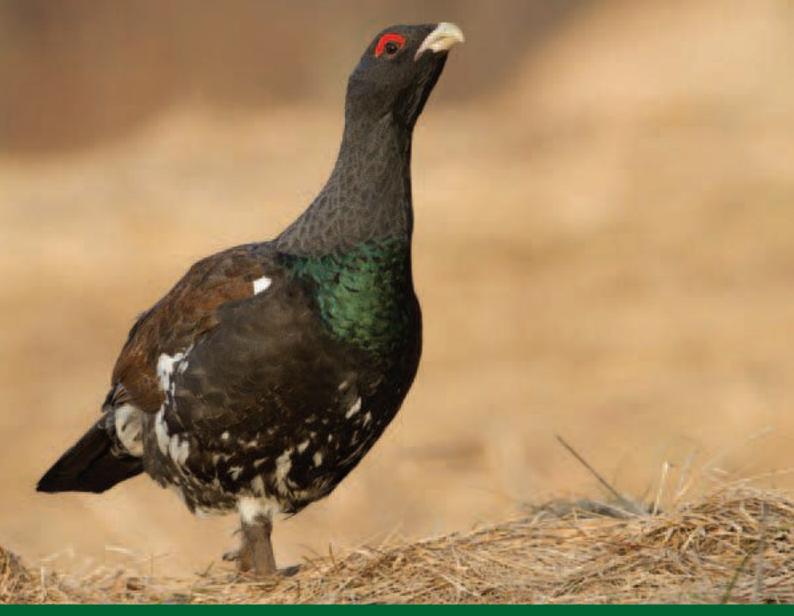






1	Natura 2000 site
Site code	Site name
HR1000019	Gorski Kotar and northern Lika
Ta	arget bird species
oreal owl (Aegolius funereus)	
ommon kingfisher (Alcedo att	his)
ock partridge (Alectoris graeca))
nwny pipit (Anthus campestris))
olden eagle (Aquila chrysaetos	
nort-eared owl (Asio flammeus)
azel grouse (Bonasa bonasia)	
urasian eagle-owl (Bubo bubo)	
uropean nightjar (Caprimulgu	s europaeus)
ack stork (Ciconia nigra)	
nort-toed snake eagle (Circaet	us gallicus)
en harrier (Circus cyaneus)	
orn crake (Crex crex)	
hite-backed woodpecker (De	endrocopos leucotos)
iddle spotted woodpecker (L	Dendrocopos medius)
ack woodpecker (Dryocopus 1	martius)
rtolan bunting (Emberiza hort	tulana)
eregrine falcon (Falco peregrini	us)
ollared flycatcher (Ficedula all	picollis)
ed-breasted flycatcher (Ficedu	la parva)
urasian pygmy owl (Glaucidiu	m passerinum)
ed-backed shrike (Lanius collu	ırio)
esser grey shrike (Lanius mino	r)
oodlark (Lullula arborea)	
uropean honey buzzard (Pern	is apivorus)
nree-toed woodpecker (Picoid	les tridactylus)
rey-headed woodpecker (Picu	ıs canus)
ral owl (Strix uralensis)	
arred warbler (Sylvia nisoria)	
estern capercaillie (Tetrao uro	gallus)





Wood grouse (capercaillie)

The mountain ranges of Risnjak and Snježnik are important areas for the distribution and nesting of wood grouse or capercaillie (*Tetrao urogallus*). The males live solitarily, except in spring when they gather to attract females by their singing and distinctive appearance. In the bird world there are very marked differences in appearance between males and females. For example, the appearance of the female grouse allows her to blend in almost perfectly with the ground, which is important because she nests on the ground. Wood grouse is threatened by the uncontrolled increase in the number of game species, especially wild boar.





Ornate bluet

Insects of the *Odonata* order are called dragonflies. Gorski Kotar is home to two Natura 2000 dragonfly species, the ornate bluet (*Coenagrion ornatum*) and the Balkan goldenring (*Cordulegaster heros*).





Balkan goldenring

The Balkan goldenring (*Cordulegaster heros*) is the largest European dragonfly (7.7 to 9.6 cm). Bearing in mind the size of today's species of dragonflies, it is interesting to note that this order once included one of the largest insects that ever lived on Earth. Indeed, the extinct giant dragonflies that lived in the Jurassic period had a wingspan reaching up to 70 centimetres, as evidenced by the fossil record of *Meganeura Monyi* found in France.





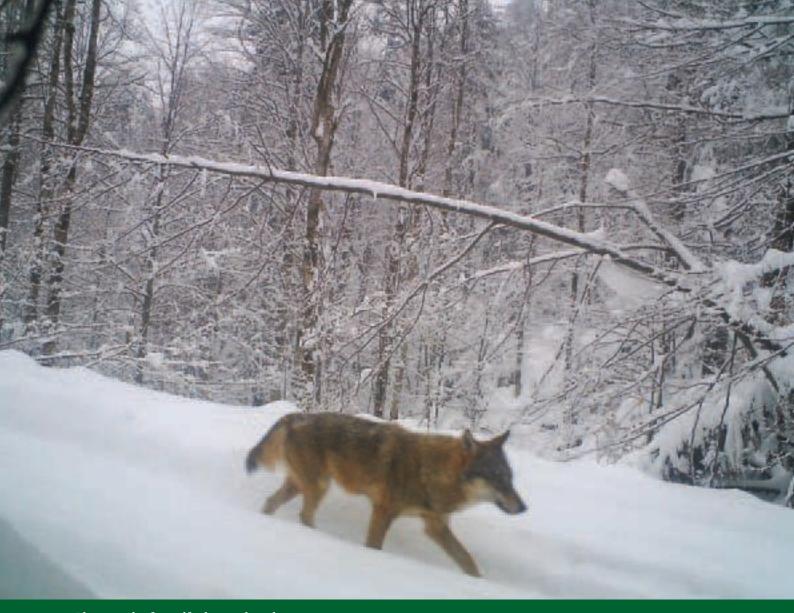
The variety of landscapes, lush and well-preserved forest vegetation, mountain rivers, streams and lakes, unspoilt natural areas, and wide and harmonious distribution of diverse habitats, all indicate the wealth of this region.

For a long time in the past, the natural landscapes of Gorski Kotar were inaccessible, wild and untamed. On old maps, Gorski Kotar was often indicated as *Hortus diabolicus*, which means *Devil's garden*. However, this inaccessibility made possible the survival of numerous plant and animal species. For this reason, Gorski Kotar was included in the Natura 2000 ecological network as a special protection area for 31 bird species, such as the golden eagle (*Aquila chrysaetos*), black stork (*Ciconia nigra*), corn crake (*Crex crex*), Ural owl (*Strix uralensis*), western capercaillie (*Tetrao urogallus*), European honey buzzard (*Pernis apivorus*), black woodpecker (*Dryocopus martius*), boreal owl (*Aegolius funereus*), and many others.

Gorski Kotar is also significant for the conservation of numerous other species and rare habitats, most notably large carnivores. Primorje-Gorski Kotar County is one of the few areas in Europe still inhabited by all three large carnivores of the European continent: the brown bear (*Ursus arctos*), wolf (*Canis lupus*) and lynx (*Lynx lynx*). In this area, humans and large carnivores have always crossed paths, as they use the same environment. Carnivores often preyed on livestock as an easily available food source, which made them man's enemies. For this reason, populations of these animals are today completely extinct in most European countries.

Apart from contributing to the biodiversity of the Republic of Croatia, large carnivores are today an indicator of the conservation of forest habitats. Being the predators at the top of the food chain, they influence both the stability of other species and the habitat itself.





Photograph of a wolf taken with a photo trap

In the past, the wolf was the most widespread species of mammal on Earth, primarily because of its ability to adapt to different environmental conditions and to live in any habitat with enough food and shelter. Today, its populations are mainly confined to inaccessible areas. According to recent studies, Croatian territory today is inhabited by 168 individual wolves in 48 packs, of which seven packs permanently inhabit Primorje-Gorski Kotar County. In Croatia, including Primorje-Gorski Kotar, large carnivores are being monitored in order to determine their numbers. One method is to set up automatic photo traps at carefully selected locations. In the winter of 2014 a photo trap recorded this wolf.







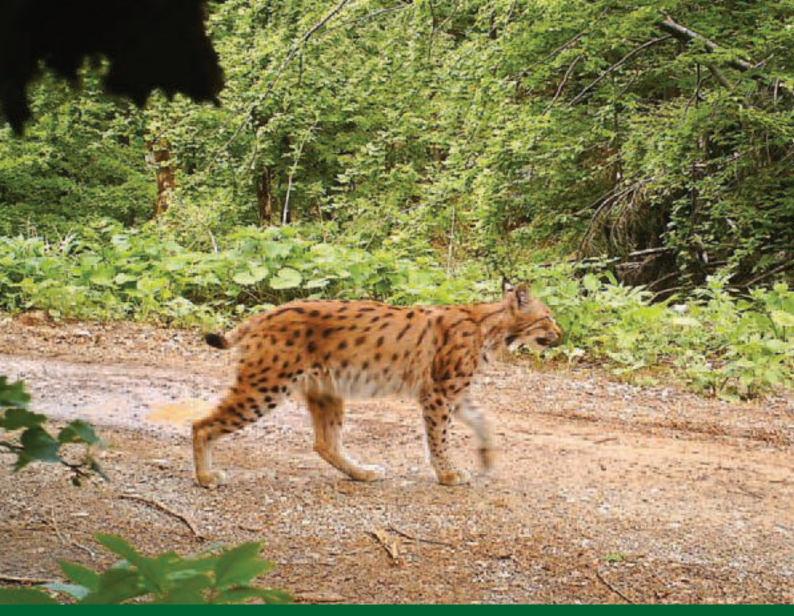
Photograph of a female bear with cub taken with a photo trap

The brown bear (*Ursus arctos*) today wanders in only a small part of what in the past used to be its territory. It is estimated that Croatia is now inhabited by about a thousand bears, most of which reside in the area of Gorski Kotar. The increasing human population has resulted in the reduction of the bears' living space and more frequent encounters with man. In the distant past, bears were considered as competitors in the hunt, and later they were even reputed to be "a monstrous enemy of valuable wildlife and livestock and a menace to people". However, although the bears fall into the category of carnivores, almost 95% of their diet is made up of herbivorous foods. They most commonly feed on herbaceous plants, soft berries and beech fruits. Other foodstuffs include various larvae of invertebrates and carrion they find in the woods, mostly the remains of a wolf's or lynx's meal. While the bear in the photo is looking for berries and edible plants, her cub has decided to take a nap in the shade.



Female bear with young

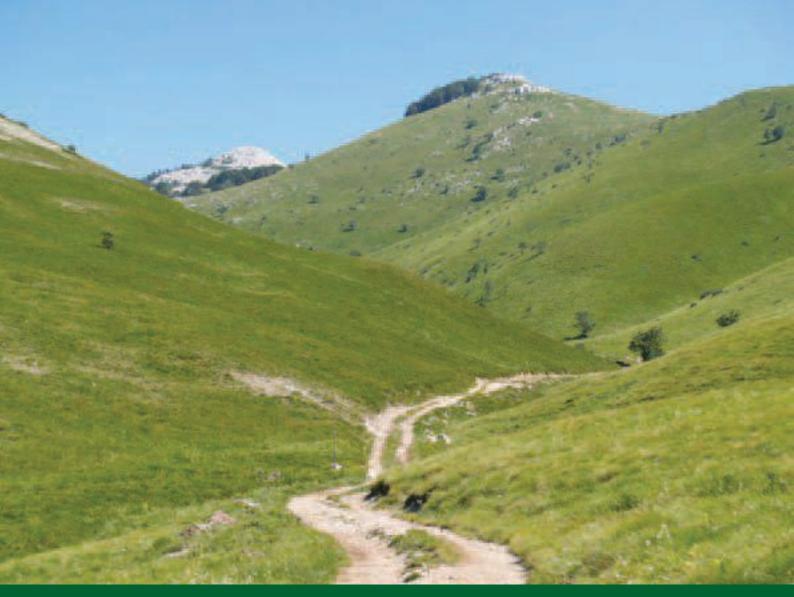
The bear, the wolf and the lynx are threatened for several reasons, one of which is illegal hunting. The reduction of their living space and in the amount of prey they feed on also plays a significant role in reducing their number. Moreover, many animals, including large carnivores, are killed in traffic accidents. Another threat for bears is the lack of dens in which to spend the winter. Females give birth in the den in midwinter, and with the appearance of warmer spring days, the cubs are big enough to follow their mother in the woods. However, interfering with the bears in a den, apart from being extremely dangerous for humans, can scare the mother bear, which in such moments often escapes and abandons her young.



Photograph of a lynx taken with a photo trap

In the past, the Eurasian lynx (*Lynx lynx*) inhabited areas all over the Eurasian continent. However, in the 19th century, due to conflicts with humans, its numbers were drastically reduced, and the lynx completely disappeared from most of Europe. It is said that the last native lynx in Croatia was caught in 1903 in the forests around Tršće in Gorski Kotar. In 1973, three pairs of lynx from the Slovakian Carpathians were released into the wild in Slovenia in order to restore the their population in this area. Soon the first individuals were seen in Croatia, where they still reside. It is believed that 40 to 60 individuals are living today in the areas of Gorski Kotar, Lika, the Croatian Littoral and northern Istria.





At the foot of Hahlić in the Obruč mountain group

The mountains of Rijeka's hinterland have always played an important role in the life of local people. The residents of the Grobnik area would graze numerous flocks of sheep on "their" mountains, which rise steeply above Grobnik Plain. In this area they had summer homes, where they produced cheese, mowed hay, collected wood, and burned charcoal. Traditionally, they went hunting, gathered dry leaves and branches as kindling wood, and picked wild berries. Livestock breeding survived up to the present day, even if to a lesser extent, and certain mountain activities associated with rural life have almost completely ceased. The mountains are now much more visited by tourists and hikers who enjoy the numerous natural attractions and the beauty of the landscape.

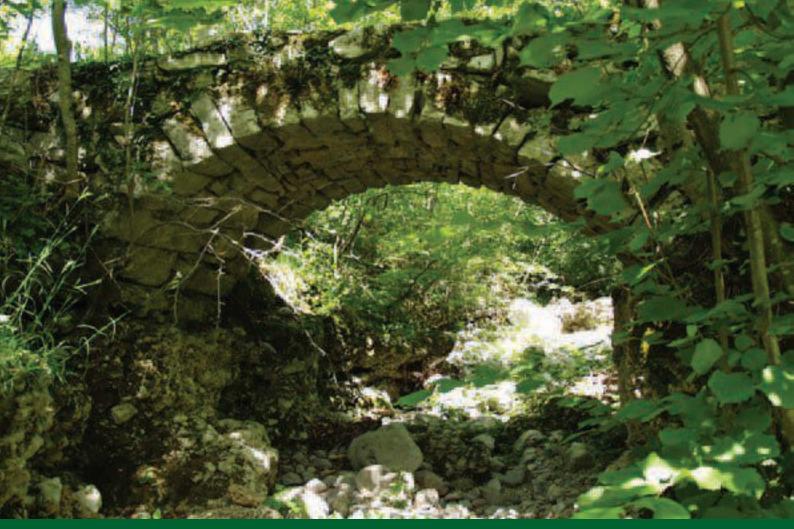
The Obruč mountain group is one of the most significant natural assets of the Liburnian karst in the county. The name Obruč (*ring* or *hoop* in Croatian) probably comes from the horizontal layers of limestone on its highest peak. These resemble rings when viewed from a distance. The area is located on the border between sub-Mediterranean and continental climates. Unlike higher Gorski Kotar peaks, the Obruč range has no freshness in the summer or large amounts of snow in the winter. This is because of its location close to the sea, low elevation and exposure to the sun. However, because of the snow that covers the slopes and barren white calcareous rocky peaks in the wintertime, these mountains are known locally as the Grobnik Alps.

The Obruč mountain range stretches in a northwest-southeast direction, and follows the orientation of the main mountain massifs of the Dinarides: Snežnik in Slovenia, and Snježnik and Risnjak in Croatia. The Obruč mountain group is made up of a tangled patchwork of peaks and slopes. The western chain of peaks is higher but shorter,

Natura 2000 site		
Site code	Site name	
HR2000643	Obruč	
Target species		
Italian crested newt (Triturus carnifex)		
Gypsywort leaved saw-wort (Serratula)		
Kitaibel's columbine (Aquilegia kitaibelii)		
Target habitats		
Eastern sub-mediterranean dry grasslands (Scorzoneratalia villosae)		
Alpine and Boreal heaths		
Bushes with Pinus mugo and Rhododendron hirsutum (Mugo-Rhododendretum		
hirsuti)		
Semi-natural dry grasslands and scrubland facies on calcareous substrates		
(Festuco Brometalia) (important orchid sites)		
Calcareous rocky slopes with chasmophytic vegetation		
Alpine and subalpine calca	reous grasslands	

OBRUČ





Bridge over Zala stream

An old stone bridge spans the Zala torrent at Podkilavac. The path leading over the bridge is one of many starting points towards the mountains and the forest. Whereas most of the year the bed of the Zala is waterless and arid, some hollows in the stone continuously hold water. The most famous such microsite is Škalna, located a hundred meters upstream from the bridge. This is a deep hollow in stone beneath the rock, actually a large and deep pothole, from which torrential waters (only during high water!) cascade and swirl when falling from the picturesque but difficult to access waterfall. The stream of Zala springs in the Dlitvo area at the foot of Mount Obruč in the territory of Klana, then runs parallel with the mountain through Ravno valley directly to the village of Studena. From there it continues in a somewhat winding course, but mostly in the same direction, along the Brgudac plateau above the source of River Rječina, to finally cut through a small but very picturesque rocky ravine of the Kuba area. Near Podkilavac it flows into the larger and more abundant torrential stream of Sušica, which collects water from another part of the Obruč mountain group. At this confluence, at high water, there is another important and unusually scenic hydrological site, Rastončica, where an intermittent source breaks up into a series of small streams all flowing into the Zala.

and includes the peaks of Trstenik (1,240 m), Štulac (1,212 m), Obruč (1,376 m) and Fratar (1,353 m). The eastern chain of peaks is lower but longer, and includes the peaks of Sleme (1,271 m), Grleš (1,325), Gornik (1,322 m), Crni vrh (1,335 m), Klek (1,210 m), Kuk (1,087 m), Vela Peša (921 m), and Jasenovica (1,337 m). These two rows of peaks are separated by several attractive torrential valleys.

The force of these torrential streams, which swell after heavy autumn rains, or after the snow melts in the mountains, is attested to by the large stones and slightly rounded blocks that accumulate after they have been carried by the strength of the water along the rather narrow stream beds. The stones in the Zala stream are significant mainly because of their two different colours: there is greenish-grey flysch sandstone (which the torrent has cut off and carried from Dlitvo in the Klana area), and the more resistant and abundant limestone that breaks off on the slopes of Obruč or is carried by the fierce power of the torrent in the canyon. In the middle reaches of the Zala, one can occasionally find greyish gravel made of dolomite breccia. Such bedrock is typical of the stream bed in the area between Brgudac and Vršine at the foot of Obruč.

The highest peaks make up an irregular labyrinth of rugged limestone rocks. Amidst them there is Pakleno, a wild and almost untouched patchwork of forests, rugged rocks, sinkholes and peaks. The rocky slopes of the surrounding higher peaks (Obruč, Suhi Vrh and Fratar) descend into it, forming a natural amphitheatre. Some of the sites are particularly scenic: the white boulders in the forest; the old beeches, of which many have broken and collapsed; the crooked spruces on the wind-exposed rocky ridges; the old firs, many of which have fallen down or withered but remain standing like white skeletons. Different kinds of moss grow on the old fallen trees and dry standing trunks, together with an abundance of mushrooms. The rocks of Pakleno





Vale of Mudna Dol

The most beautiful canyon valley in the Obruč mountain group is the vale of Mudna Dol, formed by the torrential stream of Mudni Potok over thousands of years. In the upper part of the valley, the stream is deeply etched into the friable dolomite slopes, in contrast to the lower part, where the water cuts into more resistant limestone rock. Here, therefore, the slopes of the valley are very close and become narrow, with vertical and sometimes overhanging cliffs, and a dark, narrow bed filled with potholes and cascading rocks. Numerous threatened and rare canyon birds nest here, including peregrine falcons (*Falco peregrinus*) and golden eagles (*Aquila chrysaetos*).

provide a habitat for the edelweiss (*Leontopodium alpinum*), the symbol of Alpine flora, and also the hairy alpenrose (*Rhododendron hirsutum*), whose vibrant red blossom is popular with hikers. Alpenrose and dwarf juniper (*Juniperus communis* ssp. *nana*) in places represent a separate subalpine heath community.

The foothills and sunny slopes of Obruč are overgrown with forest and scrub typical of warmer areas. The most protected and warmest places are covered with forests of downy oak and oriental hornbeam (*Querco-Carpinetum orientalis*), while more exposed areas are home to important forests and thickets of hop hornbeam (*Ostrya carpinifolia*). An interesting feature of the forest vegetation on Obruč is the relative absence of littoral beech forest: hop hornbeam and downy oak forests here are immediately followed by a subalpine vegetation zone with dwarf mountain pine (*Pinus mugo*). In places, beech descends down the torrential gullies into the oriental hornbeam zone.

The most striking feature of the vegetation of these forests are the spacious grasslands on the dolomite slopes. These are the result of centuries of sheep grazing. The soil here is shallow and skeletal. Some of the rare plants that grow here are the Clusius' gentian (Gentiana clusii), endemic three-flower spurge (Euphorbia triflora), endemic scree broom (Genista holopetala), stingy pointed sedge (Carex mucronata), and many others. The beautiful and protected rose daphne (Daphne cneorum), whose fragrant flowers can be spotted in the early spring, also grows here. In places in the higher areas, the medicinal bearberry (Arctostaphylos uva-ursi) can be found. The damp gullies are home to a moor grass and Illyrian gladiolus community (Molinio-Gladioletum). A particularly rare plant in such habitats damp with water and melted snow is the endemic subspecies of the Siberian iris (Iris sibirica ssp. erirrhiza). In the immediate area, one can also find the endemic Illyrian iris (Iris illyrica), grass-leaved iris (Iris graminea), and the strictly



The grassy slopes of Obruč

The slopes of Obruč are covered with a seemingly monotonous narrow-leaved moor grass (*Sesleria juncifolia*). However, these meadows contain an unusually interesting flora, so that the grassland vegetation can include several different types of habitats and communities. Their appearance differs significantly from season to season from bright green in spring to light yellow in other seasons.



Dolomite breccia

Dolomite breccia from the slopes of Mudna Dol consists of fragments of darker and lighter grey. The darker parts contain more organic material and are easily recognizable. Dolomite breccia is easily broken up into scattered dolomite fine sand, on which shallow soil called rendzina develops. The plant world that emerges on such a foundation is always very special and includes a wide range of rare plants. Dolomite bedrock is associated with one of the greatest vegetation rarities of the Obruč mountain group: the unique relict of indigenous black pine forest in the valley of Borovica.

protected Carniolan lily (*Lilium carniolicum*). The higher areas of the Obruč mountain range feature rock fissure vegetation that is significant because of its endemic chasmophytic community. The most interesting rock plant is the endemic Kitaibel's columbine (*Aquilegia kitaibelii*) with its unusually shaped blue flowers. In the deep sinkhole of Koprivenac, located between Fratar and Vidalj, the rare stunted willow (*Salix retusa*) has been found, a high mountain glacial relict of snowbed vegetation.

