

PROTECTED NATURAL HERITAGE OF THE COUNTY OF PRIMORJE- -GORSKI KOTAR

Strict reserve • National park • Special reserves
Nature park • Nature monuments • Protected landscapes
Forest parks • Monuments of park architecture



PROTECTED NATURAL HERITAGE OF
THE COUNTY OF PRIMORJE-GORSKI KOTAR

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The County of Primorje-Gorski kotar

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NATURAL HERITAGE
OF THE COUNTY OF
PRIMORJE-GORSKI
KOTAR



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Cover photograph

Risnjak National Park - sub-alpine grasslands on Mount Snježnik and globe flower in bloom (*Trollius europaeus*).

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FOREWORD

The County of Primorje-Gorski kotar is abundant in valuable nature areas with preserved unspoiled landscape and beauties of nature. The Tommasini (Učka) bellflower and *Degenia Velebica* endemic plants, griffon vulture, bear, wolf and lynx are just a few of the botanical and faunistic particularities that inhabit this area where the Mediterranean, continental Europe (the Pannonian plain) and the Dinarides come together. In areas where the human hand has left its traces, the landscape was not destroyed but rather transformed over centuries into marvellous rural areas more or less suitable for the dwelling of people, domestic animals and cultivated plants. Some pearls are to be found in the immediate vicinity of human settlements, or even at the very centre of some towns (like the town parks in Opatija).

Over the years, this extraordinary natural heritage has been systematically evaluated, so that today we have about thirty valuable nature areas or individual natural phenomena that are protected by law. Even greater is the number of areas that should be protected according to the land use plan of the county and of individual towns and municipalities: over 120. The total area intended for protection comprises about 18% of the county, which nearly corresponds to the standard of the Natura 2000 network, which at the moment covers 17% of EU territory.

The County of Primorje-Gorski kotar makes every effort to publish books, publications, articles and other educational materials about its natural heritage. Some already published editions include "How to Protect Nature in the County of Primorje-Gorski kotar – A Guide through the Regulations and Species", "Risnjak National Park – 50 Years" and "Natural Heritage of the County of Primorje-Gorski kotar". These publications have been very well received by readers, and the book "Natural Heritage of the County of Primorje-Gorski kotar" has run to a second edition and has also been published on the Internet. The result of this is an ever-increasing number of readers becoming familiar with the valuable natural heritage of the county. But describing the natural heritage is not just important for spreading the word about the natural beauty of the county; it should also act to stimulate visitors to come and experience direct contact with the county's wonderful nature for themselves.

Things that we know and love we preserve more easily and more conscientiously. This book serves as an invitation to all

interested people to come to know and explore the natural heritage of the County of Primorje-Gorski kotar. However, responsibility for taking care of and preserving this county's valuable areas of nature does not rest exclusively with its inhabitants: visitors too should also play an active role. For that very reason, this book has been published in Croatian, English, and German.

Zlatko Komadina, Dipl. Ing.
President of the County of Primorje-Gorski kotar

The quick pace of modern life, driven by cars, PCs and other “technical wonders” has estranged a great many people from the natural world. But deep inside each one of us there is still a deep, inextinguishable yearning for the timeless beauty of nature, no matter how suppressed it might be.

The aim of this book is to show all nature lovers, and those who have yet to become such, the value of the protected areas of nature in the County of Primorje-Gorski kotar.

This book describes all the protected areas in the county, while some of the protected species and geological phenomena are only briefly mentioned. In the County of Primorje-Gorski kotar there are 31 protected areas, which include all categories of protection except regional parks.

Some of the areas remain absolutely undisturbed, like the strict rocky reserve of Bijeje stijene and Samarske stijene; in some of them one can notice the human influence, and some were made completely artificially, like the town parks – monuments of park architecture.

We are confident that every visitor shall be able to find something nice and interesting here to suit his or her own particular taste.

This book’s philosophy is to first provide some basic information about each protected area, its category of protection and its natural features. After that comes a description of the natural points of interest, and at the end it offers brief instructions about how to reach each of the individual areas and how to move around them.

We wish the reader many pleasant moments in these protected areas and many enjoyable new experiences in contact with some of the most stunning areas of nature that the County of Primorje-Gorski kotar has to offer.

Prof. Dr. Sc. Mladen Črnjar

Head of the County Institute for Sustainable Development
and Spatial Planning

Expression of thanks

That this book could have been published in this size and in this form, we are thankful to numerous institutions and individuals that have provided us with indispensable help. In particular, our gratitude goes to the employees of the “Hrvatske šume” Croatian Forest Management Company, Forest Administrations Delnice, Senj and Buzet, as well as to individual forestry offices, tourism offices, local authorities and others that cannot be mentioned here by name.

We would, however, like to express our special gratitude to Mr. Miljenko Gašparac who has patiently read through the texts about Risnjak National Park and some other protected areas in Gorski kotar and provided us with several useful comments, pieces of data and hints with which the original text was improved. Furthermore, we would like to thank Dr. Sc. Goran Sušić for his ornithological data and literature, Mr. Rudolf Komadina for his information about caves in the Lokve region, and Mr. Stanislav Horaček for his stimulating explanations about the natural phenomenon of the Bijele stijene and Samarske stijene rocks.

TABLE OF CONTENTS

Foreword	5
Basic features of the County of Primorje-Gorski kotar	11
Protection of Nature	21
Protected natural heritage of the County of Primorje-Gorski kotar	25
Bijele stijene and Samarske stijene – strict reserve	28
Risnjak – national park	34
Vražji prolaz – Zeleni vir – special reserve (geomorphological)	47
Glavine – Mala luka (Kuntrep) – special reserve (ornithological)	52
Island of Prvić – special reserve (ornithological)	57
Ornithological reserves on the island of Cres	61
Fojiška – Pod Predoščica – special reserve (ornithological)	61
Mali bok – Koromačna – special reserve (ornithological)	61
Dundo forest – special reserve (forest vegetation)	65
Debela Lipa – Velika Rebar – special reserve (forest vegetation)	69
The Glavotok holm oak forest – special reserve (forest vegetation)	73
Učka – nature park	76
Lokvarka cave – nature monument (geomorphological) ...	84
Gotovž ponor near Klana – nature monument (geomorphological)	87
Zametska cave – nature monument (geomorphological) ...	89
Source of the River Kupa – nature monument (hydrological)	91
Old yew tree in Međedi – nature monument (individual tree specimen)	94
Old oak tree near Sv. Petar on the island of Cres – nature monument (individual tree specimen)	96
Old oak trees in Guljanov dolac near Crikvenica – nature monuments (individual tree specimens)	98
Lisina – protected landscape	101
Kamačnik – protected landscape	106
Lopar – protected landscape	112

Japlenški vrh – forest park	116
Golubinjak – forest park	121
Komrčar – forest park	125
Košljun – forest park	128
Čikat – forest park	132
Pod Javori – forest park	136
Park alongside the castle in Severin na Kupi – monument of park architecture	140
Angiolina Park in Opatija – monument of park architecture	144
Margarita Park in Opatija – monument of park architecture	148
Stone pine in the bay of Žalić on the island of Lošinj – monument of park architecture (individual tree specimen)	152
Table of references	155

BASIC FEATURES OF THE COUNTY OF PRIMORJE-GORSKI KOTAR¹

The County of Primorje-Gorski kotar is located in the western part of the Republic of Croatia and comprises an area of 7,990.57 km². 3,591.93 km² of it is land, and 4,398.64 km² of it is sea.