An interesting account of climbing up Suhi Vrh and Pakleno, and also in other areas of the Obruč mountain range, was given by Dragutin Hirc. His work reflects life in Croatia at the end of the 19th century and evokes certain lost traditions and the beauty of nature, the latter of which has hopefully remained:

When I went out, I caught sight of Suhi Vrh in all its grandeur; here, nature seems to have died. The entire slope up to the peak stretches in front of the beholder like a sea of stones. There are no high rocks, edges or peaks; only stones of different sizes and shapes that lie scattered around without any order, simply left as they were brought here. No flocks of sheep pass here, and nor do birds nest; not a voice or breath reaches the ears, and people rarely dare set foot here.

Dragutin Hirc, Hrvatsko primorje (The Croatial Littoral) (1891)

The diverse and well-preserved grassland vegetation is one of the main reasons for including the Obruč area in the Natura 2000 ecological network as a special area of conservation of species and habitats. In addition, Natura 2000 species that can be found in this area include the four-spotted longhorn beetle (*Morimus funereus*) and the Italian crested newt (*Triturus carnifex*). Obruč is important for the conservation of six habitat types, including eastern sub-Mediterranean dry grasslands (*Scorzoneretalia villosae*), alpine and subalpine calcareous grasslands, alpine and boreal heaths, and bushes with *Pinus mugo* and *Rhododendron hirsutum* (*Mugo-Rhododendretum hirsuti*).





Particularly important on the northeastern edge of the Obruč mountain chain are the grassy plateaus of Gumance, which, together with their gravel pits and glaciofluvial sediments (layers of sediment created by the action of glaciers and water courses), are ice-age remnants. In addition to their great scenic beauty and geomorphological characteristics that recall the long-ago events of glaciation, the area of Gumance is also attractive to visitors because of an aurochs fossil, approximately 17,000 years old, that was found here.

The grassy peak of Gumanačka Gora rises above Gumance. Its rare flora, butterflies and stunning views attract nature lovers, particularly those who appreciate magnificent yet less well-known places apart from civilisation. Because of its secluded location, this peak is visited by rare birds of prey, as it has spacious grasslands that are their favourite hunting grounds, though here they are partly overgrown with shrubs. The peak of Gumanačka Gora is located on the border with the Republic of Slovenia. Its sunny slopes are called Katalan, which is something of a unique name in this area. According to some interpretations, the name recalls the Japodian tribe of the Katalans. This ancient testimony rooted in the landscape in the form of a toponym has great historical significance. As far as nature protection is concerned, the dry continental grasslands located on the flat bottom of Gumance Valley are particularly important. They are distinguished by rare fauna, flora and mushrooms associated with grassy habitats. In fact, these grasslands feature a mixture of continental and littoral flora

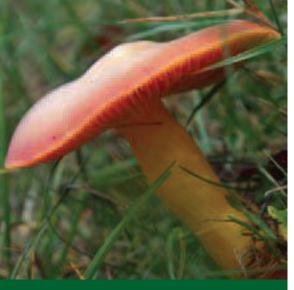
Natura 2000 site		
Site code	Site name	
HR2001041	Gumance	
Target habitats		
Semi-natural dry grasslands and scrubland facies on calcareous substrates		
(Festuco Brometalia) (important orchid sites)		
Hard oligo-mesotrophic waters with benthic vegetation of <i>Chara</i> spp.		

GUMANCE









Fruiting body of scarlet waxy cap

The scarlet waxy cap (Hygrocybe punicea), with its unusual colours, is one of a few dozen types of mushrooms that grow on grassland habitats on Gumance. It is distinguished by its bright purple red colour, like a jewel hidden among the low grass. It grows mostly on grasslands in higher, mountainous areas. However, not any area, but only those where artificial fertilisers have not been used, and which have not been ploughed for a long time. Such grasslands are rare today, as most are overgrown with scrub for not being used as pasture. What we see is only the small, above-ground part of the mushroom, its fruiting body, whose function is to produce and release spores. The incomparably larger part of the mushroom is hidden under the earth, in the form of thin filaments (hyphae), which absorb nutrients from the soil. A network of these hidden hyphae is called mycelium, which branches off and twines around dead parts of the plants, from which the mushroom obtains food.

and fauna. On the bottom of one of the gravel pits at Gumance, water accumulates, resulting in the development of rare habitats of hard oligo-mesotrophic waters. A special type of algae thrives here – stoneworts (*Characeae*). Lime crust accumulates on their thalli, which is why clusters of these algae have a crunchy whitish appearance when they lose water in times of drought. Because of these distinctive features, Gumance has been made a Natura 2000 site.

The area of Gumance is extremely interesting for geologists and everybody interested in learning about what happened in the geological past. It is not widely known that Gumance Valley was created by glacial activity in the Pleistocene. For the most part, its bottom is flat and filled with massive Pleistocene (ice-age) deposits that consist of gravel, sand and clay interbeds. These deposits were deposited in shallow intertwined streams which were created by melting glaciers, and which carried large amounts of gravel and sand. In these glacial-stream deposits, which are considered to be remnants of the last Würm glaciation (the last ice age, which covered a large part of Europe's mountains and the north of the continent, and which lasted until approximately 12,000 years ago), a fossil bone of the extinct aurochs (*Bos primigenius*) was discovered in the profile of one of the gravel pits.

A striking feature of the grassy expanses of Gumance are the area's colourful flowers and the fluttering butterflies that fly around them. Gumance is one of the few grassy complexes in the wider area of Obruč that is still regularly mown. The others are largely neglected and overgrown with shrubs and forest. Such grasslands are home to rare mushroom species, such as waxcaps, entolomas, earth tongues, and dozens of other species that form the so-called 'fairy rings'. Waxcaps are today extremely rare and endangered and, as a feature of dry continental grasslands, are also important in wildlife protection. They are distinguished by the unusually vivid colours of their fruiting bodies.



Gravel deposits on Gumance

Gumance valley has a U-shape which is typical of a valley formed by the motion of glaciers. The gravel deposits on Gumance provide a view back in time through the layers of sediment that are in places more than 16 metres thick, and which resulted from the action of glaciers, streams and rivers. Both the gravel deposits and the entire valley of Gumance are extremely interesting in terms of geology as they provide tangible evidence of events in the recent geological past.



Trstenik Bog is located in a karst depression beneath the peak of Trstenik (1,240 m) in the Obruč mountain group. It lies at an elevation of approximately 960 metres above sea level in a beech and fir forest (*Omphalodo-Fagetum*) vegetation belt. It has an elongated elliptic shape, and is approximately 500 metres long and 250 metres wide. The part overgrown with bog vegetation is several hectares in size. On the southeastern side of Trstenik, there is a permanent water source. Because of its bog, Trstenik has been included in the Natura 2000 ecological network as a special area of conservation of species and habitats. Bogs are wetlands where organic material is less degraded and accumulates in the form of peat. Bogs are very rare in Croatia. There are several types distinguished by their environmental conditions, especially with regard to the way they are supplied with water and nutrients. Trstenik Bog is one of the largest in Croatia, and a unique raised bog.

Raised bogs are mainly supplied with rainwater, and are characterised by peat moss vegetation (*Sphagnum* sp. div.) These mosses are perfectly adapted to life in such habitats and cannot be found anywhere else. The special hollow cells of peat mosses are absorbent like a sponge and retain huge amounts of water. Tufts of moss and other bog plants grow year after year. However, due to unfavourable circumstances, the parts that die out do not degrade completely, which is why the bog grows in height and gradually bulges out.

Natura 2000 site		
Site code	Site name	
HR2000659	Trstenik	
Target habitats		
Alkaline fens		
Active raised bogs		

TRSTENIK









Peat that has not degraded accumulates in deeper layers. This results in the creation of a raised bog in which the water that is retained is mostly acidic.

In addition to peat mosses, and certain other types of moss, mush-room and algae of the *Desmidiaceae* family, bogs are also characterised by certain higher plants, which is why bog vegetation consists of a series of rare and endangered species that cannot be found in other habitat types. Bogs are threatened all across Europe due to peat excavation, drying out and hydro-melioration, climate change, and the increased amount of nitrogen compounds from polluted air.

In Croatia, the survival of the few remaining bogs is in doubt. As glacial and boreal relicts, they are at the southern edge of their distribution, which is why today's climate is not favourable for them. Along with the abovementioned threats, this is the key reason for their vulnerability and disappearance.

The interesting bog vegetation at Trstenik was studied by the renowned Croatian botanist Ivo Horvat. He found here stands of midway peat moss (*Sphagnum medium*) and strict haircap moss (*Polytrichum strictum*). Other peat mosses important in raised bogs that he recorded include red peat moss (*Sphagnum rubellum*) and small red peat moss (*Sphagnum acutifolium*). More recently, a species of sedge was found on the bog that was previously unknown in Croatian flora: flea sedge (*Carex pulicaris*). The chances that flea sedge will survive in this habitat are very small, because present conditions in the bog are not favourable. In the late 1950s, irrigation channels were dug at Trstenik to dry out the bog, and in more recent times it has been afforested with young spruce trees. This has caused serious degradation of this rare habitat, and created the conditions for the succession of forest vegetation.



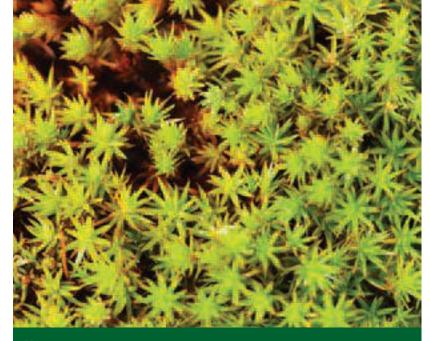






Red peat moss

Peat mosses are typical boreal (northern) organisms adapted to life in peat bogs. Their growth and life processes contribute to the acidification of the bog and its water retention, and allow, or in a greater number of cases prevent, the colonisation and life of other types of organisms. For this reason, bogs are habitats relatively poor in species, which means that the communities in such environments are composed of a small number of highly specialized species. One of the most important species of moss in the raised part of the bog in Trstenik is red peat moss (Sphagnum capillifolium var. rubellum).



Haircap moss (*Polytrichum* sp.) is typical of Trstenik. It grows together with other mosses in the bog, but usually chooses drier habitats.

To protect this extraordinarily rare type of habitat from further overgrowing, Priroda Public Institution, in collaboration with Rijeka Natural History Museum and Croatian Forests, has managed the bog for several years, which includes regular monitoring and the removal of young spruce trees growing in the bog.

The fauna of the bog has not been examined in detail, but based on findings from other bogs in Croatia it is possible that it includes boreal representatives of insect fauna that are not well known in Croatia. Apart from their rare flora and fauna, bogs are very important for another reason. Due to the constant accumulation of peat and the sparse degradation of organic residues, they are ideal places for the conservation of the remains of pollen grains and other plant parts. This is why scientific research on fossil pollen (palynological research) is occasionally performed on them.



Frost area in Trstenik

Being an extremely frost area, the valley with its bog in Trstenik contains a wide variety of species and communities that are significant in terms of their flora, fauna and fungi. Besides the remains of the raised bog, for which the area has been included in the Natura 2000 ecological network, another important feature is the spruce forest that grows on the edge of the frost area, a type of boreal habitat rare in Croatia.





Basophilic bog at Rečice

Glacier and later sediments, partly sedimented in the form of water impermeable clay, have enabled the emergence of streams, whose cold water today supports the development and survival of a small basophilic bog, together with a number of interesting bog species. Unlike acid bogs, like the one at nearby Trstenik, which obtains water and nutrients primarily from rainwater, a basophilic bog is supplied with water from the environment or from the wider hinterland, in this particular case from the stream. Important species of peat moss are very different in acid bogs, where peat mosses that like an acidic environment dominate, and basophilic bogs, where moss species are adapted to a more alkaline environment. Because of the basophilic bog species, as well as the distinctive and rare type of habitat, this area has been included in the Natura 2000 ecological network.



The dale of Rečice is located not far from Trstenik, just a few kilometres towards Platak, in the foothills of the peaks of Donji Medvejci (1,423 m) and Gornji Medvejci (1,481 m). At the bottom of the dale, a stream flows through a small marshy basophilic bog. After flowing for a short while on the surface, the stream soon disappears into the karst underground.

The sediments through which the stream flows enrich its waters with calcium carbonate and bases, which is why the water is hard. The low saturation of nutrients (oligo-mesotrophic waters) makes the development of stoneworts possible. These are a special algae species on whose thalli lime crust accumulates. It should be pointed out that the drier part of the bottom of the sinkhole, which is not marshy, is covered by important mountain hay meadows, another Natura 2000 target habitat.

The most impressive evidence of glacial action can be seen on the wooded slopes of Rečice in the form of huge wandering or glacial erratic blocks made of limestone. They were either broken off by the glacier or fell onto its icy surface from a slope above it. As the glacier advanced down the hill, it carried these boulders on its surface or in its icy interior, and eventually disposed of them randomly on the slopes of Rečice as it melted.

Natura 2000 site		
Site code	Site name	
HR2000782	Rečice	
Target species		
Drepanocladus vernicosus		
Target habitats		
Hard oligo-mesotrophic waters with benthic vegetation of <i>Chara</i> spp.		
Alkaline fens		
Mountain hay meadows		
Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels		

REČICE





Lividraga and Bjeljevina are two wooded areas of Gorski Kotar that have been protected as part of the Natura 2000 ecological network because of a very interesting and rare moss species that grows here: the buxbaumia bug moss (*Buxbaumia viridis*).

Although it is present across Europe, buxbaumia is very rare in the Mediterranean area because of the special environmental conditions in which it grows. Since it is sensitive to summer droughts, buxbaumia mostly grows at higher elevations in Croatia. Its habitat are old rotting stumps or rotten pieces of wood that lie on the ground in shaded forests with dense treetops and plenty of moisture. Occasionally, it grows on humus on the ground. This moss is considered to be an indicator of ancient primeval forest stands in which there is plenty of rotten wood.

Both Lividraga and Bjeljevina are dense, shaded forests in which, apart from the rare buxbaumia moss, numerous other species thrive that require damp and dark conditions. On the old tree stumps and rotten wood, but also on the trees that are still growing, one can find a variety of mosses, ferns and fungi.

Natura 2000 site	
Site code	Site name
HR2001431	Lividraga
Target species	
Buxbaumia bug moss (Buxbaumia viridis)	
Site code	Site name
HR2001433	Bjeljevina
Target species	
Buxbaumia bug moss (Buxbaumia viridis)	

LIVIDRAGA AND BJELJEVINA







Tiny silene

In the deep dolines of Risnjak, deposits of snow lie for long periods and slowly dissolve in spring, thereby giving rise to the distinctive vegetation of the snow pits of the Dinaric Mountains. A typical example is the tiny silene (*Heliosperma pusillum*), a mountain herb with delicate snow-white flowers.

Nowadays, it is becoming increasingly difficult to find places with prisrine nature where we can find peace and invigorate our spirit. One such rare and exceptional place is Risnjak National Park. Nature lovers come here to admire the deep forests with various plants and rare fauna, where trees are not cut down but fall down when they become old, and then slowly rot into fertile humus that provides nourishment for the new forest. They are attracted by the cliffs and peaks with magnificent views that stretch into the distance, and which are warmed by the sun or exposed to the *bura* wind, the rain and snow. These areas are inhabited by the eagles, chamois and rare carnivores that are almost extinct in neighbouring regions.

Neither naturalists nor explorers have been immune to Risnjak's scenic beauty and distinctive features. Ivo Horvat, probably the most diligent researcher of Risnjak's flora and vegetation, studying it for many years, deserves recognition for the fact that the results of his research, which involved experts from many fields, resulted in the proclamation of Risnjak National Park in 1953. In his frequently quoted explanation for protecting Risnjak, Professor Horvat wrote: May this nature be preserved without any human influence, and where man's earlier involvement has left traces, may nature heal and erase them by itself. In this way, Risnjak became an oasis of the natural world in the most beautiful part

Category of protection: National park	
Year proclaimed	1953
Area	6,350 ha
Location	Towns of Bakar, Čabar and Delnice, and municipalities of Čavle and Lokve
Altitude	290-1,528 m
Main peaks	Veliki Risnjak 1,528 m, Snježnik 1,506 m, Guslica 1,490 m and Planina 1,426 m
Deepest sinkholes	Viljska Ponikva (c. 200 m deep) and Velika Ponikva on Smrekovac (c. 150 m deep)

RISNJAK





Natura 2000 site	
Site code	Site name
HR2000447	Risnjak National Park

Target species

Marsh fritillary (Euphydryas aurinia)

Rosalia longicorn (Rosalia alpina)

Four-spotted longhorn beetle (Morimus funereus)

Stone crayfish (Austropotamobius torrentium)

Wolf (Canis lupus)

Bear (Ursus arctos)

Lynx (Lynx lynx)

Slender-necked cave beetle (Leptodirus hochenwarti)

Alpine sea holly (Eryngium alpinum)

Scopoli's rockcress (Arabis scopoliana)

Target habitats

Luzulo-Fagetum beech forests

Alpine and subalpine calcareous grasslands

Species-rich *Nardus* grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)

Mountain hay meadows

Rupicolous calcareous or basophilic grasslands of the *Alysso-Sedion albi* Bushes with *Pinus mugo* and *Rhododendron hirsutum* (*Mugo-Rhododendretum hirsuti*)

Illyrian Fagus sylvatica forests (Aremonio-Fagion)

Acidophilous Picea forests of the montane to alpine levels (Vaccinio-Piceetea)

Calcareous and calcshist screes of the montane to alpine levels (*Thlaspietea rotundifolii*)

Carbonate rocky slopes with chasmophytic vegetation

Caves not open to the public

Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco Brometalia) (important orchid sites)

European dry heaths

Alpine and boreal heaths

Juniperus communis formations on heaths or calcareous grasslands

Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)





of Gorski Kotar, right on the border with the littoral region (Primorje). Risnjak National Park is located in the northwestern part of the Dinarides, and includes more than 30 important plant communities and 14 forest communities. After 40 years of its existence, people realised that the initial borders of the national park, encompassing 3,014 hectares, were too small for efficient protection, and that the park should be expanded. This was done in 1997, so that the park now encompasses an area of approximately 6,350 hectares. The extension was in two directions: towards the northeast, where it now includes the source and upper part of the Kupa Valley, and towards the west, where it includes the Snježnik and Guslica mountain ridge. The source of the River Kupa is particularly important and has been additionally protected as a geomorphological natural monument. In the immediate vicinity of the source, there is the ravine of the Sušica torrential stream, another interesting geomorphological feature.

The second extension, which encompassed Mount Snježnik, brought into the park many interesting peaks, magnificent views, and also varied vegetation comprising alpine grasslands with an unusually rich alpine flora. Other interesting features of the park include the educational trail in the romantic Leska Valley, the impressive vegetation and geomorphological phenomena of the sinkholes or dolines, extensive glacial relicts in the form of sediments that attest to the recent glaciation of Risnjak and Snježnik, the primeval forest area of the rocks of Bijele Stijene, the interesting flora and vegetation of the subalpine grasslands in the Snježnik mountain group, dwarf mountain pine vegetation, lush tall herbs, the rugged cliffs on the peaks of Veliki Risnjak and Mali Risnjak, the presence of large carnivores (wolf, bear and lynx), and many others.

Risnjak and Snježnik are typical northwestern Dinaric mountains with a pronounced altitudinal zonation of vegetation between their foothills and highest peaks. This can be seen in the alternation of individual altitudinal belts of forest vegetation, a phenomenon that can be observed

during any of the usual climbs towards the peaks. Risnjak National Park is home to almost all the most important forest communities of Gorski Kotar. These make up the most important natural asset of the park.

In the lowest and warmest belt in the Kupa Valley, there is a community of balm-leaved red archangel and beech (Lamio orvalae-Fagetum sylvaticae). The higher montane zone is distinguished by a fir-beech forest community (Omphalodo-Fagetum), which is the most significant of the forest vegetation of the national park, as it abounds in endemic and relict species, such as hacquetia (Hacquetia epipactis), blue-eyed Mary (Omphalodes verna), and other interesting plants. Above the fir-beech forest, there is a lower subalpine belt of subalpine beech forest (Homogyno alpinae-Fagetum), which is followed by a higher subalpine belt of dwarf mountain pine (Lonicero-Pinetum mughi). These are actually not real forests but stunted shrubs bent towards the ground which resist the very unfavourable conditions that include wind, snow, ice, and sometimes sun-exposed peaks.

The park is also home to numerous natural and anthropogenic communities that have developed depending on the specific relief, climatic, geological, anthropogenic and other conditions. For example, there are individual damp dales and gentle valleys covered with groups of maples with a lush layer of tall herbs, such as perennial honesty (*Lunaria rediviva*), and numerous ferns. They make up fragments of the montane maple and ash community (*Aceri-Fraxinetum*).

A particularly interesting feature in the wider Risnjak area are the deep karst sinkholes or dolines in the areas of Smrekovac, Viljska Ponikva, and elsewhere. These are places of exceptional biological and land-scape importance. Dolines have a pronounced microclimate, and are mostly frost areas with a special vegetation distribution.

Descending from the upper edge of a sinkhole towards its bottom, we notice that its vegetation is adapted to increasingly harsh conditions.





Patchwork of vegetation

On the ridges of Risnjak and Snježnik, conifer and deciduous forests alternate, which can best be seen in autumn when the various colours show the spatial distribution of contrasting forest types. This patchwork depends on differences in relief, the exposure of the terrain, microclimate conditions and soil composition.

In Risnjak's dolines and karst depressions, temperatures can drop to below zero at any time of the year, be it winter or summer. In individual places in sinkholes, particularly at the bottom, the temperature of the ground air layer and soil surface is never much higher than a few degrees Celsius above zero. This is why when descending a sinkhole we can notice the phenomenon of temperature inversion and consequently vegetation inversion. The deeper we descend towards the bottom of a sinkhole, with the temperature becoming lower and lower, species and communities appear in the distribution that is typical of mountains but in reverse order, in the same way that the climate becomes harsher as we climb mountain peaks.

The most famous and impressive sinkhole in Risnjak National Park is Viljska Ponikva, which has a depth of 200 metres. At present, to visit this geomorphological and botanical phenomenon, one must obtain a permit from the park administration. However, its magnificence can at least be sensed when climbing the marked trail from Vilje towards Medvjeđa Vrata. On the slopes of this large and deep sinkhole, beneath the subalpine beech forest, a subalpine spruce forest has developed (such forests are typical of pronounced frost areas), and at the bottom of the sinkhole we encounter large stands of dwarf mountain pine and large-leaved willow. In other words, this is vegetation that we would typically come across when climbing the surrounding peaks that peep out from the dense forest. The bottom of the sinkhole is rocky with rare representatives of mountain flora. A distinctive feature of this sinkhole are the rocky screes on its shaded side, partly overgrown with mountain pine, and partially bare with some mountain vegetation. It formed and has remained here thanks to the damper and colder substrate and the flow of cold air through the fissures in the rocky karst.

Apart from the climate-zonal forests which grow in 'usual' types of soil, in Risnjak National Park, there are also specific forest types that occur in special climatic conditions, geological substrate, and soil.





Rosalia longicorn

The Latin name of the Rosalia longicorn (*Rosalia alpina*) remind us that this species lives mainly in mountain regions. Before the expansion of human settlements and the destruction of forests in the Mediterranean and in low-lying parts of Europe, this beetle inhabited a very wide area. But with the disappearance of lowland forests, it retreated to better preserved higher areas, which can lead us to the erroneous conclusion that this species is associated exclusively with beech trees or the mountains. The rare Rosalia longicorn is characterized by its beautiful colouration and tufts of black hair between the joints of its unusually long antennae. The larvae are associated with dead beech trees, which are not lacking in Risnjak National Park since here dead trees are usually not removed from the forest.

One such soil type is the pronounced frost areas that are most frequent in depressions. They are overgrown with pure spruce forests of the boreal (northern) type. Montane spruce forest (*Aremonio-Piceetum*) grows in the dales and valleys within the fir-beech forest belt. The most eye-catching stands can be found in the karst dale of Lazac. On the other hand, subalpine spruce forest (*Listero-Piceetum*) grows on the rocky cold slopes and at the bottom of sinkholes, mainly in the subalpine beech forest belt. Both communities are distinguished by the dominance of a northern (boreal) floral element. There are numerous mosses, clubmosses and ferns, which is why these forests most resemble the taigas of the far European north.

Another significant forest community on Risnjak is fir forest on calcareous blocks (*Calamagrostio-Abietetum*), which is one of the most impressive vegetation phenomena on this mountain. It enlivens the rugged rocks and stone blocks on the steep slopes.

Arthropoda, especially insects, are the largest group of animals in the park. The insects that inhabit the ground layer of the forest communities are being intensively researched by entomologists. This research is important because the data on their structure and numbers may indicate possible pollution of the ecosystem, and are an important parameter in monitoring the acidity of the soil. At the top of the food chain among the arthropod fauna in the lower layer, tiger beetles (Cicindelidae) and ground beetles (Carabidae) stand out. Tiger beetles are vivid daylight insects with greenish elytra that can be easily spotted as they move swiftly over barren or sparsely vegetated soil. On the other hand, finding ground beetles requires effort because they are nocturnal animals that live among dry leaves and in the surface layers of the soil, which means that we can see them only if we raise a stone or a piece of fallen rotten wood. Among the approximately 30 ground beetle species in the park, the endemic Carabus croaticus and Carabus creutzeri are particularly interesting.







Willow gentian

Under the weight of its rich blossoms, the stems of the willow gentian (*Gentiana asclepiadea*) arch to the ground, forming an interesting circular structure. The willow gentian often inhabits forest edges, and the tips of its stems are often the target of caterpillars of the rare and strictly protected marsh fritillary (*Euphydryas aurinia*), an important Natura 2000 butterfly species, which spend the entire winter in cocoons.

Wood is inhabited by numerous xylophagous insect species. Bark beetles (*Scolytidae*) are particularly noteworthy because of the damage they cause in forests by digging out branched galleries in the wood and beneath the bark. Risnjak National Park is a venue for bark beetle research, especially on the conifer ambrosia beetle (*Xyloterus lineatus*), European hardwood ambrosia beetle (*Xyloterus domesticus*), and European spruce bark beetle (*Ips typographus*).

Among xylophagous species, the numerous longhorn beetles (*Cerambycidae*) are particularly interesting. The rare and endangered rosalia longicorn (*Rosalia alpina*) stands out with its distinctive appearance and the pattern on its body. Apart from this species, which is closely connected to old forest stands with plenty of dead and rotten wood, half-rotten trees are inhabited by another rare beetle: the horned stag beetle (*Sinodendron cylindricum*).





Alpine butterwort

The alpine butterwort (*Pinguicula alpina*) is a carnivorous plant that resides in the mountain zone of Gorski Kotar. It is a relict of flora from the ice ages. The butterwort is characterised by soft fleshy leaves with sticky glands on the upper side. It is the leaves of the alpine butterwort that are a trap for insects. The tiny droplets of mucus from the glands give the impression of a dewy leaf, but they are actually glue for the insects. When an insect lands and sticks to the leaf, the plant increases the secretion of mucus and enzymes and slowly digests the insect, and the "nutrient solution" that occurs is absorbed back into the plant.

The source of the River Kupa is located within Risnjak National Park. Due to its exceptional beauty, it was protected as a hydrological natural monument in 1963. The source lies at an elevation of 321 metres above sea level beneath impressive cliffs, and has the form of a small clear lake of greenish colour. This is a karst spring of the Vauclusian type, the largest of its kind in Croatia. Its waters gush out from the unknown depths of local geological structures and drain from the wider area of Mount Risnjak, which abounds in fissured and karstic limestone sediments into which the abundant water from precipitation plunges. The spring has been studied several times and researchers have reached a depth of 154 metres so far. It was previously believed that the water springs from two separate channels similar to vertical wells. However, recent research has indicated the possibility that at a depth below 65 metres the eastern (large) channel is linked to the western (small) one by means of a steep talus, creating a spacious hall from which one narrower channel extends. The lake is characterised by the fauna of clean montane spring waters, especially numerous invertebrates. It is surrounded by dense woods, and the damp rocks overhanging its surface are covered with a variety of lush mosses. In the crevices of the rocks, there are alpine plants growing which are perhaps remnants of the ice age. These include the alpine butterwort (Pinguicula alpina) and alpine aster (Aster bellidiastrum).

In contrast to these representatives of alpine flora, the rocks on the slopes above the source are partially covered with thermophile forests of European hop-hornbeam (*Ostrya carpinifolia*) with their typical flora, including endemic Kalnik moor grass (*Sesleria tenuifolia* ssp. *kalnikensis*).

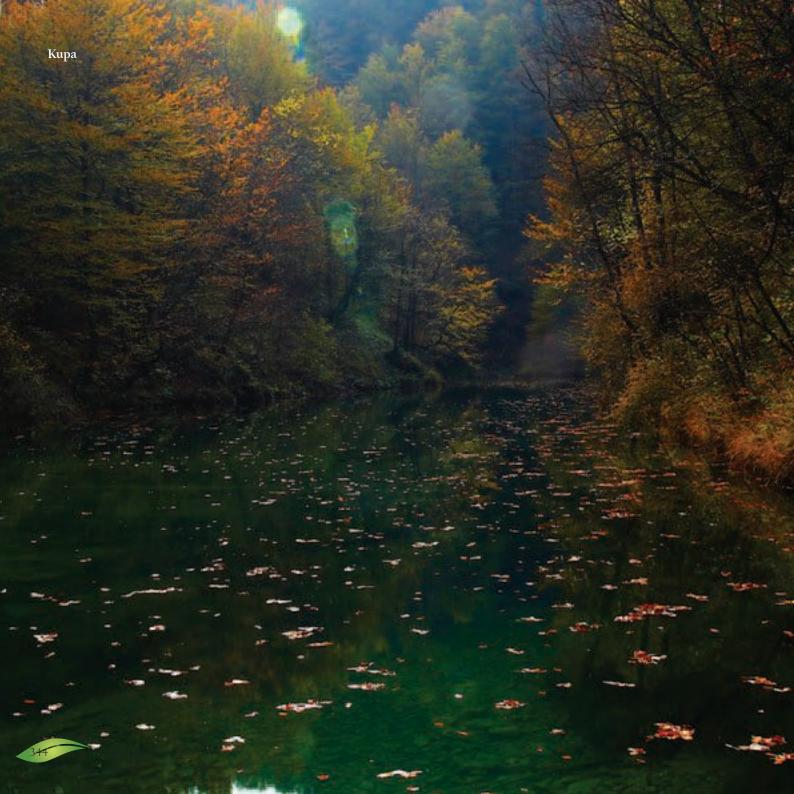
Category of protection: Hydrological natural monument	
Year proclaimed	1963
Area	10 ha
Altitude	321 m
Depth of Vauclusian spring	Researched up to a depth of 154 m
Water temperature	c. 7 °C

SOURCE OF THE RIVER KUPA









The Kupa is the largest river in Gorski Kotar and one of Croatia's most beautiful mountain rivers. It has preserved the high quality of its water up to the present day in a way that very few large rivers in Croatia have. Its valley is characterised by well-preserved nature, interesting wildlife and scenic beauty.

The Kupa emerges from a powerful karst spring beneath the rock of Gavranova Stijena at the foot of the peak of Kupeški Vrh (715 m). After flowing strongly for approximately five kilometres, it receives the small River Čabranka as a left tributary. The upper, very picturesque and well-preserved part of the Kupa Valley up to its confluence with the Čabranka is located within the borders of Risnjak National Park.

Downstream of the villages of Osilnica in Slovenia and Hrvatsko in Croatia, the River Kupa, now joined by the Čabranka, flows through a narrow canyon towards Kuželj. By the river, there are in places small wide flat areas with arable soil that allow the existence of orchards or fields, which are regrettably often neglected. In this part, steep hills and picturesque rocks tower above the river. Their elevation sometimes reaches beyond 1,000 metres above sea level. More rocks are located on the Slovenian side of the border, the rocks of Loška Stena and Kuželjska Stena being particularly picturesque. A notable detail in the part of the canyon between the villages of Gašparci and Kuželj is a small waterfall descending a rock next to the road. It is covered with curled hookmoss (*Cratoneuron commutatum*), around whose tufts there is an accumulation of tufa.

In the vicinity of the villages of Kuželj and Guče Selo, the River Kupa receives two more significant tributaries. These are the attractive mountain streams of Velika Belica and Mala Belica. This part of the Kupa Valley is also very interesting in a botanical sense, as it is inhabited by a rare plant from the bellflower family – the fragrant ladybell (*Adenophora liliifolia*), which chooses damp and shaded places

RIVER KUPA





Natura 2000 site	
Site code	Site name
HR2000642	Кира
Target enecies	

Thick shelled river mussel (*Unio crassus*)

Large copper (Lycaena dispar)

Stone crayfish (Austropotamobius torrentium)

Huchen (Hucho hucho)

Asp (Aspius aspius)

Streber (Zingel streber)

Bullhead (Cottus gobio)

Eurasian beaver (Castor fiber)

Eurasian otter (Lutra lutra)

Vladykov's lamprey (Eudontomyzon vladykovi)

Spined loach (Cobitis elongatoides)

Balkan loach (Cobitis elongata)

Balkan spined loach (Sabanejewia balcanica)

Danube barbel (Barbus balcanicus)

Pontian shemaya (Alburnus sarmaticus)

Danube whitefin gudgeon (Romanogobio vladykovi)

European bitterling (Rhodeus amarus)

Cactus roach (Rutilus virgo)

Kessler's gudgeon (Romanogobio kessleri)

Danubian longbarbel gudgeon (Romanogobio uranoscopus)

Scarce fritillary (Hypodryas maturna)

Jersey tiger (Euplagia quadripunctaria)

Target habitats

Calcareous rocky slopes with chasmophytic vegetation

Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels

Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)

Riparian mixed forest of *Quercus robur*, *Ulmus laevis* and *Ulmus minor*, *Fraxinus excelsior* or *Fraxinus angustifolia* along the great rivers (*Ulmenion minoris*)

Petrifying springs with tufa formation (Cratoneurion)

Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation

Natura 2000 site	
Site code	Site name
HR2001333	River Kupa near Severin
Target species	
Fenton's wood white (Leptidea morsei)	
Site code	Site name
HR2001282	Part of River Kupa
Target species	
Eastern eggar (Eriogaster catax)	
Fenton's wood white (Leptidea morsei)	
Target habitats	
Illyrian Fagus sylvatica forests (Aremonio-Fagion)	
Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)	

on the banks of mountain rivers. The rocks and steep slopes of the canyon are the natural habitats of the Scots pine (*Pinus sylvestris*) and black pine (*Pinus nigra*).

Other frequent species include the European hop hornbeam (Ostrya carpinifolia) and certain thermophilic species, such as the smoke tree (Cotinus coggygria). Its vivid red, purple or yellow-coloured leaves are a beautiful decoration on the steep slopes of the valley in autumn. The rocky slopes are also inhabited by the sub-Mediterranean wintery savory (Satureja montana), and in some places in Gorski Kotar one can find rare autumn moor grass (Sesleria autumnalis), while the endemic Kalnik moor grass (Sesleria teniufolia ssp. kalnikensis) is very frequent on the rocks. The steep sides of the valley are overgrown with a special, somewhat thermophilic type of beech forest. This is a beech and hop hornbeam forest (Ostryo-Fagetum). These trees find the ideal conditions to grow here in the Kupa Valley. Alongside the river, on its banks and sandbanks that are continuously dampened with water, there are thickets and groves of willow (Salix sp. div.) and black alder (Alnus glutinosa), which contribute to





the habitat and wildlife diversity here. The upper part of the Kupa Valley is known as being exceptionally rich in butterflies. 104 species of butterfly have been recorded here, which represents approximately 55% of Croatia's entire butterfly fauna. For this reason, the Kupa Valley is called the 'valley of butterflies'. The endemic subspecies of ringlet butterflies (*Erebia oeme megaspodia* and *Erebia stirius gorana*) are also particularly interesting in this area.

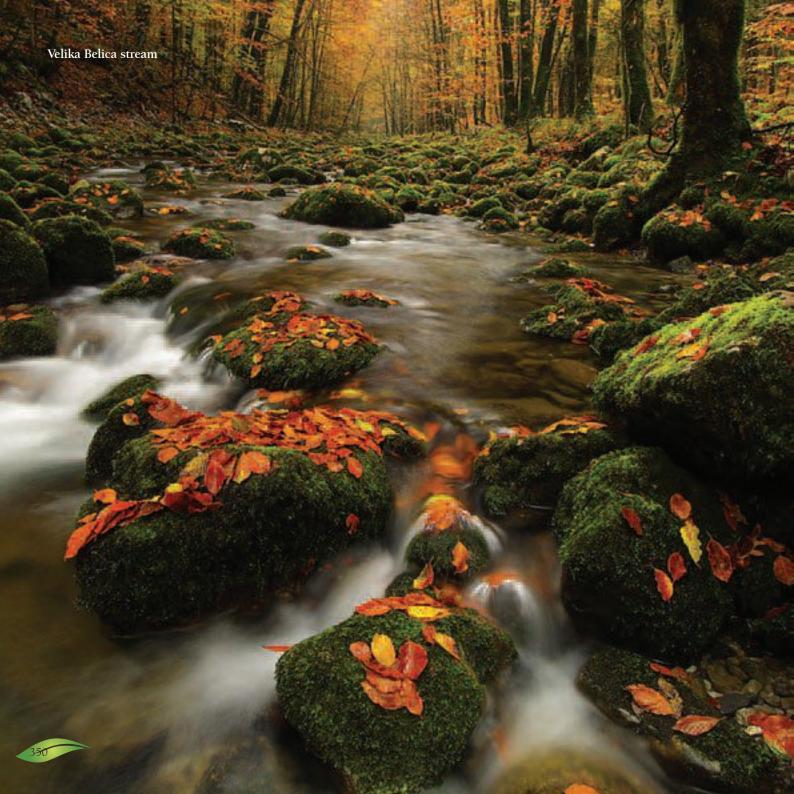
The water courses are home to various aquatic invertebrates, such as snails, oligochaetes, amphipods, caddisflies, mayflies, stoneflies, flies, etc. The banks are important habitats for marsh birds, and are also frequently visited by otters (*Lutra lutra*).

There are also many fish species. The upper reaches of the Kupa and Čabranka are known as salmonid (trout) waters. The area between Gusti Laz and Severin na Kupi is a typical environment of the huchen salmon (*Hucho hucho*). In the waters of the Čabranka and Kupa up to Zdihovo, more than 15 fish species have been recorded. The attractiveness of the Kupa has significantly contributed to the development of water sports, such as angling, rafting, kayaking, and canoeing.

Close to Brod na Kupi, the River Kupa receives a larger tributary in the shape of the River Kupica. The surrounding hills of the valley in the lower course are not as steep, rocky and wild as in the upper reaches, and the valley opens up and becomes gentler. The change is also noticeable with regard to plant life, as certain foreign plants grow along the banks, including some from other continents, most noticeably the cutleaf (*Rudbeckia laciniata*), which has large yellow blossoms similar to small sunflowers, and which is native to North America.

Downstream, the Kupa changes the direction of its flow several times, be it northwards or to the southeast, which is how the Kupa Valley, all the way to the area of Severin, contributes to the constantly changing landscape.





The Velika Belica is one of the most romantic and best preserved streams in Gorski Kotar. Its valley lies nestled at the foot of the steep slopes of Gusti Vrh and Golik. The stream flows into the River Kupa close to the village of Kuželj. Its water course is approximately five kilometres long, although the upper reaches close to the source frequently dry up. The furthest branch of the source, which has no water in the dry part of the year, is located beneath steep cliffs at an elevation of 288 metres. In this period, water emerges a little bit further downstream from several lateral sources. The area around the source of the Velika Belica is a very attractive, wild mountainous landscape, somewhat similar to the neighbouring stream of Mala Belica. However, due to its greater isolation, it is more interesting for nature lovers, as the water springs out from among the scattered boulders and rocks that have fallen from the surrounding cliffs. The part of the stream where it changes its course from south-north to west-east in a narrow valley is particularly interesting. Here, the stream abounds in water all year long. However, it branches out in many places, creating small islands of gravel and sand that are mostly covered with humus and forest vegetation.

The forest gives these alluvial sandbanks a special charm. Beech forest dominates the slopes of the valley of the stream. On the higher parts of the steep slopes of the valley, there is a mixed fir forest, and the sandbanks are distinguished by a special diversity of forest vegetation, including groves of black alder (*Alnus glutinosa*), which are typical of wetlands. Quite surprisingly, there are large pedunculate oaks (*Quercus robur*), as well as firs (*Abies alba*), and a mixture of numerous other tree

Natura 2000 site	
Site code	Site name
HR2001417	Velika Belica
Target habitats	
Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion	
incanae, Salicion albae)	

VELIKA BELICA





and shrub species of a diverse and somewhat uncommon composition. The damp forests on the alluvial deposits are of great importance to naturalists, and as a rare and endangered habitat type of alluvial forest with black alder and common ash (Alno-Padion) they have been included in the EU Habitats Directive, which is why the valley of the Velika Belica stream has been included in the Natura 2000 ecological network. The rocks along the shores of the stream are partly overgrown with dark mosses and slimy cyanobacteria and algae, which gives the landscape a distinctive, even solemn appearance. This is enhanced by the murmuring of the water and the presence of certain fauna. In the clearings along the shore, we can now and then see mayflies (Ephemeroptera) and stoneflies (Plecoptera) as they flutter above the vegetation. Their larvae live in the clear and fast-moving water of the stream. The fauna of the stream is distinguished by numerous other species that typically live in clear mountain waters. Under the stones, there are numerous cases of caddisfly larvae (Trichoptera) made of tiny stones glued together, as well as small aquatic beetles, limpets (Ancylus fluviatilis), and many other aquatic, mostly rheophilic organisms adapted to life in fast and powerful water currents with an abundant oxygen supply.

Several willow species grow here, especially bitter willow (Salix eleagnos), as well as beech (Fagus sylvatica), spruce (Picea abies), maple (Acer campestre and Acer pseudoplatanus), common ash (Fraxinus excelsior), elm (Ulmus sp.), wild pear (Pyrus pyraster), whitebeam (Sorbus aria), hazel (Corylus avellana), Alpine buckthorn (Rhamnus alpinus ssp. fallax), warted and wide-leaved spindle tree (Euonymus verrucosa and Euonymus latifolius), privet (Ligustrum vulgare), wayfarer (Viburnum lantana), guilderrose (Viburnum opulus), hawkthorn (Crataegus sp.), barberry (Berberis sp.), and February daphne (Daphne mezereum). In several places, one can also find the rare and protected European yew (Taxus baccata) and Christmas holly (Ilex aquifolium), although spineless butcher's broom (Ruscus hypoglossum) and spurge laurel (Daphne laureola) are more fre-

quent. Some tree trunks are covered with lush moss turf that reaches almost as high as the tree crowns. The most frequent moss here is *Neckera cirspa*, and one can also find the rare *Lobaria pulmonaria* lichen, which is very sensitive to air pollution. Due to the high level of humidity, some higher plants also grow on the trunks as epiphytes, particularly the common polypody fern (*Polypodium vulgare*) but also certain flowering plants, such as sedge (*Carex sp.*), liverleaf (*Hepatica nobilis*), and other species.

Notable plants in the ground vegetation include Christmas rose (Helleborus niger ssp. macranthus), European wild ginger (Asarum europaeum), ivy-leaved cyclamen (Cyclamen hederifolium), alpine barrenwort (Epimedium alpinum), wolf's bane (Aconitum sp.), widow flower (Knautia drymeia), thistle (Cirsium oleraceum and Cirsium erisithales), nettle-leaved speedwell (Veronica urticifolia), willow gentian (Gentiana asclepiadea), and many other forest species. At the top of the island, there are often large amounts of tree trunks, branches and rotten wood that have been washed ashore, and that in places are also overgrown with mosses and fungi. In the humus layer of the soil, there is a variety of wildlife, whose most significant role is to decompose plant residues. If we lift certain rotten pieces of wood, we will be astonished by the range of woodlice, ground beetles, springtails, centipedes, snails, earthworms, and other tiny organisms.

A visit to the Velika Belica in autumn, when the beech leaves have a dim yellowish-brown hue, is always a special experience. In the air, one can smell a distinctive odour of damp and rotten plant residues, and the butterbur leaves, which also exude a particular smell, point towards the ground, half withered, shrivelled, and torn by the action of precipitation and the torrential waters. Various species of fungi grow in the forest soil, such as milk caps (*Lactarius* sp. div.) and inky caps (*Coprinus* sp. div.) A particular feature in the sandy soil is the small mousepee pinkgill mushroom (*Entoloma incanum*), whose stems have a bright green, almost fluorescent colour.





The sources of the Velika Belica and Mala Belica are abundant but not used for water supply purposes. As a result, they represent a rare hydrological phenomenon of primordial nature and beauty, which gives them their special charm.

The Mala Belica is a short water course that springs up from the bottom of a valley beneath steep and partly rocky slopes in the shape of an amphitheatre. The capacity of the source of the Mala Belica is estimated at 200-250 litres of water per second. It is located at a tectonic contact between Triassic dolomites and water-impermeable Palaeozoic clastic rocks. It has been proven that the course of the Mala Belica is connected to the ponor of Lokvarka and also a ponor in Delnice.

From its source to its confluence with the River Kupa between the villages of Guče Selo and Grbajel, its course is only one and a half kilometres long. On the right-hand side of the Mala Belica, all the way up to its source, in a narrow gully beneath the rocks, there is a passable dirt track. However, this only follows the flow of the Mala Belica in its upper reaches, while further downstream it leads away from the stream past flat, partly marshy ground overgrown with reeds (*Phragmites australis*). In the vicinity of Guče Selo, there are several small lateral springs whose branches cut across the dirt track. Next to these springs, one can find the marsh helleborine (*Epipactis palustris*), an orchid species, and in the water the yellow-bellied toad (*Bombina variegata*).