The varied landscape of the county comprises four main parts: the sea, the islands, the coast and the mountains, each with its own special characteristics and points of interest. The sea area comprises a large part of the Bay of Kvarner, the Bay of Rijeka and the Velebit and Vinodol channels, as well as the four large islands: Krk, Rab, Cres and Lošinj with their surrounding small islands. In addition to these four large islands (Cres 405.78 km², Krk 405.78 km², Rab 90.84 km², Lošinj 74.68 km²) there are some more small islands and a number of islets, rocks and reefs. There are as many as 55 islands in the County of Primorje-Gorski kotar, while the number of rocks and reefs can only be estimated, but more than sixty rocks and more than ten reefs.

The littoral part can be roughly divided into Liburnia, the Rijeka coast and the Crikvenica-Novi Vinodolski coast. The mountainous parts comprise the forest areas of Gorski kotar and the mountain ranges of Učka and Ćićarija. The highest peaks are Bjelolasica 1,534 m, Risnjak 1,528 m, Snježnik 1,505 m, Obruč 1,376 m and Učka 1,401 m. In the County of Primorje-Gorski kotar there are 73 peaks higher than 1,250 metres.

According to the census from the year 2001, there are 305,505 inhabitants in the county with an average population density of 85 inhabitants/km². Large parts of the county are almost uninhabited though, especially in the wooded mountain areas.

Fifty percent of the total population lives in the city of Rijeka, the county's main urban centre. Rijeka is the administrative, cultural and university centre of the County of Primorje-Gorski kotar, a leading Croatian harbour and an important industrial town. Visitors interested in nature and flora and fauna should visit the Museum of Natural Sciences, which has an aquarium and a botanical garden. In addition, the town has a fine heritage of great cultural and historical value. Old littoral towns

¹ The County of Primorje-Gorski kotar is the official name of the Croatian unit of regional self-government that includes the Bay of Kvarner with the islands Krk, Cres, Lošinj and Rab, the surrounding coast and the mountainous hinterland of Gorski kotar. (Translator's note)



■ *The ancient town of Lubenice on the island of Cres.*

scattered across the islands and the coastline are small architectural pearls harmoniously blending with the surrounding landscape. Coastal karstic landscapes also abound in picturesque dry-stone walls (“gromače”), terraces and other testimonies to their long rural tradition.

The people of the County of Primorje-Gorski kotar are involved in many different economic activities. In the mountainous areas of Gorski kotar, people mostly live from potato cultivation, forestry and wood processing. The greatest part of industry is concentrated in the littoral area, while the islanders mostly make their living from tourism. Traditional Mediterranean agriculture (sheep breeding, olive growing and wine production) has regrettably become rather neglected.

Geological base

The geological base of the County of Primorje-Gorski kotar is made of carbonate Mesozoic and Palaeogene rocks, Palaeozoic and Triassic clastic rocks, and Palaeogene flysch rocks. They all make up the bedrock on which the layered proluvial-alluvial and lake sediments on the mainland and marine sediments on the seabed of the county are deposited.

Carbonate rocks prevail in the mountainous and littoral parts of the mainland and on the islands. They are mostly karstic and are characterised by a lack of water on their surface and streams underground. Limestone and dolomite are characterised by different features. Due to a great deal of wear, dolomite

displays a rather moderate and rounded relief, with more green areas. Limestone is mostly characterised by a developed surface and underground karst features (cliffs, sinkholes, gullies, gorges, caves, etc.).

The continuity of carbonate rocks in the continental part of the county is interrupted by water-impermeable Palaeozoic and Triassic clastic rocks. Along the coastline and on the islands, over large areas formed from carbonate rocks, there are small and large occurrences of Palaeogene flysch, which is also water-impermeable. A unique phenomenon are the small flysch islands near the coast of the island of Rab that have also been formed partially in flysch.

Unlike occurrences on the land, which are isolated and only over relatively small areas, loose sediments of proluvial-alluvial and marine origin cover large parts of the seabed.

Eruptive rocks, probably belonging to the middle Triassic period, are to be found in a few very small areas near Benkovac Fužinski and Lepenica.

An interesting particularity are the loess islands of Susak and Srakane where thick sediments of sand have been deposited



■ *Layers of limestone rocks and a shallow brown soil on Mount Učka.*

on carbonate rocks. Their origin is explained by the eolian theory (sand carried by wind during the ice ages!).

Soils

In the soils, which are closely connected to the geological bedrock, a variety of vegetation has developed. Due to the mainly karstic structure, the soils in the county are mostly shallow and stony, especially along the coastline and on the islands. Particularly picturesque are the bare rocky deserts on some parts of the islands of Krk, Cres and Rab, also known as “lunar landscapes”. These are rocky grounds with evident water and wind erosion. It may sound surprising, but even these surfaces were once covered with trees! There are 58 types of soil in the county area, a fact that indicates the variety of the ecological circumstances. The most widespread types of soil on carbonate rocks are red and brown soils on limestone at lower altitudes, while brown alpine soils are to be found at higher altitudes. Rendzina occurs on dolomite, on flysch marl and on some other loose subsurfaces. Ranker soils develop on flysch and silicate rocks, while deeper profiles, partly on carbonate rock, are occupied by lessive soils. Dystric brown soils have developed mainly in the mountainous areas of Gorski kotar on various bedrocks and in climatic conditions with lot of precipitation. Podsoles are highly washed-out and acidic soils that cover the acid silicate bedrock in the coniferous woods in Gorski kotar. Rare types of soil are, for example, eutric brown



■ *Terraces are important for the cultivation of karstic land – terraces in the hamlet of Zvoneča beneath Lisina.*

soils, some hydromorphic, salty soils near the coast, sierozems and others. Most important arable lands are anthropogenic deeply plowed soils and anthropogenic soils on terraces that were created by hard labour: extracting stones, building dry stone walls and transporting arable soils into the area.