Natura 2000 site	
Site code	Site name
HR2001257	Mala Belica
Target species	
Nodular ground beetle (Carabus nodulosus)	
Target habitats	
Water courses of plain to montane levels with the Ranunculion fluitantis and	
Callitricho-Batrachion vegetation	

MALA BELICA





It is also interesting to walk along the narrow trail beside the stream which leads from the village of Grbajel along the left bank of the Mala Belica. The left-hand side of the slope of the trail is partly covered with an old planted spruce forest, while the surrounding slopes are all covered with deciduous forest with beech, hop hornbeam and various species of maple as the dominant tree types. In the underbrush layer, the soil is densely covered with alpine barrenwort (*Epimedium alpinum*), wild ginger (*Asarum sp.*), and hellebore (*Helleborus sp.* div.). The protected spurge laurel (*Daphne laureola*) is rather rare here.

The course and banks of the Mala Belica feature a completely different flora. The groves of grey willow (*Salix cinerea*), the large stones in the stream bed, the white sandbars in the deserted branches of the stream, and the tall rocks rising over the stream, give this area an atmosphere reminiscent of the Alps. The sandbars are inhabited by dense turf and carpets of spring heath (*Erica herbacea*), whose primary habitat is on the ledges of the rocks and in the hop hornbeam groves above the valley. There are also dense populations of Velebit cow wheat (*Melampyrum velebiticum*) with yellow and purple bracts. Some of the frequent shrubs include the common barberry (*Berberis vulgaris*), wayfarer (*Viburnum lantana*), smoke tree (*Cotinus coggygria*), alpine buckthorn (*Rhamnus alpinus* ssp. *fallax*), alder buckthorn (*Frangula alnus*), and hazel (*Corylus avellana*). The lower parts of yew trees (*Taxus baccata*) are buried in the sandbars with the bark peeled off on the side facing the powerful torrential waters.

The source is located in a rather bright and raised spot without vegetation, and is surrounded by forest. The bottom of the gully has large boulders. In the source area, these are overgrown mostly with tufts of two moss species. Dark moss grows in places with lots of damp, while the rocks outside the reach of the water are covered with a yellowish-green moss coating. Beneath the rocks, clear water springs up in several places. Above the small pools enclosed by rocks, in the



Cases of caddisfly larvae

Most larvae of the order of caddisflies (*Trichoptera*) build their homes. With silk secreted from their salivary glands they build cone-shaped cases, which consist of tiny stones, pieces of wood, or anything they find.

summer numerous tiny insects of the *Diptera* order whirl around. The shaded and moist spots on the rocks are here and there overgrown with dense tufts of daisy star aster (*Aster bellidiastrum*), a mountain species of the aster family. Around the source, one can also frequently see butterflies from the admiral family (*Limenitis* sp.) and various dragonflies. Below the stones, there are caddisfly larvae (*Trichoptera*). At the foot of the rocks around the source, a large amount of scree material has accumulated. This is composed of small and large whitish debris of Triassic dolomite rocks. The torrential waters have cut deep gullies into these rocks, which in damp places are overgrown with dense tufts of butterbur (*Petasites* sp.). The surrounding slopes are covered with deciduous mixed forest.





At the foot of an impressive, thickly layered carbonate rock that rises 280 metres above the hamlet of Zamost, the compressed and narrow triangular opening of an underground channel emerges. The opening is located at an elevation of 467 metres, while the top of the rock is approximately 600 metres above sea level. During heavy rains, the waters of the Gerovčica stream gush from a rather unusual karst fissure and after a short while flow into the River Čabranka. The dense clusters of aquatic moss attest to the force of this karst spring, even in its upstream part, which occasionally dries out. One such moss is the *Cinclidotus aquaticus*, which indicates the usual level of water in the stream bed.

The animals that resist the strong flow of water (but also certain plants, such as the abovementioned *Cinclidotus aquaticus* moss in the Gerovčica stream) are called rheophilic organisms. Other rheophiles in the Gerovčica stream include flatworms (*Turbellaria*), which crawl beneath the stones protected from the water turbulence. A similar tactic is used by burrower mayfly (*Ephemeridae*) and caddisfly (*Trichoptera*) larvae. The latter choose spots beneath stones and where the water flows more calmly. Here, they build their cases of tiny stones and other material they find.

Caddisflies are particularly common in the Gerovčica stream. When their larvae build their cases, they attach them beneath a large stone.

Natura 2000 site	
Site code	Site name
HR2001227	Gerovčica stream
Target species	
Stone crayfish (Austropotamobius torrentium)	
Site code	Site name
HR2001150	Source of Gerovčica
Target habitats	
Caves not open to the public	

THE GEROVČICA STREAM





Small aquatic snails on a rock

When the source of the Gerovčica is not active, there remains a pond of water in the cave, as a sort of refuge for aquatic wildlife. Aquatic organisms in the pond somehow lay low and wait for more favourable conditions. These include, for example, numerous aquatic snails, among which are the recognizable homes of the *Ancylus fluviatilis*, a limpet whose shell has a backwardly directed, conical apex. The hydrodynamic shape of the shell is the result of adaptation to the quick and powerful water flow.

In this way, the stone becomes part of their home and helps them resist the current and prevents them from being washed away.

Protonemura julia, a rare and endemic species of stonefly whose larvae live in clear streams has also been found in the Gerovčica. This is an alpine species adapted to life in cold waters with a more or less constant temperature, that is, without significant daily or annual fluctuations. This confirmed an earlier assumption that some springs in Gorski Kotar are microrefugia for certain types of organism.

The Gerovčica is the habitat of the endangered stone crayfish (*Austropotamobius torrentium*), which is why it has been included in the Natura 2000 ecological network. In addition, the source of the Gerovčica is also a Natura 2000 site in the category of 'caves not open to the public'.

The Gerovčica is a fast and clear mountain stream that is visited by birds such as the white-throated dipper (*Cinclus cinclus*), which swiftly dives in search of aquatic insects, or the emerald-coloured kingfisher (*Alcedo atthis*), which catches tiny fish in the stream by diving headlong from the branches of bushes and trees.

Next to the stream bed, riparian damp forest vegetation grows. Mosses hang from the branches and trunks of various trees. These are places where different species intertwine: woody and herbaceous species, species adapted to constant shade and moisture, and the completely different thermophilic and heliophilous species. For this reason, we can find woody and bushy species growing together next to the stream bed, such as the beech (Fagus sylvatica), common hornbeam (Carpinus betulus), hop hornbeam (Ostrya carpinifolia), field maple (Acer campestre), sycamore maple (Acer pseudoplatanus), and cornelian cherry (Cornus mas). On the rocks, there are also certain endemic plants, such as Kalnik moor grass (Sesleria tenuifolia ssp. kalnikensis), which makes up a special chasmophytic community.



Scree plant community at the foot of a rock above the source of the Gerovčica

The small scree composed of rough stones beneath the rock of the main source of the Gerovčica is home to a plant community that has not been sufficiently researched yet and which combines elements of vegetation of forests, rock crevices and screes. Some of the species that grow here are the pale corydalis (*Corydalis ochroleuca*), hart's-tongue fern (*Asplenium scolopendrium*), herb-Robert (*Geranium robertianum*), several different species of moss, and other species.





The Debela Lipa-Velika Rebar forest vegetation reserve is located north of Lokve in the hilly region of Debela Rebar. The reserve features two forest communities significant for the Gorski Kotar area. These are beech-fir forest (*Omphalodo-Fagetum*) and fir forest with small reed-grass (*Calamagrostio-Abietetum*), also known as fir forest on calcareous blocks. This forest is widespread only in specific habitats with scattered boulders, and is therefore characterised by a special scenic beauty.

Fir-beech forests grow in the high montane zone, and are economically the most valuable forest community in Gorski Kotar. Lime trees are particularly important in the rocky parts of the reserve, where they thrive.

What makes the forest vegetation in the reserve particularly attractive is its state of preservation. Generally, only sick trees are cut down here, and the reserve also abounds in uprooted dry trees on which rich mycoflora (fungi) thrive, as well as animal species associated with dry and rotting trees.

The underbrush layer of the reserve includes the blue-eyed Mary (*Omphalodes verna*), a species important for fir-beech forests in karst areas. It blooms very early in the spring, before beech trees have fully developed leaves. The forest community (*Omphalodo-Fagetum*) also takes its name from this plant.

Fir-beech forest develops at elevations between 700 and 1,000 metres in moderately warm rainy climates. Other interesting species

Category of protection: Forest vegetation special reserve		
Year proclaimed	1964	
Area	179 ha	
Location	Town of Delnice and Municipality of Lokve	
Highest altitude	959 m	

DEBELA LIPA-VELIKA REBAR





Linden scarlet cup fungus

In spring we encounter very different types of mushrooms. Among the noticeable spring mushrooms, the linden scarlet cup fungus (*Sarcoscypha jurana*) stands out with its bright red colour. Its fruiting bodies are developed exclusively on fallen rotting linden branches, and can be noticed immediately after the snow has melted away. They resemble a cup, hence the name 'cup fungus'.





Bear's head mushroom

Numerous dry trees are the habitat of the rare bear's head mushroom (*Hericium flagellum*) mushroom, which grows on the rotting trunks of fir, especially those inhabited by insects that feed on rotting wood. The large fruiting bodies of the mushrooms can often be seen as they emerge from cavities in the trunk that were made by woodpeckers looking for insects. The mushrooms are easily recognizable because of their creamy white colour and thick spines drooping towards the ground. The unusual fruiting bodies of this strictly protected mushroom species are most often seen in autumn.





that grow here are, for example, the Alpine buckthorn (*Rhamnus alpinus* ssp. *fallax*), hacquetia (*Hacquetia epipactis*), European scopolia (*Scopolia carniolica*), bitter-cress (*Dentaria* sp. div.), Solomon's seal (*Polygonatum* sp.), and many others. The wealth of lignicolous (living on or in wood) fungi species and xylophagous (feeding on wood) invertebrates is associated with fallen, dried-out trees that slowly decay and turn into humus.

An important forest community grows in the smaller south-facing areas on very rocky terrain with huge calcareous blocks. This is fir forest with small reed-grass. However, this occupies only a small area within the reserve. The rocks are covered with moss and fern, and comb moss (*Ctenidium molluscum*) grows close to the rocks. In some places, the hart's tongue fern (*Asplenium scolopendrium*) is very widespread.

Forest reserves such as Debela Lipa-Velika Rebar aim to preserve biodiversity and allow visitors to experience the primordial beauty of unspoilt forests. Of course, reserves also have a scientific purpose, which is primarily for forestry and biological research.

It should be noted that in most of the reserve there are no logging trails. This is today a rarity that significantly contributes to the natural quality of the forest, because forest roads and logging trails facilitate the growth of invasive species and weeds. It is this natural quality and the well-preserved forest stands that make the Debela Lipa-Velika Rebar forest reserve so biologically valuable.



Hart's-tongue fern with visible sori

Sori (spore producing structures on fern leaves) are located on the underside of the leaves. In the hart's-tongue fern (*Asplenium scolopendrium*), the sori pattern is reminiscent of a centipede, which explains the scientific name of this species, the word *scolopendrium* being Latin for centipede.





Wooden sculpture on the meadow in Golubinjak

Golubinjak is an attractive destination for nature lovers of all ages. In the northern part of the plain, alongside the forest park, there is a meadow surrounded by a flat walking path. The spacious meadow features an exhibition of wooden sculptures and an open-air sculpture studio. At the edge of the meadow there is a restaurant and a children's playground, which is why Golubinjak is often visited by families with small children. For visitors seeking an active vacation, in addition to the well-maintained walking trails through the forest-park, there is a climbing route on a monolith rock at whose foot lies Golubinja Pećina (Pigeon Cave).

golubinjak, a wooded area of exceptional beauty, is located approximately one kilometre to the east of the centre of Lokve, below the railway station. A forest of old firs and spruces covers the steep, jagged and indented rocks that rise at the edge of a small field. This plateau is a natural continuation of the plain of Lokvarsko Polje from which surplus water from the Lokvarka stream probably overflowed and disappeared underneath the rocks. The young spruce forest planted on a portion of the field is the remainder of the cultivation of spruce seedlings in a forest nursery that was once located in this area. The northern part of the field is a picturesque meadow.

Forest and rocks are the basic natural phenomena of Golubinjak Forest Park. The forest communities belong mostly to two different plant associations. In the rocky part, fir forest with small reed-grass (*Calamagrostio-Abietetum*) has developed, in which spruces (*Calamagrostio-Abietetum piceetosum*) are also abundant, whilst on terrain with fewer rocks and more soil there is typical fir-beech forest (*Omphalodo-Fagetum*).

Category of protection: Forest park			
Year proclaimed	1961		
Area	51 ha		
Location	Municipality of Lokve		
Altitude	c. 730 – 800 m		
Natura 2000 site			
Site code	Site name		
HR2001430	Golubinjak		
Target species			
Buxbaumia bug moss (Buxbaumia viridis)			
Slenderneck cave beetle (Leptodirus hochenwarti)			
Target habitats			
Caves not open to the public			

GOLUBINJAK





Fir and spruce forest on calcareous rocks differs from fir and beech forest in having denser underbrush. It is generally greener and lighter, with numerous little bushes of blueberry (*Vaccinium myrtillus*), sweetberry honeysuckle (*Lonicera caerulea*), alpine rose (*Rosa pendulina*), and alpine clematis (*Clematis alpina*), as well as small reed-grass (*Calamagrostis* sp.).

Among the rocks and in the forest, numerous sinkholes can be found with luxuriant ferns and tall herbs growing at their bottoms. The most noticeable community in such habitats is that with heart-leaf oxeye (*Telekietum speciosae*), a composite flower with large yellow blossoms similar to small sunflowers. The rare ostrich fern (*Matteucia struthiopteris*) has also been found in one of the sinkholes.

The area at the foot of the rocks is full of fissures and fallen boulders, around which cold air circulates, which makes these micro-sites frost areas where cold air can be felt even on the hottest days in summer. Such areas are covered with specific plant life with lots of mosses and ferns. As far as blooming plants are concerned, we can find certain species that are not present in the surrounding terrain, such as enchanter's nightshade (Circaea alpina), forest colt's foot (Homogyne sylvestris), wood stitchwort (Stellaria nemorum), Austrian leopard's bane (Doronicum austriacum), and others. The rocks are covered with a specific community of Moehringio-Corydaletum with mossy sandwort (Moehringia muscosa), pale corydalis (Corydalis ochroleuca), and bluebells (Campanula sp.) As far as mosses are concerned, many rocks are covered with lush layers of Neckera crispa.

The animal world includes numerous forest species, for example the edible dormouse (*Glis glis*), the squirrel (*Sciurus vulgaris*), and many forest birds, butterflies, ground beetles, spiders and other invertebrates.





Stone gate in Golubinjak forest park

Golubinjak forest has long been popular as an excursion destination among the inhabitants of Lokve. However, due to the proximity of the railway station and the highway, the area is now also frequented by tourists from a much wider area. A network of walking paths leads through the maze of rocks to some particularly interesting sites, including numerous karst phenomena, such as the Golubinja Pećina (Pigeon Cave) and Ledena Špilja (Ice Cave), a natural stone gate, and a vantage point on an isolated rock, to mention just a few.







The relatively large and ecologically diverse area of Lokve-Sunger-Fužine is located in the southwest of Gorski Kotar. Its northern part borders Risnjak National Park, and stretches from Crni Lug via Mrzlovodički Zelin and Lokve to Sunger and Fužine. This mountainous area is particularly interesting because of its four lakes: Lake Lokve, Lake Bajer, Lake Lepenica and Lake Potkoš near Fužine.

The Natura 2000 ecological network in the Lokve-Sunger-Fužine area encompasses numerous habitat types, plants and animals. There are two habitat types poor in nutrients that are particularly interesting: freshwater habitats with oligotrophic waters and European dry heaths. Due to the large amount of water here, this area is important for the conservation of two Natura 2000 amphibian species: the Italian crested newt (*Triturus carnifex*) and the yellow-bellied toad (*Bombina variegata*). The area lies on substrate made

Natura 2000 site		
Site code	Site name	
HR2001353	Lokve-Sunger-Fužine	
Target species		
Large copper (Lycaena dispar)		
Marsh fritillary (Euphydryas aurinia)		
Italian crested newt (Triturus carnifex)		
Yellow-bellied toad (Bombina variegata)		
Carniolan spike sedge (Eleocharis carniolica)		
Slenderneck cave beetle (Leptodirus hochenwarti)		
Target habitats		
Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoëto-Nanojuncetea		
Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.		
Caves not open to the public		
European dry heaths		

LOKVE-SUNGER-FUŽINE





mainly of dolomite and limestone, which is why it abounds in caves and other underground karst formations. The ecological network includes the protection of important caves, such as Bukovac Cave and Špilja Cave near the playground in Lokve, which are habitats of rare underground organisms.

All four lakes in this area were artificially created. Lake Lokve is particularly interesting, as it was created by damming the small Lokvarka stream in 1955 to supply the Nikola Tesla hydroelectric power plant in Tribalj. In this way, the waters that naturally belong to the Black Sea basin and which in the past plunged through the ponors of Lokvarka towards the valley of the River Kupa have now been redirected into the Adriatic Basin.

The lakes are characterised by significant and frequent changes in water level. Such drastic changes in the living conditions in the riparian zone represent extreme conditions in which a riparian vegetation belt cannot develop. However, in the upper, marshy part of Lake Bajer, interesting marsh plant stands have formed, primarily large marsh sedge (*Carex* sp. div.), marsh marigold (*Caltha palustris*), and many other rare species typical of damp and marshy habitats. Attractive stands of black alder (*Alnus glutinosa*) grow alongside the marshy water courses that flow into the lake. The lakes are occasionally visited by birds, and aquatic macrophytes thrive in the water.

In the past, the valleys where the lakes are now featured numerous bogs with rare round-leaved sundew (*Drosera rotundifolia*), a plant that feeds on insects. On the vegetation chart of Ivo Horvat, which was drawn up in 1963, this area had 28 bog areas with sundew. The artificial lakes flooded almost all of them. Only one remnant of a bog next to Lake Lepenica remained. However, due to the changes in its habitat, the sundew became extinct in this area.

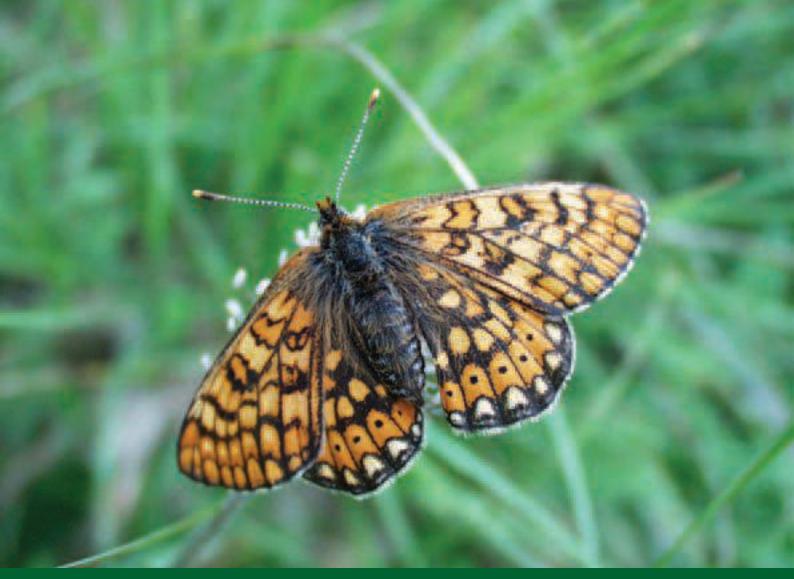


Italian crested newt

The Italian crested Newt (Triturus carnifex) is a nocturnal animal. It spends a part of its life cycle in ponds, and another part on the solid grounds of grasslands or forests. When on land, it spends the day hiding under bark and in cracks, and at night it hunts small animals. Along with the alpine newt and alpine salamander, the Italian crested newt is found in high mountain areas. In Gorski Kotar and in the mountains in the hinterland of Rijeka, it can be encountered at altitudes below and above 1,000 metres. In the areas around Fužine and Sunger, it can often be seen in intermittent highland ponds and streams, which in the summer retain small pools of water.







Marsh fritillary on a highland meadow near Crni Lug

Although the overall distribution area of the marsh fritillary (*Euphydryas aurinia*) is quite wide, covering most of Europe, some mountains in Morocco and Algeria, Turkey, Asia regions with a temperate climate, and the Korean peninsula, in Europe it is highly endangered due to the reduction and loss of suitable habitats. The marsh fritillary lives in Croatia in humid wetlands as well as dry flower meadows. The species is interesting because of the way the caterpillars spend the winter in a silky protective cocoon wrapped around a plant that provides nourishment. The caterpillar's black colour absorbs the sun rays in the spring, which effectively raises its body temperature to well above the temperature of environment necessary for the caterpillar's development. This allows the rapid growth and development of the caterpillars, at a time of year when other types of poikilothermic organisms, i.e. those which depend on the outside temperature, are not yet, or are barely, active.





Northwest of the village of Sunger, at an elevation of 780 metres above sea level, there grows a rather specific coniferous forest called Sungerski Lug. It features numerous small depressions similar to sinkholes, of which some are typical examples of small transition bogs. The depressions are often flooded in springtime, while in the summer the water mostly dries up. However, the spongy peat moss (*Sphagnum* sp.) which grows in such depressions absorbs significant quantities of water. In this way, this habitat continuously retains moisture.

The forests that grow here are acidophilus. In terms of their botanical classification, they are fir forests with hard fern (*Blechno-Abietetum*). A dark coniferous forest with fir and spruce as the predominant tree species almost completely overshadows the surfaces of the botanically interesting depressions with small bogs. One such damp depression in the forest is Sunger Bog (Sungerski Cret), which is important because the rare marsh calla (*Calla palustris*) plant was found here on the surface of peat moss.

Marsh calla belongs to the arum family (*Araceae*). It is a boreal relict, which means that it was much more widespread during the last glaciation. Its population in Sungerski Lug is the only remaining one in Croatia that we know about. The species is mostly found in Central and North Europe, which means that here it is located at the southern border of its distribution, and is in the process of becoming extinct. The reasons for this are the long periods of relatively dry years, the overall change in climate, and damp forest depressions becoming overgrown.

The only remaining refuge of this plant in Sungerski Lug is a metredeep forest sinkhole with an area of approximately 0.5 hectares characterised by an acidic soil and long periods of retaining snow and water after precipitation.





In Gorski Kotar, south of Fužine, there is the spacious plateau of Lič Polje. The village of Lič stretches along the western part of the plateau, while above it the area of Zvirjak rises, the slopes of which are covered predominantly with stands of Dinaric beech and fir forest (*Omphalodo-Fagetum*). Above the eastern part of the plateau, in an area called Rudine, there are several hills: Kravarski Vrh (1,019 m) and Mala Viševica (1,058 m) on the eastern side, and Zapadak (960 m) and Gradina (798 m) in the northeast. The slopes of the hills are becoming overgrown with forest communities of moor grass and hop hornbeam (*Seslerio autumnalis-Ostryetum*) and also moor grass and beech (*Seslerio autumnalis-Fagetum*).

The Lič Polje plateau encompasses pastures and meadows and, to a lesser extent, arable land. With regard to habitat types, Lič Polje can be divided into two areas: the western part, in which *Molinio-Arrhenatheretea* damp grassland habitats dominate, and the eastern part with *Festuco-Brometea* dry grassland communities. The banks of the Ličanka stream are in places overgrown with picturesque damp groves of black alder (*Alnus glutinosa*) that are rich in varied ground vegetation. This is most remarkable in the spring when the yellow blossoms of marsh marigold (*Caltha palustris*) are in bloom. The wider area along the stream is distinguished by a backdrop of groves of silver birch (*Betula pendula*), among which there are pastures and meadows.

Natura 2000 site		
Site code	Site name	
HR2001042	Lič Polje	
Target habitats		
Juniperus communis formations on heaths or calcareous grasslands		
Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco Brometalia) (important orchid sites)		
Molinia meadows on calcareous, peaty or clavey-silt-laden soils (Molinion caeruleae)		

LIČ POLJE



Burnt orchid

On the warm, sunny meadows of the plain of Lič Polje, there are large populations of two types of orchids, the burnt orchid (*Orchis ustulata*), which has smaller flowers, and the early-purple orchid (*Orchis mascula*), whose handsome appearance adds to the attractiveness of colourful meadows in bloom.





Tachina flies

Tachina flies (*Tachinidae*) are distinguished by the hair bristles on their bodies. Their larvae are parasites on other insects and are therefore very important in controlling the number of insects in nature. They are especially useful in agriculture as they attack harmful insects. Tachina flies of the genus *Linnaemya*, like the one pictured, gladly sit on the blossoms of the plants from the Apiaceae family in search of the nectar which these plants secret from their glands.





Lič Polje has several interesting small lakes, which are mainly stocked with tench (*Tinca tinca*). One of the largest of these lakes is Lake Marasovo, which is considered to be the last remnant of a former marshy area or larger lake that was present in Lič Polje in earlier geological periods. The waters of the Ličanka basin are today mostly used for supplying the Lake Bajer and Lake Potkoš reservoirs. This is why the natural ponors of the Ličanka have mostly dried up.

The grasslands in Lič Polje are of exceptional natural importance. Because of this, this area was included in the Natura 2000 ecological network. Here, we encounter stands of Central European meadows of moor grass (*Molinia*), a rare community that grows on only several sites in Croatia.

In addition to its interesting plant diversity, Lič Polje is inhabited by numerous insect species. Its aquatic habitats are also suitable for several amphibian species, such as the yellow-bellied toad (*Bombina variegata*). The meadows and pastures of Lič Polje are among the most important sites in Primorje-Gorski Kotar County for the corn crake (*Crex crex*), a Natura 2000 bird species.

The corn crake (*Crex crex*) is a shy bird of the rail family (*Rallidae*) that lives on the ground. It inhabits hay meadows and pastures with large amounts of herbaceous plants that are more than 30 cm tall. These provide shelter and enable it to move undisturbed and without being noticed. Due to its secluded way of life, the corn crake is difficult to see, but its specific *krek krek* call indicates its presence. This is a bird whose survival largely depends on humans, as it has been significantly endangered due to the abandonment of traditional forms of raising livestock and inappropriate ways of mowing.





The basic natural phenomenon of Japlenški Vrh Forest Park is its firbeech forest, known in botany as *Omphalodo-Fagetum*. The name comes from an important spring plant with beautiful blue flowers called the blue-eyed Mary (*Omphalodes verna*). This forest type is exceptionally rich in species, much more so than similar forest community types in Europe.

The layer of trees in this community at Japlenški Vrh includes beech, fir and sycamore maple, while the shrub layer includes fly honeysuckle (*Lonicera xylosteum*), Alpine buckthorn (*Rhamnus alpinus ssp. fallax*), February daphne (*Daphne mezereum*), and spurge laurel (*Daphne laureola*).

The layer of ground vegetation is characterised by many endemic and relict species, such as the abovementioned blue-eyed Mary, balm-leaved red archangel (*Lamium orvala*), hacquetia (*Hacquetia epipactis*), European scopolia (*Scopolia carniolica*), and many others.

The area of Japlenški Vrh Forest Park is occasionally visited by bears. If you walk in silence, you will often have the opportunity to encounter roe deer, whose favourite habitats are here (at *Lovački Dom*, there's also a small zoo with fallow deer – *Dama dama*).

Children will love the sight of squirrels. Unlike the dormouse, which is also quite common in this area, the squirrel is mostly active during the day.

Category of protection: Forest park		
Year proclaimed	1953	
Area	171 ha	
Location	Town of Delnice	
Altitude	750-842 m	

JAPLENŠKI VRH





When walking in the forest park, we can spot certain birds or at least hear their calls. These include several species of the tit family, the black woodpecker and other woodpeckers, the jay, blackbird, robin, nuthatch, wren, and other species.

The variety of mushrooms is also very interesting, and the area's numerous, branching trails that are connected to the urban area of Delnice provide plenty of opportunities to enjoy nature and relax.

Limestone and dolomite are the most important and common carbonate rocks in Croatian karst areas, and the massif of Japlenški Vrh is no exception. Rainwater dissolves these rocks, which causes the formation of pronounced karst phenomena on the carbonate geological substrate.

The most common and most pronounced karst phenomena in Japlenški Vrh Forest Park are karst sinkholes or dolines. On some slopes, we can find plenty of small limestone forest rocks protruding from the soil. They are covered with thick layers of moss, the most common being comb moss (*Ctenidium molluscum*). Mosses and lichens made possible the initial amounts of humus to accumulate on the rocky substrate.

In the past, local limestone was used to burn lime in limekilns, which are called *japnenice* in the local dialect. This is where the name Japlenški Vrh comes from.

Even small differences in the geological substrate and type of soil, such as the occurrence of interlayers of dolomite in the limestone, can lead to changes in the local flora and fauna. For example, on the dolomite bedrock of Japlenški Vrh we can find populations of Christmas rose (Helleborus niger), liverleaf (Hepatica nobilis) or hacquetia (Hacquetia epipactis), which are very rare or even completely absent on limestone. On the other hand, on limestone

we can typically find the relatively rare European scopolia (*Scopolia carniolica*), which grows mostly in rocky habitats on the slopes of sinkholes.

The fir-beech forests are inhabited by numerous xylophagous insects (species feeding on wood). Bark beetles are particularly noteworthy because of the damage they cause in forests. Their branched galleries can be seen if we lift up the bark of a dry tree. We can tell the individual bark beetle species by the shape of the galleries they dig in the wood and beneath the bark. In fact, each bark beetle species chooses a specific type of wood, which is why we differentiate between the fir bark beetle, spruce bark beetle, elm bark beetle, and so on.

After the disastrous ice that struck Gorski Kotar in early February 2014, many treetops and entire fir, beech and other trees in Japlenški Vrh Forest Park were destroyed. Because of the great risk of bark beetles and other forest parasites spreading to other areas, many trees that were destroyed were removed from the forest.

Nevertheless, many felled trees remained lying on the ground. Such disasters in forests can sometimes be beneficial for another important group of insects whose larvae feed on dead wood: longhorn beetles (*Cerambycidae*). Their distinctive features are their long antennae and the ability to emit particular sounds.

In Japlenški Vrh, longhorn beetles have a variety of shapes, which can be related to the abundance of decayed wood in the forest. Adult beetles can sometimes be seen in large numbers on the blossoms of large plants from the *Apiaceae* family such as wild angelica (*Angelica sylvestris*), whose small populations grow on the edges of forests and in forest clearings that are becoming overgrown.









In the vicinity of Skrad, there are two natural phenomena that together form the Vrajži Prolaz and Zeleni Vir protected landscape. The area was protected in 1962 as a result of its extraordinary scenic beauty and geological importance. In addition, the first hydroelectric power plant in Gorski Kotar, *Munjara*, is also located here.

Vrajži Prolaz (the Devil's Passage) is the name of one of the most attractive canyons in Gorski Kotar. In literature and documents, we can often find the official Croatian spelling *Vražji*, but local people use the dialectal version: *Vrajži prolaz*.

The 800-metre-long canyon, which in places is only two metres wide, is the result of the action of the water that for thousands of years has cut into the stone and carved this unusual passage. The Jasle stream flows through the canyon; this is also the name of a nearby forest. In the canyon, there is a walkway that in places has been cut into the rock above the stream, and which in others is made of bricks and steps.

The entire gorge is in deep shadow, and only the tops of the rocks are in the sun. A series of small streams gushes down these cliffs. In

Category of protection: Protected landscape			
Year proclaimed	1962		
Area	200 ha		
Location	Municipality of Skrad		
Altitude	302-650 m		
Natura 2000 site			
Site code	Site name		
HR2001345	Vražji Prolaz and Zeleni Vir		
Target habitats			
Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels			
Tilio-Acerion forest of slopes, screes and ravines			

VRAJŽI PROLAZ AND ZELENI VIR





extremely cold weather, they freeze and make impressive ice waterfalls. In this narrow passage, the gentle murmur of water turns into a deafening roar. In years when there is lot of snow, the canyon is often impassable as large quantities of snow fall down the cliffs onto the walkway, which in such conditions cannot be seen under the snow cover.

The damp rocks are overgrown with a specific flora. The rare insectivorous alpine butterwort (*Pinguicula alpina*) and alpine aster (*Aster bellidiastrum*) grow here, as well as numerous other flowering plants, ferns, and various mosses adapted to life in shaded and moist places. The communities in such habitats are probably remnants of former colder periods, or glacial relicts. The stream and its immediate surroundings are inhabited by fauna typical of clear waters, including species such as the fire salamander (*Salamandra salamandra*), grass snake (*Natrix natrix*), and numerous tiny invertebrates.

At the end of Vrajži Prolaz, 14 metres above the Jasle stream, there is an opening in the rock. This is the entrance to Muževa Hišica Cave. The cave is approximately two hundred metres long, and at its end there is a hall with a small lake. Different authors state that the remains of ancient crockery and several boats were found in this cave. It is assumed that the inhabitants of Skrad and its surroundings used to hide here during Turkish invasions. There is even a claim that the proteus (olm) salamander was found in the cave, although this has not been scientifically confirmed. However, strictly protected horseshoe bat species overwinter here. These must not be disturbed during visits to the cave.

Another natural phenomenon in the protected landscape is Zeleni Vir (the Green Spring). An impressive 70-metre-high rock that rises between two wooded slopes hides a cave with a spring. The rock itself is an interesting geological phenomenon, as it is an overfold of





Mesozoic sediments. Two streams tumble down from the top of the rock. One soon disappears into a fissure, while the other gushes down as a waterfall that cascades in front of the opening of a cave with a small lake and empties into the Curak stream, which emerges here.

Inside the cave, there is a small lake of an emerald-green colour with crystal clear, calm water. The spring is called Zeleni Vir. It is located at the bottom of the cave and cannot be seen. The lake is enclosed by an artificial concrete wall and its water supplies the nearby small hydroelectric *Munjara* power plant. Downstream of the *Munjara* plant, the Curak and Jasle streams join and flow towards the village of Iševnica, where they flow into the River Kupica.

At the point where the two walkways start towards Zeleni Vir and Vrajži Prolaz, there is the small hydroelectric *Munjara* power plant. It was built back in 1921 and was put into operation the following year. Today, after more than 90 years, it is still functioning and is considered a monument of technical culture. The original machines are still used to produce electricity.

The famous Croatian naturalist Dragutin Hirc mentioned this area in his works:

He asked us where we were would like to go the following day and I told him: 'You know what sir? Take us to a place of wild and silent romanticism; a place where we can admire nature in awe.'

After a short break, Mr J. smiled at us and replied: 'Ok, if you gentlemen want to see something awesome, then let's go tomorrow morning to Zeleni Vir.' 'Very well, to Zeleni Vir!', we exclaimed and raised our glasses to our excursion.'

Gorski kotar (1898)





Chamois

Herds of chamois (*Rupicapra rupicapra*) are also frequent inhabitants of these regions. In the winter, when there are not many visitors, they can be observed on the slopes around the stream of Iševnica. Their tracks in the snow can often be seen in Vrajži Prolaz. A visit to this area requires special caution because chamois sometimes cause stones to fall while climbing the steep slopes.





The 'Forest around Skrad' Natura 2000 site is located in the northwestern part of Gorski Kotar, in the area that stretches from Skrad towards Brod Moravice. It encompasses the glades of the surrounding hills and the wooded areas next to the villages of Gorica Skradska, Goran, Mala Dobra and Gramalj. This site is distinguished by its well-preserved natural stands of acidophilic beech forests that belong to the beech and woodrush (*Luzulo-Fagetum*) forest community. It is a Natura 2000 habitat, and also one of the most widespread forest types in Central Europe. In this community, the dominant tree species is beech (*Fagus sylvatica*), which, depending on the elevation, can be joined by other species, such as fir (*Abies alba*) and spruce (*Picea abies*).

The appearance of the wooded areas near Skrad to a great extent depends on the structure of the geological substrate on which they have developed. On carbonate bedrock, comprising soluble dolomite and limestone, the most prominent are thermophilic hop hornbeam (Ostrya carpinifolia) forests, while silicate bedrock favours acidophilic forests (those that grow in acidic soils), such as the beech and woodrush forest community. On soluble carbonate bedrock, streams of water have dug out narrow canyon passages with cliffs and overhanging rocks above the stream bed. A good example of this is the deep and narrow canyon of Vrajži Prolaz not far from Skrad. On silicate bedrock, which is water impermeable,

Natura 2000 site		
Site code	Site name	
HR2001413	Forests around Skrad	
Target habitats		
Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels		
Luzulo-Fagetum beech forests		

FORESTS AROUND SKRAD



flowing water has formed deep gullies with wooded slopes, and also ridges stretching between and parallel with the gullies.

The ridges usually feature young forests with bracken fern (*Pteridium aquilinum*) and many heliophilous shrubs (that need a large amount of sunlight), such as hazel (*Corylus avellana*). On the steep slopes of the gullies in the forests, the high shrub layer is completely missing. The forest is closed and has less light, but has a well-developed lower layer of small shrubs of common blueberry (*Vaccinium myrtillus*) and a ground layer of mosses.

Uprooted trees have particularly important biological and landscape functions in beech forests with woodrush. Tree uprooting is a geomorphological process that takes place on steeper terrains. A tree can be uprooted by the force of the wind or due to the weight of snow and ice. Both of these tend to occur in winter. In most cases, the soil is already sodden from precipitation, which is why the roots of the trees cannot support the weight of a crown covered with wet snow or branches burdened with heavy ice.

Some of these trees may have been uprooted recently and are still relatively fresh with bark on the trunk and green leaves on the branches, but there are also those whose trunks have almost completely disintegrated and decayed. When uprooted, the roots of the tree pull up a lot of soil and rock material with them and form a mound and hollow. Such micro-relief formations can remain visible long after the tree has been uprooted and before other geomorphological processes flatten them over several decades.

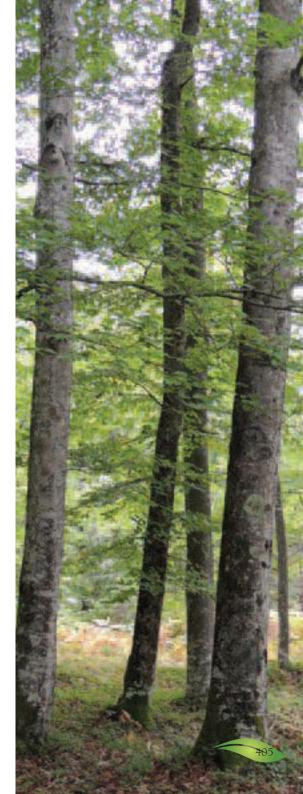
In this way, uprooted trees play a certain role in forming the terrain, but they also provide new substrates for the colonisation of microorganisms, plants, animals, lichens and mushrooms. Thus, uprooted trees constantly create new microhabitats in the forest.

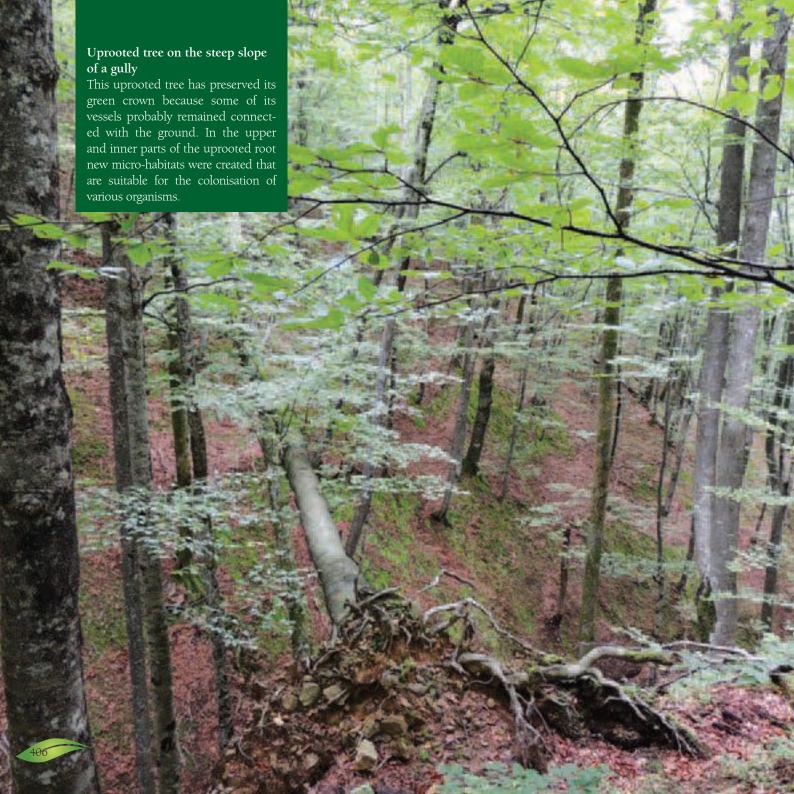


Lichen

The remnants of an uprooted tree located on a steep slope near Gorica Skradska, which has already almost rotted and disappeared, are covered with a greyish-green lichen. On the surface of the powdery, granulated thallus, the lichen has formed small growths, like small, irregular rounded heads, distinctly pink in colour, atop short whitish stalks. Probably it is the rare type of lichen (in Croatia), *Baeomyces Rufus*, which is strictly protected, and in the area of Gorski Kotar has only ever been found in Fužine, and around Sokol in the area of Čabar.

In forests that are not intensively managed, like the abovementioned stands on the steep, inaccessible gullies around Skrad, over time many trees become uprooted or dry up, get eaten away by insects and fungi, and drilled out by birds. Their remains then return to the soil, which rounds off the life cycle of the forest, which typically includes the following phases: young forest, mature forest, overmature forest in which ancient trees prevail, uprooted trees, and finally dead and decaying wood.







Crown coral fungus

The fruiting body of the unusual and easily recognizable crown coral fungus (*Artomyces pyxidatus*) grows out of cracks in the rotten beech tree trunk, which lies uprooted on a steep slope of a mountain stream gully. The disintegration of the trunk, however, does not occur uniformly, because, as seen in the photograph, part of the trunk is attacked by black rot (dark upper part of the trunk), while on the side of the trunk there is still a well-preserved structure of barkless wood (greyish part of the trunk). The coral-like fruiting bodies of crown coral fungus grow out of the crack right on the border of the two structures.





Mededi is a hamlet consisting of just a few houses in a pleasant sunny location above the village of Vučinići close to Moravice. An old yew (*Taxus baccata*) grows here which was protected as a natural monument in 1965. The tree grows next to the road beside an orchard in richly fertilised soil, which can be seen from the amount of nettles that grow beneath its crown. The top of the yew and some of its branches have dried up for some unknown reason. In the year when it was protected, the tree was 15 metres high and 2.5 metres in circumference. Apart from this yew, there are also interesting old pear trees in the nearby orchards in Mededi.

The yew is a dioecious plant, which means there are male and female specimens. The yew in Mededi is a female one that bears abundant seeds surrounded by a fleshy reddish scale known as an aril. The arils are eaten by birds, which in this way spread the seeds. It is this juicy fruit that distinguishes the yew from most other conifers, whose fruits are usually woody cones. All the parts of the yew tree, except the red aril, are very poisonous for humans and animals, because they contain the toxic alkaloid taxine.

The yew grows slowly and can reach a significant age. One of the secrets of its longevity is the fact that the tree, if any of its parts are broken, is only rarely attacked by disease. Even the occurrence of rot on the tree is not as dangerous for the yew as for other conifers. The popularity and quality of its wood, over-exploitation and slow growth are the reasons why the yew is disappearing from its natural habitats. Because of this, the yew has been included on the list of strictly protected species.

Individual tree specimen protected as a natural monument		
Year proclaimed	1965	
Tree species	Yew (Taxus baccata)	
Location	Town of Vrbovsko	
Altitude	c. 615 m	

THE OLD YEW IN MEĐEDI





The entire course of the River Kupica and its tributary the Curak stream are unspoiled jewels of Gorski Kotar that cascade through the gorges and wooded areas. Because of the wildlife living in their waters and the nearby surroundings, this area has been included in the Natura 2000 ecological network.

The fish species that live here make these water courses particularly important. The high quality of the water, the variety of habitats, and the wealth of aquatic invertebrates provide the conditions for indigenous populations of fish species that are increasingly under threat in Europe today. These are above all the grayling (*Thymallus thymallus*), brown trout (*Salmo trutta* m. *fario*), bullhead (*Cottus gobio*), southern barbel (*Barbus meridionalis*), minnow (*Phoxinus phoxinus*), and schneider (*Alburnoides bipunctatus*). Indigenous populations of these fish species contain unique genetic material that is worth preserving and protecting.

A large part of this area is also a water protection area that is accessible only on foot, as the road that leads here is closed off by a

Natura 2000 site		
Site code	Site name	
HR2001351	Area around the Kupica	
	Target species	
Stone crayfish (Austropotamobius torrentium)		
Rosalia longicorn (Rosalia alpina)		
Bullhead (Cottus gobio)		
Huchen (Hucho hucho)		
Yellow-bellied toad (Bombina variegata)		
Target habitats		
Illyrian Fagus sylvatica forests (Aremonio-Fagion)		
Acidophilous <i>Picea</i> forests of the montane to alpine levels (<i>Vaccinio-Piceetea</i>)		
Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels		

AREA AROUND THE KUPICA







Nuthatch

The nuthatch (*Sitta europaea*) is a common inhabitant of forests and old orchards, and in the winter months it also visits feeders in yards. It is very easy to recognize as it has the unusual habit of climbing along the trees head first.

barrier. The road first passes the foot of steep limestone slopes covered with stunted lime and hop hornbeam forest. Ferns and hazel thicket grow on the scree at the foot of the rocks. The hart's tongue fern (*Asplenium scolopendrium*) is particularly striking at all times of the year. The moss-covered tree trunks on the banks of the Kupica are overgrown with lush tufts of polypody fern (*Polypodium vulgare*) that grow as epiphytes.