Waters

The occurrence of surface water flows and standing waters in the area of the County of Primorje-Gorski kotar is mostly connected to the geological structure of the area and the amount of precipitation. Carbonate karst rocks are characterised by surface waterlessness and underground water streams, numerous pits and ponors, abundant karst springs in places where carbonate rocks (limestone and dolomite) come together with water-impermeable rocks, as well as many submarine springs near the coast. On the impermeable rocks a hydrographic network of surface water flows – rivers and streams – developed. The River Kupa is the most important flow of water in the County of Primorje-Gorski kotar and the largest preserved mountain river in Croatia. Its pearl is a completely untainted vaclusian spring that wells up underneath a steep cliff out of a clear small lake over 80 metres deep. The largest tributary rivers of the Kupa are the Čabranka and Kupica. In the high karst area there are some streams that disappear into ponors and continue flowing underground. These waters are mostly used for power-supply purposes, although it is planned



■ *At certain times of the year, swollen springs turn the karst doline of Ponikve into a temporary lake.*

to use them for water-supply purposes as well. There are several picturesque storage lakes that fit relatively well into the mountainous landscape - these are the lakes of Lokve, Križ, Bajer and storage reservoirs of Lepenica and Potkoš.

The watershed between the Adriatic and the Black Sea catchment area passes through the high mountain karst area at a distance of only 12 kilometres from the Adriatic Sea.

The islands of Cres and Krk are the only islands in Croatia that have significant permanent surface waters. Lake Vrana, or Vransko jezero, on the island of Cres is listed as one of the world's foremost hydrological phenomena and the stream of Suha rečina (Vela rika) in the Baška area of the island of Krk is the only permanent surface stream of water on all the Adriatic islands!

Wonderful hydrological phenomena, especially karst springs, clear rivers and streams, ravines and gorges; small water habitats with rich flora and fauna such as ponds, streams and tiny springs; as well as the unusual variety of water landscapes attract ever more tourists to come here to enjoy these unique beauties.

Climate

The climatic conditions of the county vary quite a bit because the relief barrier of the north-western Dinarides prevents greater influence of the sea on the continental hinterland, and vice versa. The local climate mostly depends on altitude and closeness to the sea. There are three basic types of local climate: Mediterranean climate on Kvarner islands and along the coastline, sub-Mediterranean on littoral slopes, and continental in most of Gorski kotar.

In the Mediterranean area the summers are hot and the rainy periods are divided across autumn, winter and spring. The yearly average precipitation is between 963 and 1,250 mm (or l/m²). In the higher, sub-Mediterranean climatic belt the temperatures are slightly lower, especially in winter, with more precipitation. The climate in the mountain areas is harsh with low yearly temperatures and most precipitation in Croatia – the average is 3,600 mm (or l/m²)! In winter there is a lot of snow in these mountain areas.

Karst dolines or sinkholes have a very interesting micro-climate - they represent a kind of “frosty ravines”, places with low temperatures all year round, characterised by the phenomenon of “inversion of vegetational belts”, meaning the deeper you go into the doline, the more plants you find that usually grow at



■ The plant and animal world on Kvarner has adapted to the strong bora wind – meadows of narrow-leaved moor grass (*Sesleria juncifolia*) beneath Mount Učka.

higher altitudes. The temperature in some deep sinkholes in Risnjak can sink below zero at any time of the year!

The most common winds are the *bora*, a cold wind that blows down from the mountains, and the *jugo* (sirocco), the southern wind. Visitors should be warned about their sometimes-evil nature!

The *bora* is a cold, dry wind that blows in gusts often with ferocious force and velocity, mostly from the north-western quadrant. It can appear at any time of the year, but is most common in winter. It creates clouds of sea foam and salt. The *jugo* is a wind from the southern quadrant that brings humidity, rain and snow in winter. It blows continuously and creates rather high waves. While the *bora* usually brings bright weather and cheers people up, the *jugo* brings gloomy and rainy weather and usually has a negative effect on people's temper.

The greatest ever velocity of the *bora* recorded in the County of Primorje-Gorski kotar was on 14th November 2004 when a gust of *bora* at the bridge that connects the island of Krk with

the mainland reached 215 km/h. Such conditions usually lead to material damage and represent a danger to human life, especially for those who find themselves unprotected out at sea.

Flora, fauna, vegetation

The flora and fauna of the County of Primorje-Gorski kotar is of interest to natural scientists because this relatively small but ecologically diverse area is the meeting point of the Mediterranean and the Eurosiberian-North-American biogeographical region of the northern hemisphere (Holarctis), which causes great varieties in biology and landscape.

Due to a rather southerly position on the European mainland and the vicinity of the sea, the flora and fauna in the area of the County of Primorje-Gorski kotar has not experienced such great changes and impoverishment during the ice ages as was the case with some other parts of the European continent. Today we know that there were smaller glaciers in the area around Risnjak, but they did not significantly disturb the continuity of life in this region. This and the variety of ecological conditions are the main reasons for its abundant natural life today, with a number of endemic and relict species.

Some facts show this very clearly: it is estimated that the flora of higher plants (flowering plants and ferns) in the county comprises over 2,700 species. Some islands have more than 1,300 plant species, which is more than the total number of plants in some European states. This is where the last populations of griffon vultures and dolphins in Croatia live, as well as all three great European carnivores – the wolf, lynx and bear. Numerous endemic species have also developed here. Endemic plants include species specific to Kvarner-Liburnia and the Illyrian-Adriatic region. Special fauna includes underground karst fauna, which is significant due to its unique forms and relicts, mostly endemic. Among other species, here you can find the proteus or olm, and a row of biologically interesting snails, crustaceans, pseudoscorpions, beetles and other invertebrates.

The primeval vegetation in the county area consists exclusively of forests. There are approximately thirty basic forest associations (out of fifty that are to be found across Croatia), which are divided into several zones and altitudinal belts. In the areas that due to ecological conditions are not covered with woods, there are associations of rocks, screes, alpine grasslands, floodlands and bogs, etc. These associations are highly significant for natural science because they represent rare and endangered types of vegetation and include numerous endemic and relict spe-



■ *Lot of endemic species grow on the rocks of Kvarner – endemic plant association in the fissures of coastal rocks near Brseč.*

cies. Meadows and pastures are the result of deforestation, and today they have become partly overgrown with forests again due to lesser extent of agricultural usage.

There are several vegetation zones in the county area:

- 1) Zone of evergreen forests and holm oak macchia, developed in warm parts of Kvarner islands and with interruptions along the Liburnian coast up to the Medveja cove.
- 2) Zone of deciduous sub-Mediterranean vegetation, developed on most of the island of Krk, in the northern parts of the island of Cres and along most of the coastline. It consists mainly of degraded oriental hornbeam and downy oak forests and thickets as well as of rocky pastures and meadows.
- 3) Mediterranean-mountainous vegetational belt with hop hornbeam forests and thickets, as well as with special

types of rocky pastures with various plants. It exists between altitudes of 450 – 900 m on the slopes of the littoral mountain range.

- 4) Zone of moderate humid beech forests spread across Mount Učka and most of Gorski kotar. Horizontally and vertically it is divided into several associations with beech as the prevailing tree. In a special altitudinal belt fir also grows, and these are the most beautiful and economically most valuable forests in Gorski kotar. Mountain meadows and heaths are the result of the deforestation of these forests.
- 5) Zone of moderate humid sessile oak and common hornbeam forests comprising the border areas of Gorski kotar towards the continent. Here we find meadows, brake-tracts and heaths. The soil is partly arable.
- 6) Zone of mountain shrub pine comprising the highest parts of Gorski kotar, where vegetation associated with rocks and mountain grasslands has also developed.



■ Karstic subterranean areas are abundant in cave fauna – scientists investigate a bat colony in the cave of Peč va Zagori.

PROTECTION OF NATURE

The valuable natural resources in the County of Primorje-Gorski kotar should be particularly taken care of.

In the Republic of Croatia, the protection of nature is regulated by the Law for the Protection of Nature ("Narodne novine", Official Gazette, no. 70/05). According to this law, valuable areas of nature and individual specimens are protected by several categories of protection:

- strict reserve
- national park
- special reserve
- nature park
- regional park
- nature monument
- protected landscape
- forest park
- monument of park architecture

National parks and nature parks are proclaimed by the Croatian Parliament (Hrvatski sabor). Strict and special reserves and protected nature areas that spread across two or more counties are proclaimed by the Croatian Government at the suggestion of the relevant ministry. The County Assembly or the Assembly of the City of Zagreb proclaim regional parks, protected landscapes, forest parks, nature monuments and monuments of park architecture.

There are approximately 430 protected areas in the Republic of Croatia (national parks, nature parks, strict and special reserves, forest parks, monuments of park architecture and protected landscapes), including eight national parks and ten nature parks.

All the protected areas in Croatia together cover an area of 5,988 km² or 9.4% of the state territory, of which 994 km² or 1.1% of the state territory is taken up by national parks.

In the County of Primorje-Gorski kotar there are approximately thirty protected areas and individual phenomena covering an area of 276.58 km², or 7.7% of the county territory. Included in this are all the categories of protection except regional parks. The largest are Učka Nature Park comprising 160 km² (of which approximately 50% lies in the County of Primorje-Gorski kotar and the rest in the County of Istria) and Risnjak National Park covering 64 km².

According to the spatial plan for the County of Primorje-Gorski kotar ("Službene novine" official gazette, no. 14/00) and the individual spatial plans for its municipalities and towns, approximately a further one hundred valuable nature areas in the county should be protected by law under different categories of protection. The legal procedure for their protection must first be completed.

This book contains descriptions of the natural areas in the County of Primorje-Gorski kotar that are protected by law. For each area we have collected - partly on the spot - interesting information that should prompt visitors to do some further research on their own.

Visitors shall be warned about the following regulations from the Law for Protection of Nature:

- In a strict reserve, no economic or other activities are permitted. This type of reserve is intended exclusively for the preservation of unspoilt nature, scientific research that does not affect the biological diversity, observations of the state of nature, and education that does not endanger natural processes. For visits to a strict reserve aimed at research or education, permission from the relevant ministry must be obtained.
- In a national park, only activities that do not endanger nature are permitted. The rules of behaviour in a national park are to be found in the *Regulations about internal order in Risnjak National Park* that were published in the *Narodne novine* official gazette, no. 75/00. Some of the rules in Risnjak National Park are:
 - No waste disposal outside marked areas
 - No picking, gathering, removing from their habitat or damaging of plants without permission from the Ministry
 - No scattering, chasing, disturbing, catching, hurting or killing of animals
 - No gathering of frogs, snails, fungi or medicinal herbs
 - No hunting or any type of hunting activities
 - No fishing, except recreational fishing with a valid permit
 - No hunting, gathering or removing of water animals, except for scientific and educational purposes with a permit from the Ministry
 - All scientific research in the area of the National Park must have the agreement of the Risnjak National Park Public Institution

- Visitors may only enter the park through the marked entrances
- Inside the park, visitors may only walk on marked areas and paths that are intended for sightseeing
- Dogs must be kept on a leash
- No camping except in designated areas
- No open fires outside settlements or marked areas
- No swimming.
- In a special reserve, no activities are allowed that endanger the very qualities for which the area was proclaimed a special reserve.
 - No picking or destroying plants
 - No disturbing, chasing or killing animals
 - No introduction of new biological taxa
 - No irrigation or other land improvement interventions
 - No economic or other types of land usage.
- In a nature park, only economic and other types of activities are permitted that do not endanger the park's essential qualities and role.
- On a nature monument and in the immediate surroundings that are part of the protected area, no activities are allowed that would endanger its qualities and values.
- In a protected landscape, no activities and interventions are allowed that would endanger the very qualities for which the area was proclaimed a protected landscape.
- In a forest park, only activities and interventions for maintenance purposes are allowed.
- On a monument of park architecture and in the immediate surroundings that form part of the protected area, no interventions or activities are allowed that would change or endanger the very quality for which it was protected.

Protected species

Individual plants and animals as well as some fungi that are classified as endangered and rare are protected by the State. The protection of such taxa is announced by the minister of the relevant ministry on the basis of an expert assessment with prior agreement by the minister of forestry, hunting and fishing.

Through a number of decrees issued before 1991, a great number of plant species were protected, while a lot of animal

species and some fungi were protected in the last decade by corresponding regulations. The amounts of fines for damaging protected animals have also been set. These regulations can be found on the Internet at: http://www.min-kulture.hr/propisi/propisi_fr.html and <http://www.nn.hr>.

Any activity by which a protected plant, fungus or animal could be disturbed in its natural life and free development is forbidden.

Protected also are all the wild plants, fungi and wild animals in a strict reserve, national park or special reserve, as well as animals in caves, even if they are not explicitly protected as species.