Perennial honesty (*Lunaria rediviva*) is found frequently in damp places. In spring, it is decorated with fragrant purple flowers, and in autumn and winter with the silvery membranous remains of pods. In winter, when there is no other green vegetation, the leathery leaves of wild ginger (*Asarum* sp.) and blackberries (*Rubus* sp.) stand out. In this part of the valley, the River Kupica meanders between the steep hills and slopes covered with various types of forest. The

right side of the valley in this part of its course has a milder relief, but it is also overgrown with lush forest.

In places, the River Kupica produces a loud noise as it cascades over the barriers in rapids. The calmer part of the riparian landscape is on the left. Here, we encounter a remarkable fragment of damp, marshy black alder forest (*Alnus glutinosa*) with great horsetail (*Equisetum telmateia*) lushly growing in the underbrush.

Behind this marshy oasis, we get close to the source of the Kupica and a rather large wooded island surrounded by two arms of the river. The island can be reached across the left, stronger arm via two large fir logs. The island has a resting area with wooden benches and tables with a view of the Kupica rapids at the spot where it flows from its source.

Unfortunately, the need for drinking water has taken its toll on the natural scenic beauty of the area. The water protection area and source are enclosed by a wire fence, which means that it is not possible to experience the phenomenon of the source directly and without restrictions.

The karst source of the Kupica is a phenomenon like other similar sources of this kind. It is a small pool of a milky green colour that springs from the depths of the karst underground beneath the rock of Jezerska Stijena. The steep, partly rocky slopes tower above the source in a semi-circular shape from the eastern and southern side. They are mostly overgrown with beech forest. On the western side of the source, at the foot of the hill, there is a young fir forest.









Kamačnik is the 3.2-kilometre-long right tributary of the River Dobra. Its mouth is south of Vrbovsko, not far from the railway station. There is also a restaurant nearby. This is where the very attractive Kamačnik canyon begins, which is approximately 1 kilometre long. This gorge, which cuts deep into the carbonate rock, is characterised by a series of rapids, potholes and small waterfalls that form a tangled network of passages shaded by rocks. A path leads through the canyon over a series of wooden galleries and small bridges.

The source of the Kamačnik is located at an elevation of 405.4 metres, whilst its confluence with the River Dobra occurs at approximately 370 metres above sea level. The stretch between the source and the canyon is somewhat calmer, with flatter banks, so different from the lively stream running through the canyon. This is caused by the geological structure of the substrate. The canyon stretch is characterised by a larger fall in the bed, which increases its visual attractiveness because of the large number of cascades and the canyon's steep, narrow sides. This contrasts with the calmer stretch, the small gravel deposits and a milder relief upstream towards the source area.

The Kamačnik flows into the River Dobra over a small waterfall, as there is a barrier at the entrance to the canyon. On the western side,

Category of protection: Protected landscape		
Year proclaimed	2002	
Area	74.44 ha	
Location	Town of Vrbovsko	
Altitude	370-600 m	
Length of the water course	3.2 km	
Natura 2000 site		
Site code	Site name	
HR2001158	Source of Kamačnik	
Target habitats		
Caves not open to the public		

KAMAČNIK





Ruin of old sawmill

The sawmill was built in the early 20th century, but was soon destroyed in a fire. To operate it used the power of water. Today the ruin lends a romantic atmosphere.

there is stratified limestone rock, and the initial part of the canyon and the surrounding area are covered with lush forest. Several picturesque spruces have been planted along the access path that leads to the ruined walls of a large sawmill.

The path soon reaches the first rocky narrowing with a little wooden bridge. The rapids and pools in the potholes of the bed enchant visitors with the bluish-green colour of their clear waters, so different from the slightly turbid water of the River Dobra. The bed and rocks of the canyon are in places thickly covered with dark mosses. Old beeches, uprooted as a result of their age, lie decaying along the path, providing substrate for the numerous animals and fungi that live on rotten wood. On the rocks overhanging the bed of the murmuring stream, the dark evergreen crowns of yew trees (Taxus baccata) can be seen here and there. The flora comprises many plant species. On the rocks, alpine rose (Rosa pendulina), nettle-leaved speedwell (Veronica urticifolia), and sand rock-cress (Cardaminopsis arenosa) grow. A common species in shaded spots is the forest colt's foot (Homogyne sylvestris). The beech forests in the valley of the Kamačnik grow in damper habitats and belong to the montane type of beech forest (Lamio orvalae-Fagetum sylvaticae). Other plants that grow in this type of forest are the alpine barrenwort (Epimedium alpinum), the protected spineless butcher's broom (Ruscus hypoglossum), and the rare and protected spurge laurel (Daphne laureola).

On the other hand, on the sun-exposed rocky sides of the valley, we encounter a thermophile forest with European hop-hornbeam (Ostrya carpinifolia), manna ash (Fraxinus ornus), whitebeam (Sorbus aria), and wild service tree (Sorbus torminalis). On one dolomite rock, spring heath (Erica herbacea) grows luxuriantly. In the upper part of the valley, on the left-hand side, the dolomite slope is moistened by small lateral springs, and the marshy soil is covered with moor grass (Molinia sp.) along with certain rare species of sedge. The area in which the lateral torrential streams below the hamlet of Japići join the Kamačnik

from the left-hand side is environmentally important. These streams form the broadened part of a valley covered with fragments of riparian willow thickets (*Salix* sp. div.) and black alder groves (*Alnus glutinosa*).

In the upper part of the valley, small sources arise from half-caves in lateral gullies. This is the source area of the Kamačnik. After approximately one hour of walking from the entrance to the canyon, we reach an unusual, depression-like area surrounded by semi-circular steep slopes and covered with beech forest and numerous ferns. This is the spring of Kamačnik, a typical rising karst spring in which the water emerges from an unknown depth. After reaching the surface, the water spreads calmly and flows slowly along the entire upper part of the valley. The spring area is also interesting for its endemic underground fauna that still has to be researched. Several studies have so far revealed the presence of the endemic *Monolistra* sp. and *Niphargus* sp. subterranean crustaceans. Because of this, Kamačnik Spring has been included in the Natura 2000 ecological network.

Kamačnik is also worthy of protection because of its well-preserved fauna found at the bottom of the clear mountain river, as well as for its ichthyofauna, as this is an important refuge for the brown trout (Salmo trutta m. fario), a species close to threatened status. The invertebrates here include stoneflies (Plecoptera) and caddisflies (Trichoptera), whose larvae live in the clear waters of the Kamačnik. The canyon is also inhabited by the fire salamander (Salamandra salamandra), and grey herons sometimes fly to the banks of the upper part of the valley. A visit to the Kamačnik during high-water season is a unique experience. Although the water level of the Kamačnik varies significantly during the year, its source and flow make it one of the most important water contributions to the River Dobra, especially during rainy periods, when it is full of water. Being a typical karst stream, the waters of the Kamačnik partly disappear underground in certain parts of the canyon stretch.





The castle in Severin na Kupi has a very interesting location on a steep, mostly wooded slope on the right-hand bank of the River Kupa. In the past, it belonged to the Frankopan, Zrinski, Oršić and Vranyczany-Dobrinović families. In 1803, it received its present form. Its owner at the time, Ivan Oršić, had a park laid out around the castle. Although the site at present is not used for tourism purposes, its interesting history and magnificent scenic value provide all the prerequisites for it to become an important part of tourism in Gorski Kotar.

The most interesting item situated near the entrance to the castle is a belvedere with a stone well which offers a magnificent view of the River Kupa as it winds through the meadows and forests beneath the wooded mountain slope of Ravan, foaming and roaring as it cuts its way through the canyon.

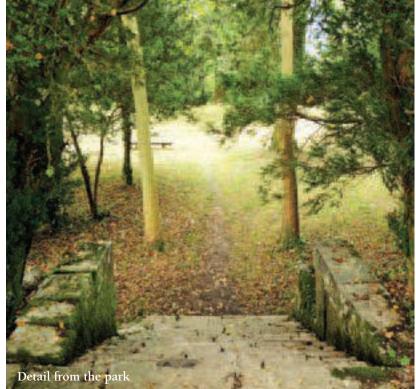
The historical park surrounding the castle has been built on three levels. The first and highest level is located right next to the castle. It contains a rather small row of holly trees (*Ilex aquifolium*) that bear red berries in winter, and also a few Lawson cypresses (*Chamaecyparis lawsoniana*) and horse chestnut trees (*Aesculus hippocastanum*).

On the south side of the castle, elms (*Ulmus* sp.), yew trees (*Taxus baccata*) and boxwood bushes (*Buxus sempervirens*) have been planted. The second and third levels of the park can be reached down a flight of stone steps. The second terrace is the most valuable part of the park because of its central group of old trees.

Category of protection: Park architecture monument		
Year proclaimed	1966	
Area	7 ha	
Location	Town of Vrbovsko	
Altitude	c. 230 m	

THE PARK BY THE CASTLE IN SEVERIN NA KUPI





Some of the impressive specimens here include the Lawson cypress (*Chamaecyparis lawsoniana*), white pine (*Pinus strobus*), northern red oak (*Quercus rubra*), northern white cedar (*Thuja occidentalis*), and other trees. These are mostly species originating from North America, which makes the park especially interesting.

Among the indigenous species present, there is an old lime tree (*Tilia platyphyllos*) with a hollow trunk. Nuthatches (*Sitta europaea*) often use their beaks to thrust seeds into the cracks in the bark of the old Lawson cypress trees in order to extract the edible part of the seeds. The rapid pecking of woodpeckers (*Dendrocopus major*) can also often be heard from the old trees. Roe deer (*Capreolus capreolus*) are frequent visitors to this area as well.



Primrose

Several walking trails descend from the castle down the steep slope to the Kupa valley. It is a special feeling to come down these slopes to the river bed in the early spring, when the forest is not yet green, and the forest floor is blooming with plenty of spring flowers, such as the primrose (*Primula vulgaris*). Snowdrops (*Galanthus nivalis*) are also a particularly interesting sight, as they sometimes cover the entire slopes.





Matić Poljana

The scenic beauty of the meadow of Matić Poljana is enhanced by a series of monuments, 26 limestone rocks, placed in a row in memory of 26 partisans who, in a freezing snow blizzard, lost their lives on 24 February 1944. The monument was designed by the famous Rijeka architect Zdenko Sila.



On a hilly plateau that stretches at an elevation of more than 1,000 metres, there is a series of slopes and peaks that reach 1,300 metres. Between them lie exceptionally scenic grassy valleys.

The biggest of them is the meadow of Matić Poljana. In the summer, it is frequently visited by day-trippers in search of blueberries (*Vaccinium myrtillus*), which indicate the acidity of the soil. Other interesting plant species include Šloser's silene (*Silene sendtneri*), maiden pink (*Dianthus deltoides*), mountain everlasting (*Antennaria dioica*), mountain arnica (*Arnica montana*), and many other grassy habitat species. The grasslands today are gradually retreating before the expanding spruces, blueberries, and other forest species.

In the fir-beech forests on the surrounding slopes, the snow melts earlier than in frost areas such as Matić Poljana. In the early spring, when the beech leaves start to shoot, thousands of flowers bloom here. The wood anemone (*Anemone nemorosa*), yellowish Kitaibel's coralroot (*Cardamine kitaibelii*), and forest false rue anemone (*Isopyrum thalictroides*) cover large areas of forest soil, and the numerous purple flowers of the spring fumewort (*Corydalis bulbosa*) fill the air with a mild intoxicating scent.

Natura 2000 site		
Site code	Site name	
HR2001025	Matić Poljana	
Target species		
Marsh fritillary (Euphydryas aurinia)		
Target habitats		
Species-rich <i>Nardus</i> grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)		
Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco Brometalia) (important orchid sites)		
European dry heaths		
Mountain hay meadows		

MATIĆ POLJANA







Blueberry

Along the edges of the forest, the blueberry (*Vaccinium myrtillus*) is spread in great abundance. This is an important food for bears in summer, who therefore often visit the meadow of Matić Poljana to pick blueberries. For this reason, encounters between people and bears are not uncommon here.

This is the time when we can already hear cuckoos (*Cuculus canorus*) in certain forest areas, while the soil in the spruce forests is still barren and lifeless, as piles of snow lie around the spruces and firs. The only green that we see comes from the numerous mosses and the broad leaves of the greater woodrush (*Luzula sylvatica*) and blackberries (*Rubus hirtus*), as these overwinter under snow cover. On the muddy forest soil, one can spot the fresh tracks of bears (*Ursus arctos*).

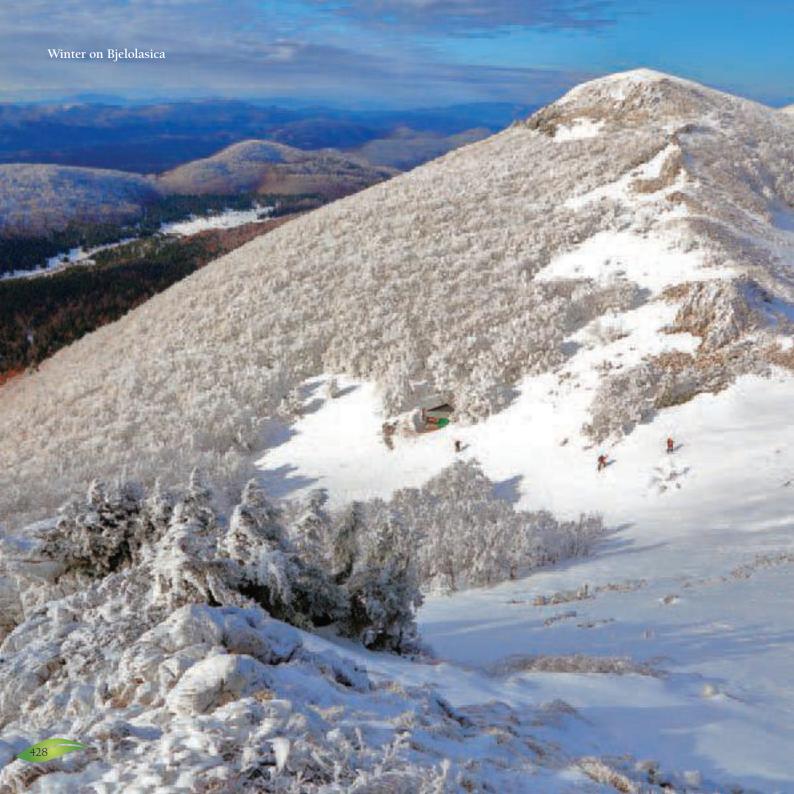
In the vast forest areas, there are many forest pools that have formed in the wheel tracks of heavy logging vehicles. Their interesting dark brown colour comes from humic acid, floating tiny green clusters of water starwort (*Callitriche* sp.), and the spawning of alpine newts (*Ichtyosaura alpestris*) and the even more numerous toads (*Bufo bufo*), whose quiet calls in the springtime can be occasionally heard from the shaded ponds in the silence of the forest. In some places along the edge of the forest and in its clearings, we can see the common European adder (*Vipera berus*), which is completely black in colour.



Arnica

On the grassy parts of the frost area of Matić Poljana, the soils are deep and they are inhabited by some rare species of plants, such as arnica (*Arnica montana*), which in summer has beautiful blooms which attract many butterflies and insects. It is a strictly protected species, and very attractive to collectors of medicinal plants. One of the reasons why arnica is disappearing from Gorski Kotar is the overgrowing of grasslands, which is the case in Matić Poljana.





Bjelolasica is an elongated mountain ridge that stands out from the dense forest vegetation. In the peak area of the ridge, when observed from the nearby meadow of Vrbovska Poljana in the west, three smaller grassy peaks are visible with a few rocks on their slopes. The fourth peak observed from this perspective is distinguished by a darker green colour that comes from the dwarf mountain pine (*Pinus mugo*) that grows there. The highest peak is Kula (1,534 m), which is also the highest peak of the Velika Kapela mountain range and the entire Gorski Kotar region. In the winter, the ridge of Bjelolasica, when viewed from a distance, is white with snow, which probably explains the Croatian name of the mountain (*bijelo* means white). The highest part of Bjelolasica Ridge between the peaks is rather flat.

The subalpine part of Bjelolasica is beautiful not only because of the magnificent views it offers but also because of its varied mountain flora. In the summer, the rock crevices are decorated with the blue flowers of the endemic wide-leaved rock bell (*Edraianthus graminifolius*), the white flowers of the alpine saxifrage (*Saxifraga paniculata*), which is also distinguished by lime-encrusted white pores at the edge of its

Natura 2000 site		
Site code	Site name	
HR2000645	Bjelolasica	
Target species		
Lesser horseshoe bat (Rhinolophus hipposideros)		
Alpine sea holly (Eryngium alpinum)		
Target habitats		
Alpine and Boreal heaths		
Alpine and subalpine calcareous grasslands		
Calcareous rocky slopes with chasmophytic vegetation		
Illyrian Fagus sylvatica forests (Aremonio-Fagion)		
Bushes with Pinus mugo and Rhododendron hirsutum (Mugo-Rhododendretum hirsuti)		

BJELOLASICA





Special subtype of Siberian Iris

The subalpine grasslands are home to the rare and distinctive subspecies of the Siberian iris (*Iris sibirica* ssp. *erirrhiza*). For the first time in the world, it was found and described on Ćićarija, and it has also appeared in Gorski Kotar, on Bjelolasica and on other peaks in the wider hinterland around Rijeka Bay.

leaves, and a series of other attractive and colourful flowering plants. The alpine leek (*Allium victorialis*) is also very common.

The slopes of Bjelolasica descend steeply on both sides to the foothills, and are covered with subalpine beech forest with lush tall herbs in the undergrowth, such as the yellow-flowered Austrian leopard's bane (*Doronicum austriacum*), alpine blue sow thistle (*Cicerbita alpina*), and other thriving plants. In places, one can encounter the rare great marsh thistle (*Carduus personata*), which can grow up to two metres tall.

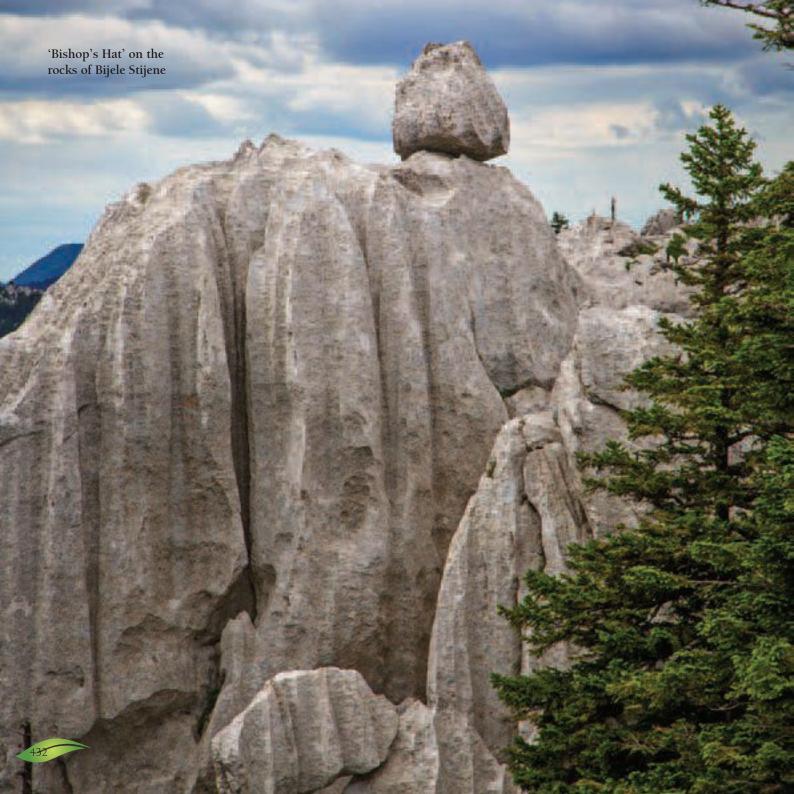
The stands of subalpine beech forest on the southeastern slopes of Bjelolasica are frequently visited by bears at certain times of the year, especially in the spring during the 'harvest season' of the tasty and healthy leaves of the bear leek (*Allium ursinum*). Local hunters claim that the bears become so preoccupied with the fresh leaves of the bear leek that they completely forget about the food left for them next to the hunting stands. The bears, which have used up their fat reserves during their stay in their winter dens, rush into the forest for a week or two to replenish themselves with vitamin *C* and other important natural chemical substances that are contained in the young leaves. The bear leek and the juicy young shoots of the alpine blue sow thistle (another important element of the bear's spring diet) can be found in abundance in the forest expanses of Gorski Kotar.

The alpine blue sow thistle is a composite flowering plant related to lettuce, which is why it is sometimes called wild lettuce. On the sunny slopes of Bjelolasica, right beneath the ridge and on the way to the mountain lodge, entire areas are blue with its handsome flowers, which give the local beech forests a distinctive appearance. In terms of phytocenology (the study of vegetation and plant communities), these forests should probably be classified as a special type of subalpine forest because of this specific feature.



Alpine sea holly

The Natura 2000 area of Bjelolasica is particularly important for the protection of the alpine sea holly (*Eryngium alpinum*) because this is its densest population in Croatia. The alpine sea holly is an extremely rare plant that, due to its attractive appearance, is often picked by hikers who are not informed about its status of protection. It selects special habitats, mainly deeper karst sinkholes (dolines) with rich black soil. Although this is not the case with this specific alpine species, the sea holly is known as a plant of arid habitats. The wind pulls these plants from the ground and twirls them around the meadows, thus disseminating the seeds.



The washed out white cliffs of Bijele Stijene and Samarske Stijene rise up to the sky in a variety of shapes. The seemingly lifeless rocks come to life thanks to the persistent and tough spruce, fir, maple and beech trees on them. The rocks have stood here for thousands of years, but due to the weather and climatic conditions, as well as geological processes, they have gradually changed, creating the various fantastic shapes of the cliffs, crags, dolines, sinkholes, and other interesting formations.

The famous rocks of Bijele Stijene and Samarske Stijene are situated in the central part of the Velika Kapela mountain group in Gorski Kotar. Velika Kapela is made up of three parallel mountain ranges, and Bijele Stijene and Samarske Stijene belong to the middle one. They were proclaimed a strict reserve in 1985 because of their well-preserved nature and inaccessibility. Apart from Bijele Stijene and Samarske Stijene, there is only one other strict reserve in Croatia: Hajdučki Kukovi and Rožanski Kukovi on Mount Velebit.