Species that are not protected by law

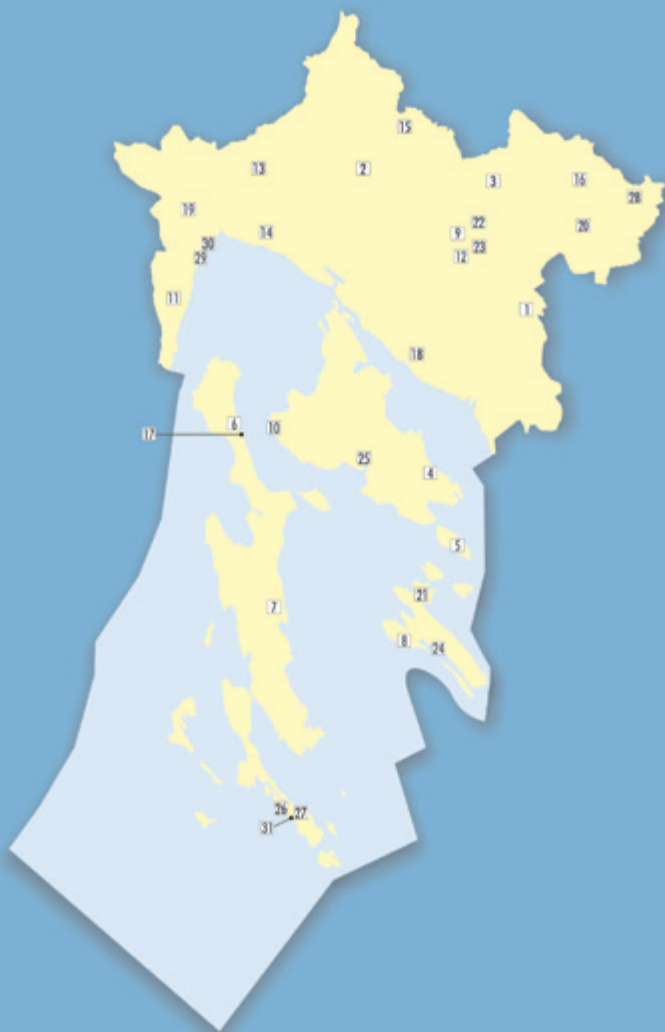
Permission must be obtained from the relevant ministry to gather species or to hunt or kill, for processing, trading or other commercial purposes, any animals that are not protected.

Surveillance of the protected nature

National parks and nature parks are controlled by inspectors (rangers) who are employed by the public bodies that manage the parks, or by the inspectorate for nature protection, which is also responsible for other protected areas. At present, there are no rangers in the County of Primorje-Gorski kotar within public bodies that were established by local authorities according to the law.

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Forest parks
Monuments of park architecture

PROTECTED NATURAL HERITAGE OF THE COUNTY OF PRIMORJE-GORSKI KOTAR



1. Bijele stijene and Samarske stijene – strict reserve
2. Risnjak – national park
3. “Vražji prolaz” and “Zeleni vir” – special reserve (geomorphological)
4. Glavine – Mala luka – special reserve (ornithological)
5. Prvić – special reserve (ornithological)
6. Ornithological reserve on Cres: Fojiška – Pod Predošćica – special reserve (ornithological)
7. Ornithological reserve on Cres: Mali bok – Koromačna – special reserve (ornithological)
8. Dundo – special reserve (forest vegetation)
9. Debela Lipa – Velika Rebar – special reserve (forest vegetation)
10. Glavotok – special reserve (forest vegetation)
11. Učka – nature park
12. The cave of Špilja Lokvarka – nature monument (geomorphological)
13. Ponor Gotovž – nature monument (geomorphological)
14. The cave of Zametska pećina – nature monument (geomorphological)
15. Source of the River Kupa – nature monument (hydrological)
16. Old yew tree in Međedi – nature monument (individual tree specimen)
17. Old oak tree in Sveti Petar – nature monument (individual tree specimen)
18. Two ancient oaks in Guljanov dolac near Crikvenica – nature monuments (individual tree specimens)
19. Lisina – protected landscape
20. Kamačnik – protected landscape
21. Lopar – protected landscape
22. Japlenški vrh – forest park
23. Golubinjak – forest park
24. Komrčar – forest park
25. Košljun – forest park
26. Čikat – forest park
27. Pod Javori – forest park
28. Park near the castle on Severin na Kupi – monument of park architecture
29. Angiolina Park in Opatija – monument of park architecture
30. Margarita Park in Opatija – monument of park architecture
31. Stone pine in Žalić bay near Mali Lošinj – monument of park architecture (individual tree specimen)

BIJELE STIJENE AND SAMARSKJE STIJENE

Bijele stijene (White Rocks) and Samarske stijene (Samarske Rocks) are the only strict reserve in the County of Primorje-Gorski kotar. This area is protected by the strictest regulations. Only one other area in Croatia has similar protection – “Hajdučki i Rožanski kukovi” on the Velebit! In the Strict Reserve everything is subordinated to the goal of preserving unspoiled nature. A permit from the relevant ministry should be obtained even for educational or research visits. Due to the natural wilderness and the inaccessible karst terrain with numerous sinkholes, rocks and stone towers, Bijele stijene and Samarske stijene are impassable beyond the marked trails. Actually, visitors are not even permitted to deviate from the marked trails. It is precisely because of its wilderness and inaccessibility that this area has preserved the authentic features of untouched nature, leaving a deep impression on every visitor.

Category of protection: Strict Nature Reserve

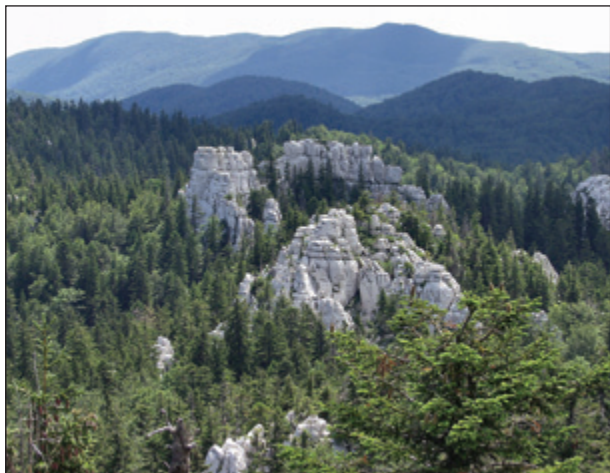
Proclaimed in the year: 1985

Document proclaiming protection: The Law Designating Bijele stijene and Samarske stijene a Strict Nature Reserve, *Narodne novine* Official Gazette, No. 5/85

Area: 1,175 hectares (a smaller part of this area, around 191 ha, is in the County of Karlovac, in the area of the Town of Ogulin)

Location: area of Novi Vinodolski and the Municipality of Mrkopalj (Gorski kotar)

Altitude: 1,000 - 1,335 m



■ Karst detail from Samarske stijene – a group of stones known as "The stairs" rises above the surrounding forests.