Category of protection: Strict reserve			
Year proclaimed	1985		
Area	1,175 ha (a small part, c. 191 ha, is located in Karlovac County in the area of the Town of Ogulin)		
Location	Town of Novi Vinodolski and Municipality of Mrkopalj		
Altitude	1,000-1,335 m		
Natura 2000 site			
Site code	Site name		
HR2001299	Bijele Stijene and Samarske Stijene		
Target habitats			
Calcareous rocky slopes with chasmophytic vegetation			
Calcareous and calcshist screes of the montane to alpine levels (<i>Thlaspietea rotundifolii</i>)			
Alpine and Boreal heaths			
4 · 1 1 · 1 · Dr	forests of the montane to alpine levels (Vaccinio-Piceetea)		

BIJELE STIJENE AND SAMARSKE STIJENE





Bijele Stijene and Samarske Stijene are made of layered limestone and bulky limestone breccia (sediment rocks composed of rock fragments cemented together), which give them the distinctive appearance of a developed karst relief. They are distinguished by many unusual rock forms, sharp-toothed peaks, 50 metre-high sheer cliffs, crags, grooves, narrow passages, crevices, and deep sinkholes which sometimes contain perennial snow. This treasure of stone formations mixes with the forest world from which individual groups of rocks stand out, which gives them a wild and inaccessible appearance but at the same time magnificent scenic beauty.

Due to its specific relief, this area was isolated and shrouded in mystery for a long time. There were no roads, and just a few walking trails (the only traffic routes between Lika and Gorski Kotar in this area). It is interesting that the wilderness and inaccessibility of Bijele Stijene and Samarske Stijene represented one of the main obstacles to Turkish invasions in Gorski Kotar.

Given their geographical location and elevation between 1,000 and 1,335 metres, the climate of Bijele Stijene and Samarske Stijene is characterised by long and cold winters and plenty of precipitation. Despite the large amounts of rain and snow, the rocks have no streams or springs on their surface. The reason for this is their geological structure: limestone full of fissures through which water quickly disappears underground.

With the exception of their barren peaks, large parts of Bijele Stijene and Samarske Stijene are covered with forest. Like elsewhere at this elevation in Gorski Kotar, fir-beech forest (*Omphalodo-Fagetum*) is present, although fir forest with small reed-grass (*Calamagrostio-Abietetum*) is particularly significant in the rocky soil. Spruce, which is also common in these forests, chooses mostly colder habitats in shaded places, and also grows at the bottom of sinkholes and dales.





Fir trees on stone blocks

The fir forest on stone blocks gives the area of Bijele Stijene and Samarske Stijene its distinctive appearance. The soil in which the firs grow is very shallow and poor, which is why the trees have a very small annual growth, and very narrow growth rings. The trees with a diameter of 20-30 centimetres at breast height have been growing here for several hundreds of years, therefore it is no wonder that the spruces, which, together with the firs, grow in these conditions, provide quality wood that in the past was used for making musical instruments such as the violin.

The highest parts are covered with subalpine beech forest and shrub vegetation with dwarf juniper (*Juniperus communis* ssp. *nana*). Due to the inaccessibility of the rocks, the forests of Bijele Stijene and Samarske Stijene have been spared from being cut down and have preserved their partially primordial forest structure right up to the present day.

Because of its well-preserved and primeval wild nature, the reserve has a very rich flora and fauna. Inside the forest communities in certain micro-locations, there are some other communities, such as rock and crevice vegetation, scree vegetation, and tall herbs.

Rock crevices feature the untouched habitats of the edelweiss (*Leontopodium alpinum*). On the summit of Bijele Stijene, a rare species of mountain sedge has been found: the rock sedge (*Carex rupestris*). Rock crevices are also the habitat of the rare alpine sea holly (*Eryngium alpinum*), wall rue (*Asplenium ruta-muraria*), mountain currant (*Ribes alpinum*), and numerous other interesting species.

At the foot of the rocks, erosion has created small scree comprising loose material. The plants that grow in such specific and difficult conditions are rose root (*Rhodiola rosea*), alpine/encrusted saxifrage (*Saxifraga paniculata*), alpine daphne (*Daphne alpina*), alpine toadflax (*Linaria alpina*), and many others.

The tall herb vegetation is distinguished by the variety of colours of the numerous flowering plants that grow here. These include the heart-leaf oxeye (*Telekia speciosa*), mountain daisy (*Leucanthemum adustum*), pink adenostyle (*Adenostyles alliariae*), alpine blue sow thistle (*Cicerbita alpina*), monk's hood (*Aconitum napellus*), and others.

With regard to its natural features, the area of Bijele Stijene is somewhat different from Samarske Stijene due to the differences in their geological structure. The rocks of Bijele Stijene feature a variety



Fox

This area is an ideal habitat for many animal species. Along with the three large carnivores (wolf, bear and lynx), its permanent inhabitants are the fox, badger, skunk, pine and stone marten, wild cat, and many other small mammals. Important reptile species include the Horvath's rock lizard (*Iberolacerta horvathi*) and the viviparous lizard (*Zootoca vivipara*). Among amphibians, the alpine salamander (*Salamandra atra*) is particularly rare. Unlike most amphibians, this species does not need water for breeding as it brings into the world one or two fully developed young capable of independent life on land rather than hatching eggs. This adaptation has enabled the alpine salamander to select such waterless mountainous regions as its habitat.









Ural owl

This area is inhabited by some rare birds such as the blue rock thrush (Monticola solitarius), the alpine chough (Phyrrocorax graculus) and the black woodpecker (Dryocopus martius) as well as several species of owl, such as the Eurasian eagle owl (Bubo bubo), the brown owl (Strix aluco), the Ural owl (Strix uralensis), the boreal owl (Aegolius funereus) and the Eurasian pygmy owl (Glaucidium passerinum). Particularly worth mentioning is the three-toed woodpecker (Picoides tridactylus), which is a glacial relict (remnant of the fauna of the ice ages), a highly endangered and rare species that lives mainly in coniferous forests.

of interesting stone shapes. These rocks are composed of limestone breccia and are more resistant to erosion. Interesting formations with a pronounced vertical development have formed here. The area of Bijele Stijene is also more accessible, which is why a mountain lodge and shelter are located here.

The rocks of Samarske Stijene consist of approximately twenty separate groups of rocks. Their cliffs, crags, and small grooved ridges are composed of layered Jurassic limestone. Among the rocks, there is a network of sinkholes. Hikers will find a mountain lodge (shelter) in an unusual and interesting spot here: in a half-cave under a hanging rock, which means it is well protected from the weather conditions.

Two foresters from Begovo Razdolje, Jakov Mihelčić and Ivan Karlović, were the first to discover the path that leads to the impassable and magnificent Bijele Stijene in the late 19th century. They found it following bear tracks that led them to previously unknown and impassable areas. They showed the path to hikers, who then marked it.

One of the two foresters, Jakov Mihelčić, brought to Bijele Stijene the naturalist Dragutin Hirc, who discovered here the plant that is today known as edelweiss. Hirc wrote about the edelweiss in Croatia and its discovery in his numerous works:

We should protect and cherish this sweet alpine flower, because better days are dawning for Gorski Kotar, and when its magnificent doors of nature are solemnly opened, the edelweiss will be its most beautiful ornament.

Dragutin Hirc, Gorski kotar (1898)



Carniolan lily

The Carniolan lily (*Lilium carniolicum*) is very common in the forest belt of the area of Bijele Stijene and Samarske Stijene. Here we can also find the Turk's cap lily (*Lilium martagon*), the spurgelaurel (*Daphne laureola*), the perennial honesty (*Lunaria rediviva*), and numerous other species.



Each boulder is almost a peak on its own, difficult to climb, because many rocks fall vertically, but once you have climbed them, you take a look around and you notice they are full of scary fissures, pits and caves; you gaze at the giant firs and spruces, and finally you stare, tired from the wonders, in the dead silence, that reigns in this area.

Dragutin Hirc, Gorski kotar (1898)

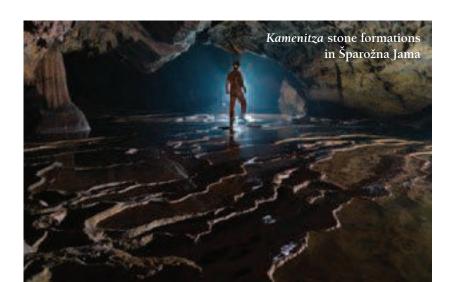




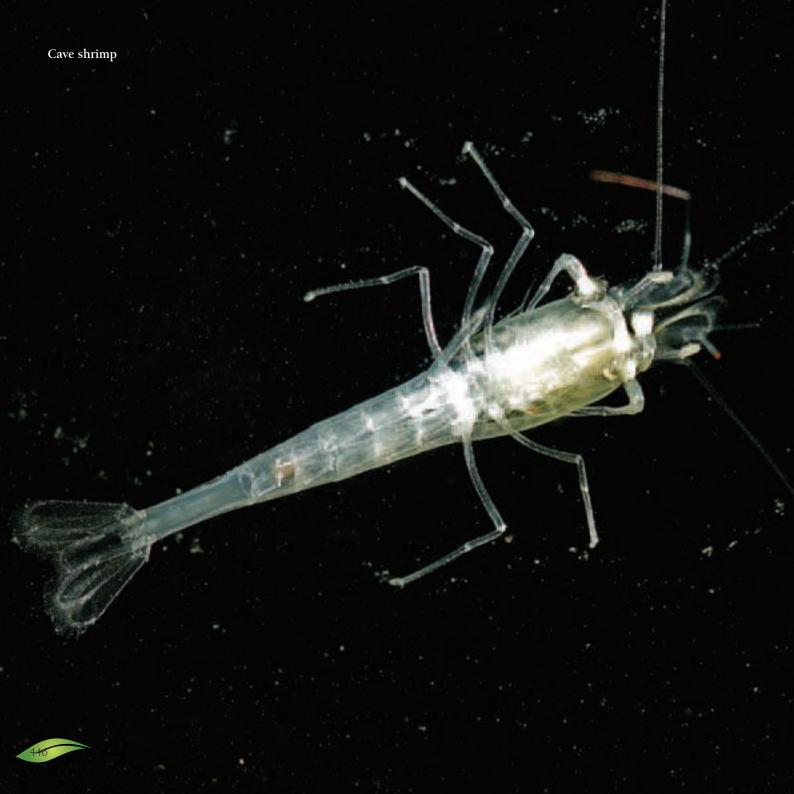
Back in prehistoric times, man used caves as permanent or temporary shelters, and also as places for performing religious ceremonies and burying the dead. Today, caves and swallow holes offer the challenge and opportunity to discover locations in which man has never set foot.

The entire area of Primorje-Gorski Kotar County, like half of Croatia's territory, is situated on karst relief that comprises soluble rock full of underground caves and other interesting geological phenomena typical of karst. These include sinkholes or dolines, streams, ponors, springs and canyons, all of which are made by water. Due to a shortage of water and arable land, and the fact that the mountains are often almost inaccessible, Croatia's karst areas have always been sparsely populated. From the modern nature lover's point of view, this is an advantage because these areas are to a great extent well preserved and are characterised by an exceptional biodiversity with particularly rare and interesting underground fauna.

Life underground has different rules to that on the surface. The temperature does not change here, the humidity level is high, and it is dark all the time. Because of the lack of light, there are no plants, so all underground organisms have to adjust to a lack of food, which is only brought to them by water from the surface. This is why their



SUBTERRANEAN LIFE



metabolism is so slow and their life expectancy longer than that of related species that live on the surface.

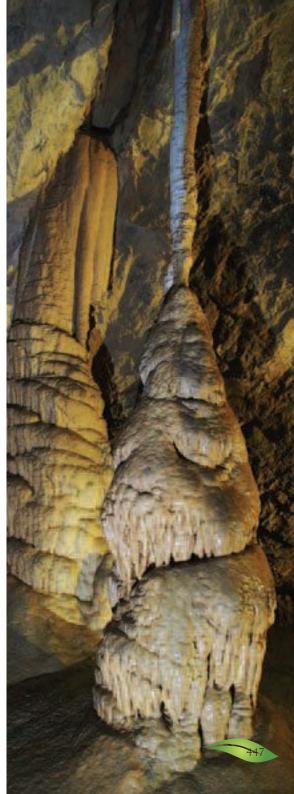
Underground areas need to be protected for many reasons. Caves in which a new animal species is first found and described are particularly important. Such caves are known as a *locus typicus* or type locality.

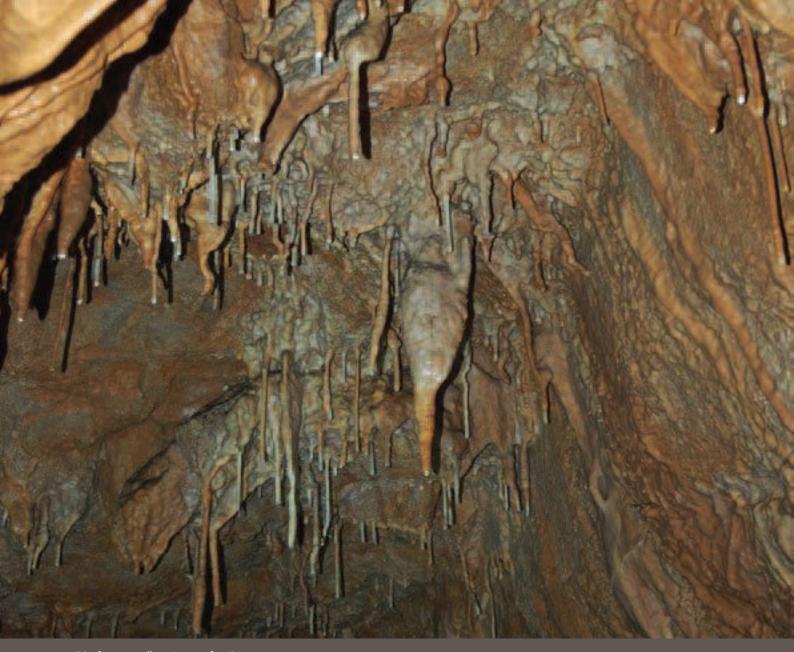
Individual sites are also protected because of their extraordinary beauty and fascinating geological structures. In addition, a great part of the drinking water in karst areas comes from underground karst springs. This means that by protecting the underground world, we protect our own health.



Zypress Hall in Biserujka Cave

Biserujka Cave on the island of Krk is the type locality for several invertebrate species, such as pseudoscorpions (*Neobisium insulare*) and the Krk cave beetle (*Anophthalmus maderi maderi*). It is also the only place in the world where you can find the Krk cave woodlouse (*Alpioniscus christiani*). Biserujka is the only archaeological site where cave bear fossils have been found. It is estimated that these fossils are approximately 16,000 years old.





"Soda straws" in Zametska Cave

Stalactites hang from the ceiling towards the floor of the cave. When a drop of water reaches the ceiling, it falls and deposits a thin ring of calcite. Each subsequent drop deposits another calcite ring, and these rings form a narrow hollow tube known as a "soda straw" stalactite. Over time, the stalactites grow thicker and become cone-shaped.

Zametska Cave is located in Zamet, which is only a couple of kilometres from the centre of Rijeka. It was discovered in the 1920s when, according to the famous geologist Josip Poljak, the cave was located: "right above the last houses on the northwestern side of Zamet, not far from the former quarry."

The cave is 200 metres long, and its deepest part is 23 metres below its entrance level. The entrance resembles a pit-hole or well, with its bottom disappearing suddenly beneath our feet. In order to make the cave more easily accessible, metal stairs have been constructed at its entrance. After the entrance, the bottom descends steeply and the cave's main channel turns west and widens into a gallery eight metres high. Further on, the ceiling of the cave becomes lower and widens into the largest hall of the cave, which has a diameter of approximately 10 metres.

Smaller side channels branch off in several places in these halls. They either end with their ceiling lowering abruptly or by narrowing into impassable cracks that carry seepage water. In the southeastern part of the main hall, a larger channel branches off and descends further. This channel has more calcite formations than the rest of the cave, and ends abruptly with a hole that leads to further channels which are accessible only to speleologists.

According to records left by the first explorers, the cave used to be adorned with numerous beautiful calcite formations. Unfortunately,

Category of protection: Geomorphological natural monument		
Year proclaimed	1981	
Location	City of Rijeka (Zamet)	
Altitude of entrance	140 m	
Measured length	approximately 200 m	

ZAMETSKA CAVE



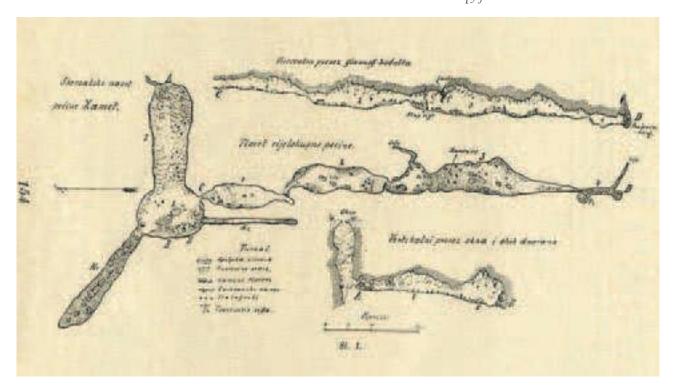
due to unsupervised visits over the last century, many of these were destroyed. Moreover, during the Second World War the cave was occasionally used as a safe shelter on the outskirts of the then occupied town. Evidence for this, such as writing on the walls and torch marks, are still visible today in some parts of the cave.

This small cave represents a rare opportunity to experience a karst cave in an otherwise urban setting. It has great potential in terms of education about the underground world and the importance of protecting specific natural sites that cannot be recovered once they have been destroyed. Although there have been some efforts to open the cave to visitors, Zametska Cave is at present still closed to the public.

Josip Poljak's drawing published in the *Hrvatski planinar* magazine in 1928

Josip Poljak described the cave in the article *A New Cave in Zamet* that was published in the *Hrvatski planinar* magazine in 1928 as follows:

"The floor, ceiling and side walls of this hall are dotted with calcite formations of all shapes, which gives the impression of a beautiful and harmonious temple. Its dignity and beauty would be even greater if the dripstone was white and not tainted by the red soil that makes it dark red and in places almost black in colour. The floor around the sinkhole is covered with a thick layer of sinter whose surface is full of stalagmites and lumpy formations."





Gotovž Ponor is located in the plain of Klanjsko Polje not far from Klana. Its name is probably derived from the Croatian phrase for "a cavern that swallows water", and it was formed by the torrential Klanjska Ričina stream which plunges into it.

The first research on it was conducted by Italian speleologists back in 1926. However, the most important research was carried out by Croatian speleologists some thirty years later. The expedition was very demanding and involved as many as 74 professionals.

An interesting detail concerning this expedition is the fact that the equipment of all the speleological societies in Croatia was lost due to a sudden influx of water into the cave. Thanks to the good organisation of the speleologists, no human lives were lost. Only the main channel was researched and several lateral channels remained unexplored. The estimated depth of the ponor is 320 metres.

The biospeleology of the cave is also significant, as it is the type locality of the *Typhlotrechus bilimeki clanensis* cave beetle. For this reason, Gotovž has been included in the Natura 2000 ecological network.

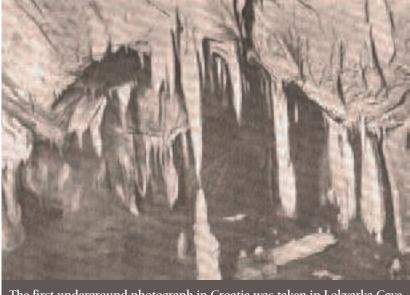
Category of protection: Geomorphological natural monument			
Year proclaimed	1969		
Location	Municipality of Klana		
Altitude of entrance	560 m		
Measured depth	320 m		
Natura 2000 Caves not open to the public			
Site code	Site name		
HR2000034	Gotovž		

GOTOVŽ PONOR



Lokvarka Cave is the deepest cave in Croatia that is open to visitors. It is located on the slopes of the wooded hill of Kameniti Vrh, not far from Lokve. The cave was discovered by chance in 1911 by the merchant Jakov Bolf during limestone excavation. The first tourists visited the cave as early as the following year, when the first steps and a wooden bridge were constructed to facilitate the visit.

Category of protection: Geomorphological natural monument				
Year proclaimed	1961			
Location	Municipality of Lokve			
Altitude of entrance	approximately 780 m			
Length of underground channels	explored so far – 1.2 km			
Depth	270 m known so far			
Temperature	8°C			



The first underground photograph in Croatia was taken in Lokvarka Cave

LOKVARKA CAVE



Ice stalagmites at the entrance to Lokvarka Cave

Even though the deeper parts of Lokvarka Cave have a constant temperature of approximately 8°C, during the harshest winters, the temperature at the entrance can drop low enough to allow the creation of ice stalagmites. These are formed by drops of water that drip from the ceiling and turn into ice once they touch the ground. These ice formations come in different shapes and can be transparent or a milky white colour. The swirly relief structures on their surface are particularly striking.



Stalagnate in the 'Cathedral'

A magnificent stalagnate in the hall known as the 'Cathedral' captures the attention of every visitor to the cave. This 16-metre-high column seems to be holding up the ceiling of the entire hall. Stalagnates or columns are formed when stalactites and stalagnates meet. Josip Poljak estimated that the calcite formations in Lokvarka Cave were formed 20,000 years ago, and that the cave itself is much older.





Lokvarka Cave consists of six levels, of which the first four, which descend to a depth of 70 metres, are open to visitors. The fifth level, the Virgin Hall, and the sixth, Gordan's Level, are only open to speleologists, as to reach them one has to pass through long, narrow vertical passages with intermittent streams of water. Gordan's Level is situated at a depth of 275 metres, and is particularly interesting because of its wide channel of water, which is actually the underground part of the River Lokvarka. This is also the largest hall in the cave. The channel is filled with stone blocks weighing between 25 and 30 tons, which are covered in dark mud.

The cave is distinguished by interesting calcite formations, especially flowstones, and also endemic cave fauna. Among the animals that live in the cave the *Parastalita stygia* underground spider, *Brachydesmus inferus inferus* millipede, and *Typhlotrechus bilimeki* and *Parapropus sericerus stilleri* cave beetles are particularly worth mentioning.

The Virgin Hall, which got its name because of its immaculate beauty, contains a hidden gem. The world's only specimen of the endemic *Croatodirus ozimeci* beetle was found here. The search for other examples of this rare and hidden species is one of the goals of future expeditions to this cave.





Young greater horseshoe bat

Even if bats are not true cave animals, some species regularly choose underground areas as their habitat. Their distinctive nose with its horseshoe-shaped skinfolds helps greater horseshoe bats orientate by echolocation. The sound they emit is directed through a structure in their nose. Their extremely sensitive ears pick up the rebounding sounds, which helps them orientate and identify prey. Even though they have good eyesight, which they use to move during the daytime, the ability to "see with their ears" removes their dependence on daylight. This extremely sensitive navigation system allows bats to fly in very dark and confined caves. For this reason, contrary to popular belief, it is almost impossible for them to get caught in human hair.

There are many speleological sites which are under the protection of the Natura 2000 ecological network. The selected caves and swallow holes serve as a home for rare and endemic species which need to be conserved. There are 25 individual sites in Primorje-Gorski Kotar County which are protected by the Natura 2000 ecological network. Many more speleological sites have been protected as parts of wider areas in the network.