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 the mentioned rocks belong to the middle range which begins at Mrkopalj with Čelimbaša (1,089 m), continues over Velika crna kosa and Mala crna kosa (1,223 m and 1,163 m, respectively) on to the Samarske stijene (1,032 m) and Bijele stijene (1,335 m) and further on to Velika Javornica (1,375 m), the highest point of this range. Due to their preserved nature and hardness to reach, the rocks were proclaimed a Strict Nature Reserve in 1985. They cover an area of 1,175 hectares, a smaller part of which is in the County of Karlovac.

Bijele stijene and Samarske stijene are made of layered limestone and lumpy limestone breccias that give them the characteristic feature of a developed karst relief. They present many unusual rock forms, sharp edged peaks, sheer rock faces up to 50 metres tall, towers, grooves, narrow passages and crevices, stone scales and deep dolines which sometimes contain perennial ice... This treasure of stone forms is intertwined with the forest world from which individual rock forms protrude, giving them a wild, inaccessible, but at the same time superbly aesthetic look. Bijele stijene are separated from Samarske stijene by the wooded and impenetrable Crna draga gorge. Although the aerial distance between the two rock formations is

Flora: edelweiss (*Leontopodium alpinum*), rock sedge (*Carex rupestris*), Austrian leopard's bane (*Doronicum austriacum*), adenostyle (*Adenostyles alliariae*), alpine sow thistle (*Cicerbita alpina*), alpine sea holly (*Eryngium alpinum*), numerous forest plant species, ferns, mosses...



Fauna: bear (*Ursus arctos*) and numerous other forest mammals, three-toed woodpecker (*Picoides tridactylus*), black woodpecker (*Dryocopus martius*), Eurasian eagle owl (*Bubo bubo*), viviparous lizard (*Lacerta vivipara*), Horvath's rock lizard (*Iberolacerta horvathi*), alpine salamander (*Salamandra atra*), an abundance of invertebrates



Vegetation: mixed fir-beech forest (*Abieti-Fagetum* s.l.), silver fir forest with small-reed, better known as fir forest on calcareous blocks (*Calamagrostio-Abietetum*), vegetation of rocks and tall herbs ("mountain gardens")



Special site of interest: karst relief very difficult to access and unusual forms of white calcareous rocks intertwined with luxuriant woodland



small, just over two kilometres, several punishing hours of walking are necessary to cover this distance on the ground.

Climatically, the rocks are characterised by a harsh sub-alpine climate with lots of precipitation, as much as 2,000 – 3,000 millimetres per year, particularly snow. Nevertheless, they contain no surface water or springs, and are entirely waterless. All the water quickly vanishes into the karst sub-terrain. Only in hollows does the snow ever remain for a long time, sometimes throughout the year.

The picturesque rock forms, their furrowed surfaces and indentedness are mostly due to the activity of precipitations and the melting of snow and other atmospheric influences, particularly the hot and cold cycles that the rocks are exposed to. Although less impressive than the bizarre rock formations, it is the varied forest world which gives the characteristic appearance to these regions of pristine nature. Fir trees, spruces, beeches, maple trees... of all shapes and ages, growing often in the most “impossible” sites, make a marked contrast to the whiteness of the rocks.

As elsewhere at this altitude in the Gorski kotar mountains, the fir-beech forest is represented (*Abieti-Fagetum* s.l.), but particularly important is the fir forest on rocky terrain, the association of fir trees and small-reed (*Calamagrostio-Abietetum*).

The spruce forest chooses cooler habitats in shaded areas and at the bottom of dolines (sinkholes) and depressions. Due to the inaccessibility of the rocks, these forests have been spared from logging and have partially preserved their virgin forest



■ *Ratko's shelter in Samarske stijene.*



■ Horvath's rock lizard (*Iberolacerta horvathi*) – a relict and endemic species.

structure until the present day. The forest here dies of itself and regenerates itself! The highest parts of the mentioned rocks are also overgrown with sub-alpine beech forest and shrub-like vegetation with alpine juniper (*Juniperus communis* ssp. *alpina*). Due to its preserved and wild nature, the reserve is characterised by abundant flora and fauna. In the rocky crevices one can find untouched habitats of the edelweiss (*Leontopodium alpinum*), while rich mosses grow in the more shaded areas. Due to the variation in the amount of sunlight received, however, there are also great differences in the flora and fauna of the rocks themselves. On slopes exposed to sun one can find some thermophile species. On the summit of Bi-jele stijene a rare species of alpine sedge has been found – rock sedge (*Carex rupestris*). In dolines and humid depressions between the rocks there is a rich vegetation of tall herbs. Apart from luxuriant ferns, at the time of flowering one can see the yellow heads of the Austrian leopard's bane (*Doronicum austriacum*); elsewhere predominate the violet flowerings of common adenostyle (*Adenostyles alliariae*), or the blue heads of the alpine sow thistle (*Cicerbita alpina*) and the rare alpine sea holly (*Eryngium alpinum*). Juicy shoots of the alpine sow thistle are a favourite food for bears who find these rocks an ideal undisturbed location for making their den.

The wolf is also an occasional visitor to the rocks, while their permanent residents include the fox, badger, skunk, pine marten, stone marten, wildcat, squirrel, dormouse, numerous small mammals and other species. Among birds, there are



■ Blossoms of the alpine blue-sow-thistle (*Cicerbita alpina*) – juicy shoots of this alpine composite are a favourite food of bears.

several rarities: three-toed woodpecker (*Picoides tridactylus*), black woodpecker (*Dryocopus martius*), Eurasian eagle owl (*Bubo bubo*) and others. Of particular interest is the three-toed woodpecker (*Picoides tridactylus*) which is a glacial relict linked to the boreal coniferous forests.

Significant for the herpetofauna are the Horvath's rock lizard (*Iberolacerta horvathi*) and the viviparous lizard (*Lacerta vivipara*). Particularly interesting and rare among the amphibians is the alpine salamander (*Salamandra atra*) which does not need water for multiplying (because its young are born directly rather than hatching from an egg), which is why it chooses this type of waterless mountain area for its habitat.

Bijele stijene and Samarske stijene are somewhat different in their natural characteristics. This can be ascribed to differences in geological structure – differences in resistance of limestone rocks of the Jurassic Period. Bijele stijene have amassed a treasure of most interesting stone forms, and these rocks –

consisting of limestone breccias – are resistant to erosion. Here, jagged rocky peaks with a pronounced vertical indentedness have formed. Bijele stijene are also somewhat more accessible and host a climbers' hut and a climbers' shelter.

Samarske stijene consist of around twenty independent stone groups. Forms of rock – cliffs, towers, smaller grooved ridge tops are shaped in layered Jurassic limestone. Between the rocks there is a labyrinth of dolines or sinkholes. The log shelter for climbers in Samarske stijene is situated in an unusual and interesting position – in a half-cave under a hanging rock. It is thus well protected from adverse weather conditions.

Tour

The approach to Bijele stijene and Samarske stijene is by a gravel road through forest starting from Vojni Tuk (3 km from Mrkopalj and 18 km from Delnice) over the Matic poljana field and further on to Mlečikov lug where a climbing path takes off for Samarske stijene. Two kilometres further, another path branches off for Bijele stijene. The road leads all the way to Jasenak, so that the rocks can be approached from that side as well. Needless to mention, all nature in the strict reserve is fully protected. It should not be damaged or endangered in any way and the visitors should keep themselves strictly to the marked paths.

ADDRESSES

- Municipality of Mrkopalj Tourism Office, Stari kraj 3, 51315 Mrkopalj; tel.: +385 (0)51 833 225
e-mail: tz.mrkopalj@inet.hr, web: www.tz-mrkopalj.hr
- Bijele stijene Croatian Mountaineering Club, Stari kraj 3, pp 9, 51315 Mrkopalj (the club is willing and able to provide a competent guide through the Reserve)

RISNJAK

Although the regions of Risnjak, the only national park in the County of Primorje-Gorski kotar, lack the grandeur of the Alps or the massive body of Velebit and some other high mountains, they nevertheless make a unique and lasting impression on their visitors. The secret lies in a combination of their compact rocky karst relief, stupendous views, a varied and fascinating forest world, the mixing of alpine and dinaric flora on the grasslands of Snježnik close to the sea, and the turquoise waters of the vaclusian spring of the River Kupa as it rushes forth from the unknown depths of the karst structures.

Some visitors will be fascinated by the changing appearance of the mountain as the seasons fluctuate, others will become absorbed in contemplation of the micro-worlds of the mountain trees, shrubs, grasses, ferns, flowers, butterflies, mushrooms... all the way to the worlds of miniature bugs, mosses, lichens and algae in the crevices of rocks and on the bark of the trees. The images and shapes of nature change quickly here; a cloudless blue sky can suddenly produce threatening stormy clouds. On a wall of fog one might briefly perceive one of the curious optical phenomena that sometimes occur amidst such changes.

As one climbs towards the peaks, one witnesses, as if arranged by floors, different forest communities. Even when descending into the deep sinkholes, the vegetation changes quickly, but in reverse order than on the peaks...

Category of protection: National Park

Proclaimed in the year: 1953

Document proclaiming protection: the Law Designating Risnjak Forest a National Park, *Narodne novine* Official Gazette No. 43/53 and the Law on the Amendments and Additions to the Law Designating Risnjak Forest a National Park, *Narodne novine* Official Gazette, No. 13/97

Area: 6,400 hectares

Position: the town areas of Bakar, Čabar and Delnice and the areas of Čavle and Lokve Municipalities (Gorski kotar)

Altitude: 290 - 1,528 m

Main peaks: Veliki Risnjak 1,528 m, Snježnik 1,505 m, Guslica 1,490 m, Planina 1,426 m

Deepest dolines (sinkholes): Viljska ponikva (200-m deep) and Velika ponikva on Smrekovac (around 150-m deep)



Flora: dwarf mountain pine (*Pinus mugo*), edelweiss (*Leontopodium alpinum*), alpine sea holly (*Eryngium alpinum*), hairy alpenrose (*Rhododendron hirsutum*), silvery yarrow (*Achillea clavinae*), alpine aster (*Aster alpinus*), yellow gentian (*Gentiana symphyandra*), Clusius gentian (*Gentiana clusii*), alpine pasque-flower (*Pulsatilla alpina ssp. alpina*), globe-flower (*Trollius europaeus*), long-flowered primrose (*Primula longiflora*), alpine snowbell (*Soldanella alpina*), Carniolan lily (*Lilium carniolicum*), narrow-leaved moorgrass (*Sesleria juncifolia*), Bosnian fescue (*Festuca bosniaca* = *F. pungens*), sedge (*Carex firma*), grassy bells (*Edraianthus graminifolius*), many forest plant species, ferns, mosses and mushrooms.



Fauna: bear (*Ursus arctos*), wolf (*Canis lupus*), lynx (*Lynx lynx*) and numerous other forest mammals, chamois (*Rupicapra rupicapra*), capercaillie or wood grouse (*Tetrao urogallus*), black woodpecker (*Dryocopus martius*), Eurasian eagle owl (*Bubo bubo*), three-toed woodpecker (*Picoides tridactylus*), Ring Ouzel (*Turdus torquatus*), viviparous lizard (*Lacerta vivipara*), Horvath's rock lizard (*Iberolacerta horvathi*), alpine salamander (*Salamandra atra*), ground-beetles, an abundance of butterflies in the Kupa valley.



Vegetation: 14 different forest associations, over twenty types of grasslands, rock communities, tall herbs, bogs and other



Special sites of interest: the Leska educational trail, a vegetational phenomenon of dolines (sinkholes), an integral high-altitude vegetational profile of Gorski kotar, a rich fauna, virgin forest region of Biješe stijene, interesting flora and vegetation of sub-alpine grasslands in the Snježnik group, the vauculian spring of Kupa, geomorphological phenomenon of the Sušica ravine

Note: The park is managed by the Risnjak National Park Public Authority.



■ *Risnjak's peak*

The beauty of nature, numerous natural phenomena and the richness of Risnjak's flora and fauna have attracted the attention of naturalists for a long time. Since it was declared a National Park, an increasing number of nature lovers have been visiting its forests, cliffs and peaks in search of a peace and spiritual regeneration that is only to be found amid unspoiled nature. Prof. Dr. Ivo Horvat,¹ a long-time student of the flora and vegetation of Risnjak, and probably one with the greatest number of written contributions on the subject, bears most of the merit for Risnjak being proclaimed a national park. He is also credited with having included a number of experts of different profiles in his research. In his often-quoted statement of reasons for proclaiming Risnjak a national park, Professor Horvat wrote: "May this nature be preserved without any human influence, and where man's earlier involvement has left traces, may nature of itself heal and erase them." These words came true, and, in 1953, by the proclamation of protection, Risnjak became an oasis of the natural world in the most beautiful part of Gorski kotar, on its border with the coastal region - Primorje. On the north-western node of the Dinaric range, a location of more than 30 important plant communities, 14 of which are forest associations, Horvat wrote the following words: "Among the steep cliffs of Risnjak, and its deep

1 Prof. Dr. Ivo HORVAT (1897 – 1963) Croatian botanist, described a great number of plant communities, well known for his studies of the mountain flora and vegetation of the Balkan peninsula; among the first in Croatia who drew modern vegetational maps based on phytocenological science.

chasms, in wonderful coniferous and deciduous woods, may the plant and animal life live undisturbed, and may man climb its paths full of respect for the great natural arena unfolding all around him.”