Natura 2000 speleological objects			
Site code	Site name		
HR2000034	Gotovž		
HR2000051	Jama nad Zasten		
HR2000106	Ponikve II Ponor		
HR2000110	Pustinja Cave		
HR2000131	Škabac Cave		
HR2000146	Velika Špilja Cave in Permani		
HR2000149	Cave near Stara Sušica		
HR2000190	Vlaška Peć		
HR2000200	Zagorska Peć near Novi Vinodolski		
HR2000667	Medvjeđa Špilja Cave		
HR2000755	Hajdova hiža		
HR2000759	Vela Špilja Cave in Krug		
HR2001148	Dazdaland Jama		
HR2001149	Velika Jama		
HR2001150	Gerovčica Spring		
HR2001153	Stupina Jama		
HR2001158	Kamačnik Spring		
HR2001246	Spring in Medveja		
HR2001435	Sniježnica beneath Lisina		
HR2001436	Sojkina Jama		
HR2001437	Špilja 2 near the Zala stream		
HR2001438	Karst pit next to forester's house		
HR2001439	Karst pit next to forester's hut		
HR2001441	Abyss beneath Vučjak		
HR2001508	Prva Brizićeva Jama		

CAVES NOT OPEN TO THE PUBLIC



Slender-necked cave beetle

The slender-necked cave beetle (*Leptodirus hochenwartii*) is a true cave beetle. There are four suborders of this species living in Croatia, mainly in the mountain areas of Učka and Ćićarija, Gorski Kotar, and in certain parts of Lika and the Velebit mountain range. It has no eyes, since it lives in complete darkness, and uses its large antennae to move about. Living underground has caused the absence of any pigment and the brown colour in this photograph comes from the light of the torch passing through its protective chitin cover.



Rather than regarding our heritage as a mere set of objects protected by law, we should see it as a collection of active subjects that ensure the continuity of life, and also as a driver of economic development.

Heritage should not be protected from humans but improved for people and the generations to come

Academic Mladen Obad Šćitaroci

In the preceding chapters of this book, we have tried to present in words and pictures what Primorje-Gorski Kotar County has to offer in terms of nature protection, and which of its areas have been included in the Natura 2000 ecological network. In future, these valuable resources, rather than being a source of additional expense due to the cost of protecting and preserving them, should be seen as drivers of economic and social development.

This is the motto of the HERU scientific-research project (Heritage Urbanism – Urban and Spatial Planning Models for the Revival and Enhancement of Cultural Heritage), which is financed by the Croatian Science Foundation, and managed by the Faculty of Architecture of the University of Zagreb under project supervisor Academic Mladen Obad Šćitaroci. The main principle of this project is the idea that heritage is not just a collection of protected items and monuments related to the past, but rather an active element and creative factor in modern life that contributes to the cultural, social, economic and spatial development of the community.

In line with the example of this project, the aim of which is to improve heritage in terms of its identity, and the criteria for using it and making interventions in important heritage sites, as well as methods, models and scenarios for evaluation, planning and design in heritage areas, the objectives of nature protection in Primorje-Gorski Kotar County must be to preserve natural heritage for future generations, but also create green jobs, educate local people, boost the attractiveness of tourism, and increase the number of visitors. This must not be carried out unsystematically and without knowledge of the value of individual areas, but, on the contrary, in a well-organised and measured way with awareness of the wealth that we have at our disposal as a nation. In doing so, we should also take into account how many visitors certain areas can accept.

It should be emphasised that Primorje-Gorski Kotar County and the Priroda Public Institution have been working in this direction for many

... AND FINALLY, A LOOK INTO THE FUTURE

... AND FINALLY, A LOOK INTO THE FUTURE

years and that these objectives are defined in their programmes for the years to come. Over the last ten years, several protected areas have been made accessible to the public, numerous educational trails have been opened, several dozen interpretation boards erected, and more than 30 publications brought out with the aim of popularising important natural areas in the county.

For tourism purposes, approximately ten concessions have been issued for receiving and guiding visitors. In addition, the brochure *Protected Natural Heritage – A Guide to Kvarner's Natural Environment from Sea Depths to Mountain Peaks* was published in collaboration with Kvarner County Tourism Office. A guide to protected natural areas in Primorje-Gorski Kotar County has also been published in Croatian, English, German and Italian.

In the last year, activities have focused on establishing and designing two visitor centres: the Centre in Beli on the island of Cres, which will present to visitors the importance of preserving the griffon vulture, a Natura 2000 species, and the Centre for Large Carnivores in Stara Sušica.

An ecological network impact assessment has been successfully implemented for the county's spatial plan as part of its strategic environmental assessment, and also for several specific interventions. All of the above confirms that natural heritage in Primorje-Gorski Kotar County is not a limitation but rather an opportunity for economic and social development.

We feel confident that these principles will be implemented in the forthcoming period and wish all readers and nature lovers many memorable moments in discovering the attractive natural areas of our simply beautiful county.

Asst.Prof. Koraljka VAHTAR-JURKOVIĆ, Ph.D. Head of the Department for Physical Planning, Construction and Environmental Protection of Primorje-Gorski Kotar County

Publications

LITERATURE

- Alegro, Antun, et al. 2010. *Botanički važna područja Hrvatske*. Školska knjiga; Prirodoslovno-matematički fakultet. Zagreb.
- Andrić, Josip; Lončarić, Robert (Ed.). 2012. *Rapski zbornik II*. Ogranak Matice hrvatske u Rabu. Rab.
- Antolović, Jasna; Flajšman, Emil; Frković, Alojzije; Gregurev, Marin; Grubešić, Marijan; Hamidović, Daniela; Holcer, Draško; Pavlinić, Igor; Vuković, Marijana; Tvrtković, Nikola. 2006. *Crvena knjiga sisavaca Hrvatske*. Ministarstvo kulture; Državni zavod za zaštitu prirode; Republika Hrvatska. Zagreb.
- Badovinac, Zvonimir; Bralić, Ivica; Kamenarović, Marinka; Kevo, Ratko; Mikulić, Zvjezdica; Piškorić, Oskar. 1974. *Prirodne znamenitosti Hrvatske*. Školska knjiga. Zagreb.
- Bakran-Petricioli, Tatjana. 2011. Priručnik za određivanje morskih staništa u hrvatskoj prema Direktivi o staništima EU. Državni zavod za zaštitu prirode. Zagreb.
- Bakran-Petricioli, Tatjana; Jakl, Zrinka. (no date given). *Morska staništa inventarizacija i praćenje stanja*. Državni zavod za zaštitu prirode. Zagreb.
- Belančić, Anita; Bogdanović, Tomislav; Franković, Matija; Ljuština, Maša; Mihoković, Nino; Vitas, Boria. 2008. *Crvena knjiga vretenaca Hrvatske*. Ministarstvo kulture; Državni zavod za zaštitu prirode; Republika Hrvatska. Zagreb.
- Benac, Čedomir; Čanik, Jelena; Gašparac, Miljenko; Randić, Marko; Vahtar-Jurković, Koraljka. 2003. *Nacionalni park Risnjak. 50 godina*. Primorskogoranska županija. Županijski zavod za održivi razvoj i prostorno planiranje. Rijeka.
- Bišćan, Antonija; Budor, Ivica; Domazetović, Zrinka; Fontana Pudić, Karmela; Francetić, Ivica; Gospočić, Stjepan; Grubešić, Marijan; Huber, Đuro; Jeremić, Jasna; Modrić, Mario; Sindičić, Magda; Tomljanović, Marko; Ugarković, Damir. 2014. Akcijski plan gospodarenja smeđim medvjedom u Republici Hrvatskoj u 2014. godini. Ministarstvo poljoprivrede. Uprava šumarstva, lovstva i drvne industrije; Ministarstvo zaštite okoliša i prirode. Uprava za zaštitu prirode. Zagreb.
- Byatt, Andrew; Fothergill, Alastair; Holmes, Martha. 2002. Plavi planet priroda zemljinih mora i oceana. IZVORI d.o.o. Zagreb.
- Dulčić, Jakov; Kršinić, Frano. 2012. *Povijest prirodoznanstvenih istraživanja Jadranskoga mora*. Hrvatska akademija znanosti i umjetnosti; Institut za oceanografiju i ribarstvo. Split.

- Državni zavod za zaštitu prirode. 2014. *Izvješće o stanju* populacije vuka u Hrvatskoj u 2014. godini. Zagreb.
- Franjić, Jozo; Škvorc, Željko. 2010. *Šumsko drveće i grmlje Hrvatske*. Sveučilište u Zagrebu. Šumarski fakultet. Zagreb.
- Frković, Alojzije. 2012. Tetrijeb gluhan u Gorskom kotaru. Lovački savez Primorsko-goranske županije. Rijeka.
- Gottstein, Sanja. 2010. Priručnik za određivanje podzemnih staništa u Hrvatskoj prema direktivi o staništima EU. Državni zavod za zaštitu prirode. Zagreb.
- Gottstein Matočec, Sanja; Ozimec, Roman; Jalžić, Branko; Kerovec, Mladen; Bakran-Petricioli, Tatjana. 2002. *Raznolikost i ugroženost podzemne faune Hrvatske*. Ministarstvo zaštite okoliša i prostornog uređenja. Zagreb.
- Heinzel, Hermann; Fitter, Richard; Parslow, John. 1999. Collinsov džepni vodič. Ptice Hrvatske i Europe sa Sjevernom Afrikom i Srednjim Istokom. Zagreb.
- Hirc, Dragutin. 1891. Hrvatsko primorje slike, opisi i putopisi. Lavoslav Hartman. Zagreb. (reprint 1993, Tiskara Rijeka).
- Hirc, Dragutin. 1898. *Gorski kotar*. Lavoslav Hartman. Zagreb. (reprint 1993, Tiskara Rijeka).
- Hirc, Dragutin. 1905. Prirodni zemljopis Hrvatske. Zagreb.
- Horaček, Stanislav. 2006. *Strogi rezervat Bijele i Samarske stijene*. Hrvatsko planinarsko društvo. Mrkopalj.
- Jalžić, Branko, et al. 2010. Atlas špiljskih lokaliteta faune Republike Hrvatske. Vol. 1. Hrvatsko biospeleološko društvo; Državni zavod za zaštitu prirode. Zagreb.
- Jalžić, Branko, et al. 2013. Atlas špiljskih lokaliteta faune Republike Hrvatske. Vol. 2. Hrvatsko biospeleološko društvo. Zagreb.
- Jardas, Ivan. 1996. *Jadranska ihtiofauna*. Školska knjiga. Zagreb.
- Jardas, Ivan; Pallaoro, Armin; Vrgoč, Nedo; Jukić-Peladić, Stjepan; Dadić, Vlado. 2008. *Crvena knjiga morskih riba Hrvatske*. Ministarstvo kulture; Državni zavod za zaštitu prirode; Republika Hrvatska. Zagreb.

- Jelić, Dušan; Kuljerić, Marija; Koren, Toni; Treer, Dag; Šalamon, Dragica; Lončar, Mila; Podnar Lešić, Martina; Janev Hutinec, Biljana; Bogdanović, Tomislav; Mekinić, Stjepan; Jelić, Katja. 2015. Crvena knjiga vodozemaca i gmazova Hrvatske. Ministarstvo zaštite okoliša i prirode; Državni zavod za zaštitu prirode; Hrvatsko herpetološko društvo HYLA. Zagreb.
- Kovačić, Sanja; Nikolić, Toni; Ruščić, Mirko; Milović, Milenko; Stamenković, Vanja; Mihelj, Darko; Jasprica, Nenad; Bogdanović, Sandro; Topić, Jasenka. 2008. Flora jadranske obale i otoka. 250 najčešćih vrsta. Školska knjiga. Prirodoslovno-matematički fakultet Sveučilišta u Zagrebu. Zagreb.
- Matoničkin, Ivo; Habdija, Ivan; Primc-Habdija, Biserka. 1998. *Beskralješnjaci*. *Biologija nižih avertebrata*. 3rd edition. Školska knjiga. Zagreb.
- Matoničkin, Ivo; Habdija, Ivan; Primc-Habdija, Biserka. 1999. *Beskralješnjaci. Biologija viših avertebrata*. 3rd edition. Školska knjiga. Zagreb.
- Milišić, Neven. 1991. Školjke i puževi Jadrana. Logos. Split.
- Mohorovičić, Andre (Ed.). 1987. Rapski zbornik. Zbornik radova sa znanstvenog skupa o otoku Rabu. Jugoslavenska akademija znanosti i umjetnosti. Zagreb.
- Nikolić, Toni; Topić, Jasenka. 2005. *Crvena knjiga vaskularne flore Hrvatske*. Ministarstvo kulture; Državni zavod za zaštitu prirode; Republika Hrvatska. Zagreb.
- Ozimec, Roman; Bedek, Jana; Gottstein, Sanja; Jalžić, Branko; Slapnik, Rajko; Štamol, Vesna, Bilandžija, Helena; Dražina, Tvrtko; Kletečki, Eduard; Komerički, Ana; Lukić, Marko; Pavlek, Martina. 2009. *Crvena knjiga špiljske faune Hrvatske*. Ministarstvo kulture; Državni zavod za zaštitu prirode; Republika Hrvatska. Zagreb.
- Pevalek-Kozlina, Branka. 2003. *Fiziologija bilja*. 1st edition. Profil International. Zagreb.
- Rafajlović-Dragović, Gordana; Starac, Ranko; Uroda, Gordana. 2005. Kulturno-povijesna baština Primorsko-goranske županije. Graditeljska baština. Primorsko-goranska županija. Rijeka.

- Randić, Marko, et al. 2003. Prirodna baština Primorskogoranske županije. Vrijednost koja nestaje. Ed. Randić, Marko. Primorsko-goranska županija; Županijski zavod za održivi razvoj i prostorno planiranje. Rijeka.
- Randić, Marko. 2010. Zaštićena prirodna baština Primorskogoranske županije. Primorsko-goranska županija, Rijeka.
- Rucner, Dragutin. 1998. *Ptice hrvatske obale Jadrana*. Hrvatski prirodoslovni muzej; Ministarstvo razvitka i obnove. Zagreb.
- Sokolić, Julijano (Ed.). 1992. *Biologija Cresa i Lošinja*. Otočki ljetopis. Fond za kulturu Cres-Lošinj. Katedra Čakavskog sabora cres-Lošinj. Mali Lošinj – Rijeka.
- Sušić, Goran; Radek, Vesna. 2007. *Bioraznolikost kroz lokve otoka Cresa*. Eko-centar Caput Insulae Beli. Rijeka.
- Šašić, Martina; Mihoci, Iva; Kučinić, Mladen. 2015. *Crvena knjiga danjih leptira Hrvatske*. Ministarstvo zaštite okoliša i prirode; Državni zavod za zaštitu prirode; Hrvatski prirodoslovni muzej. Zagreb.
- Španjol, Željko. 1995. Prirodna obilježja Raba. Grad Rab. Rab.
- Tkalčec, Zdenko; Mešić, Armin; Matočec, Neven; Kušan, Ivan. 2008. *Crvena knjiga gljiva Hrvatske*. Ministarstvo kulture; Državni zavod za zaštitu prirode; Republika Hrvatska. Zagreb.
- Topić, Jasenka; Vukelić, Joso. 2009. Priručnik za određivanje kopnenih staništa u Hrvatskoj prema Direktivi o staništima EU. Državni zavod za zaštitu prirode. Zagreb.
- Turk, Tom. 2011. Pod površinom Mediterana. Školska knjiga. Zagreb.
- Tutiš, Vesna; Kralj, Jelena; Radović, Dragan; Ćiković, Davor; Barišić, Sanja. 2013. *Crvena knjiga ptica Hrvatske*. Ministarstvo zaštite okoliša i prirode; Državni zavod za zaštitu prirode; Republika Hrvatska. Zagreb.
- Vahtar-Jurković, Koraljka. 2004. Opatija urbanistički razvoj i perivojno naslijeđe. Glosa. Rijeka.
- Vahtar-Jurković, Koraljka. 2010. Opatijski gradski perivoji. Arhitektonski fakultet Sveučilišta u Zagrebu; Glosa. Rijeka.

- Vukelić, Joso. 2012. Šumska vegetacija Hrvatske. Sveučilište u Zagrebu; Šumarski fakultet; Državni zavod za zaštitu prirode. Zagreb.
- Vukelić, Joso; Mikac, Stjepan; Baričević, Dario; Bakšić, Darko; Rosavec, Roman. 2008. *Šumska staništa i šumske zajednice u Hrvatskoj*. Nacionalna ekološka mreža. Državni zavod za zaštitu prirode. Zagreb.
- Wittmann, Rudolf. 2009. Veličanstveni svijet drveća. ITD Gaudeamus. Zagreb.

Publications by Priroda Public Institution

- Mance, Vladimir; Briški Đorđević, Ivana; Žagar Moćan, Marjana; Cindrić, Marinko; Pavoković, Gordana; Randić, Marko. (no date given). *Posebni geomorfološki* rezervat. Vrajži prolaz i Zeleni vir. Javna ustanova Priroda. Rijeka.
- Randić, Marko. (no date given). Biološka raznolikost primorskih i podmorskih staništa Primorsko-goranske županije. Upute za nautičare i posjetitelje obalnih područja za očuvanje ugroženih vrsta. Javna ustanova Priroda. Rijeka.
- Randić, Marko; 2010. Čudesni svijet šuma. Osnovne šumske zajednice Primorsko-goranske županije. Javna ustanova Priroda. Rijeka.
- Randić, Marko. 2010. Flora zaštićenih planinskih područja Primorsko-goranske županije. Javna ustanova Priroda. Rijeka.
- Randić, Marko. 2010. Poluotok Lopar. Zaštićeni značajni krajobraz. Javna ustanova Priroda. Rijeka.
- Randić, Marko. 2011. Turistički uređene špilje u Primorsko--goranskoj županiji. Špilje. The Caves. Javna ustanova Priroda. Rijeka.
- Randić, Marko; Cindrić, Marinko. 2010. *Značajni krajobraz Kamačnik*. Javna ustanova Priroda. Rijeka.
- Randić, Marko; Krstinić, Patrik. 2013. Park-šuma Komrčar. Posebni rezervat šumske vegetacije Dundo. Javna ustanova Priroda. Rijeka.

- Randić, Marko; Modrić, Marko. 2011. Park-šuma Japlenški vrh. Park-šuma Golubinjak. Javna ustanova Priroda. Rijeka.
- Rogić, Ivana; Strišković, Sunčica. 2012. Velike zvijeri. Javna ustanova Priroda. Rijeka.
- Tuftan, Pino. ed. 2014. Krajobrazna i biološka raznolikost Primorsko-goranske županije u djelima Dragutina Hirca. Javna ustanova Priroda. Rijeka.

Acts and Laws

Uredba o ekološkoj mreži. 2013. Narodne novine No. 124/2013. i 105/2015. Zagreb.

Zakon o zaštiti prirode. 2013. Narodne novine No. 80/2013. Zagreb.

Websites

http://www.enciklopedija.hr/

http://www.dzzp.hr/

http://www.bioportal.hr/

http://www.natura.org/

http://hirc.botanic.hr/fcd/

http://www.hhdhyla.hr/

http://www.biom.hr/

http://www.plavi-svijet.org/

Scientific studies and reports by Priroda Public Institution

- Bogdanović, Tomislav. 2013. Vrijednost i značaj lokvi Krka kroz istraživanje faune vretenaca (Odonata). Study. Valpovo.
- Grupa autora. 2009. Materijal za izradu stručne podloge za proglašenje staništa močvarnog zmijinca Calla palustris u šumskoj depresiji u Sungerskom lugu botaničkim spomenikom prirode. (Study for proclamation of protection). Javna ustanova Priroda. Rijeka.
- Istraživačko edukacijski centar za zaštitu bjeloglavih supova i prirode Gyps fulvus. 2013. Procjena stanja populacije bjeloglavih supova na području ornitoloških rezervata na Cresu, Krku i Prviću, te Plavniku u 2013. godini. Report. Rijeka.
- Plavi svijet institut za istraživanje i zaštitu mora. 2014. *Utvrđivanje područja kretanja dobrih dupina* (Tursiops truncatus) u sjevernom Jadranu. (Report). Veli Lošinj.
- Studio Perivoj d.o.o. (no dana given). *Projekt obnove park- šume Košljun*. (Study). Malinska.
- Surina, Boštjan. 2014. Analiza i valorizacija staništa gniježđenja kosca (Crex crex) na Natura 2000 području Lič polja (HR2001042). Study. Rijeka.
- Surina, Boštjan; Modrić Surina, Željka. 2012. Istraživanje i vrednovanje flore i vegetacije na području ornitološki vrijednog područja Jezero kod Njivica na otoku Krku. (Elaborate). Prirodoslovni muzej Rijeka. Rijeka.
- Surina, Boštjan; Modrić, Surina; Kružić, Borut. 2012. Regionalni park Obruč. Znanstveni elaborat u svrhe proglašenja područja Obruča regionalnim parkom na osnovu odabranih segmenata prirodne baštine. Javna ustanova Priroda. Rijeka.

Articles

- Poljak. Josip. 1928. *Nova pećina u Zametu*. Hrvatski planinar. No. 7. Zagreb.
- Šašić, Martina; Mihoci, Iva. 2011. Annotated checklist of Croatian butterflies with vernacular names. Natura Croatica. Vol. 20. No 2. 425-436. Zagreb.

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Vedran Lucić (pp. 115, 172)

Kristijan Mandić (p. 387)

Marko Matešić (pp. 92, 97 – lower, 98 – left, 114, 200, 236-237, 286, 287, 388, 400, 440) Nadir Mavrović (p. 198) Marko Modrić (p. 337) Dragan Pelić (p. 446) Josip Poljak (p. 455, archive photograph, published in 1928 in Hrvatski planinar magazine) **Andrej Radalj** (pp. 83, 86-87, 124, 192) Ervin Raguzin (pp. 25, 118 – right, 138 – lower, 228 – left, 272, 310) Marko Randić (pp. 18, 26, 48, 91 – right, 118 – left, 119, 133, 137, 149, 151, 169, 176 – right, 180, 181, 186, 189, 194, 202, 204, 205, 210, 211, 214, 219, 229, 234, 244, 245, 253, 256, 260, 263, 266, 276, 298, 300, 302, 303, 304, 311, 316, 320 – left, 322, 328, 331, 335, 340, 352, 354, 356, 357, 362, 364, 365, 366, 367, 370, 373, 379, 380, 381, 384, 390, 391, 392, 396, 418, 420, 423, 427, 452, 463) Ivana Rogić (pp. 122, 123, 162, 184, 185, 188, 208, 212, 218, 284, 371, 372, 382, 386, 397, 402, 404, 405, 406, 407) Sunčica Strišković (pp. 73 – right, 93, 100, 102, 103, 104, 105, 106, 132, 145, 174, 177, 182, 220, 222, 223, 226, 232-233, 240, 241, 246, 248, 250, 252, 308-309, 317, 318, 319, 320 - right, 324, 326, 339, 368, 422, 426 – left, 436, 437, 441, 448, 450) Vedran Šegota (p. 327) **Sonja Šišić** (pp. 80, 113, 163, 216) Dario Štefančić (pp. 249, 277 – left) Ante Žuljević (p. 58) **Dijana Župan** (pp. 203, 273) *** Priroda Public Institution (pp. 292, 294, 296, 305, 394) **Plavi Svijet** (pp. 74, 76-77)

BIOM Association (p. 158)



Primorje-Gorski Kotar County