National parks, along with strict nature reserves, are places where nature is fully protected. The peak of Risnjak and surrounding forests are a testing ground of a sort, where the untamed forces of nature still rule, forming, according to timeless laws, the animate and inanimate mountain worlds, almost devoid of human influence. After 40 years of existence, it was felt 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 has 6,400 hectares. The extension went in two directions – towards the north-east where it now includes the source and the upper part of the Kupa valley, and towards the west where it includes the ridge tops of Snježnik and Gus-



■ *The sunny slopes of Mount Guslica with rocks and sub-alpine grasslands; at the foot of the mountain is the Veliko Snježno doline, known as a frosty ravine and one characterised by inversion of the vegetation belts.*

lica. The Kupa river source is a special natural rarity and has been under protection for a long time. In the vicinity of the source is the Sušica ravine, an interesting geomorphological feature. By gaining this extension to the untouched water world of the River Kupa's source, the park acquired a significant additional value. The other extension, encompassing the Mount Snježnik, brought into the park numerous peaks, first-class views, as well as a varied vegetation of sub-alpine grasslands with an unusual richness of the alpine flora. The sub-alpine grasslands are scarcely represented on the rocky Risnjak complex covered with mountain shrubs, so that the broad grasslands of Snježnik and Guslica strengthen the park's natural diversity from this angle.

Visitors who don't have the time or desire to see the greater part of the park, or climb to the very peak of Risnjak, should by all means visit the Leska valley, which is situated near the National Park Authority and the motel. Leska can be viewed in a short time, and the educational trail points to many interesting details that the visitor might otherwise miss.

The Leska valley opens toward Crni Lug, presenting a varied geological substrate: some parts are made of impermeable rock, others from permeable carbonate rock. Impermeable rocks have several permanent springs, whose water, after only a short course, disappears into surrounding karst sinkholes or ponors. Characteristic for this type of impermeable rock substrate is the



■ *Sub-alpine spruce forest on Smrekovac*

forest association of fir with hard fern (*Blechno-Abietetum*). This association is rare in the park, and presents numerous Central European and boreal species. Along with beech and fir tree, a significant place in this forest belongs to the rowan (*Sorbus aucuparia*), while low herbs flourish on acid soil, particularly hard fern (*Blechnum spicant*). There are also numerous bogs and mushrooms. Among mushrooms, a particular rarity is fir's cauliflower fungus (*Sparassis nemecii*), which, as a mycorrhizal species, is the fir's regular companion. The springs and watercourses are associated with swampy terrains, which have the characteristic flora and vegetation of fragments of basiphilous bogs. Several different meadow communities are represented in Leska, significant for their multitude of colourful flowers. In order to prevent them from growing into a forest, a frequent occurrence in Gorski kotar (a consequence of agricultural negligence!), the Park Authority is obliged to regularly mow the meadows, thereby preserving the biological and landscape diversity. Adjacent to the source of the Klada is the hamlet of Leska with only a couple of houses, most of them regrettably deserted. All of these curiosities, along with many others, are written on wooden plates along the educational trail.

From Leska the mountain paths lead further into the area of fir and beech (*Abieti-Fagetum dinaricum*). One path goes toward Markov brlog, and the other – the well-known “Horvatova staza” (Horvat's path), leads toward Smrekovac and further on towards the peak of Risnjak. The fir-beech forest is the most important forest association on carbonate geological substrate of the higher mountain belt in Gorski kotar, and the same is true for Risnjak. A particular significance of this association is the abundance of endemic and relic species among low herbs such as hacquetia (*Hacquetia epipactis*), blue-eyed Mary (*Omphalodes verna*), deadnettle (*Lamium orvala*) and numerous other species. This forest association covers large areas of the park: a whole karst plateau east of the Risnjak summit, spreading towards the north and west and circling Risnjak's sub-alpine zone like a horse-shoe. In the extended part of the park, it spreads over Mount Kaličak, the forest areas of Rebar, Mašiničak and Strmac and continues along the rim of the peaks of Police-Peč-Zajčji vrh above the valleys of Krašičevica and Sušica. Smaller areas can be found on the edge of the depression on the other side of the Kupa, above Razloge.

Forests are the abode of nearly all Risnjak's important mammals: bears, wolves, lynxes, wild cats, foxes, does, deer, boars,

various small mammals. The bird fauna is also numerous. This is the home of hazel grouse (*Tetrastes bonasia*) – today a very rare species of forest hen. Black woodpeckers (*Dendrocopos martius*) and other woodpeckers knock on dry tree trunks. In spring one can hear the cuckoo (*Cuculus canorus*), and the forest is often flown over by ravens (*Corvus corax*). A total of 97 bird species have been registered in the National Park and surrounding area, 72 of which are nesting birds. A typical forest species among Coleoptera beetles are ground beetles (*Carabidae*), a carnivorous species that inhabits the soil's ecosystems. Twenty-three species have been registered in the national park area; particularly interesting among them are the ground beetles *Carabus croaticus* and *Carabus creutzeri*. Two kinds of butterflies can be seen around the fir tree – the pine hawk moth (*Hyloicus pinastri*) and *Limantria monacha*, while *Agria tau* can be seen on the beech. Alongside the forest paths it is interesting to observe the life of forest ants (*Formica rufa*) whose large anthills are a rarity, even in the national park.

As we reach Markov brlog it is worthwhile seeking out the habitat of Horvath's rock lizard or Velebit lizard (*Iberolacerta horvathi*), which lives on the rocks along the road above Leska. After a 15-minute walk on the road above Leska in the southerly direction, one reaches the other important forest association of Risnjak. These are coniferous sub-alpine spruce forests. They are linked to specific habitats, particularly dolines or sinkholes, which are prominent frosty ravines. These forests can also be reached by following "Horvatova staza" (Horvat's path) in the Smrekovac region. Alongside the road above Leska, on the northern side of Travnik, is an area overgrown with spruces, occupying a steep groove carrying a stream of cold air. The atmosphere here is special, strikingly different than that of the fir-beech forest we just visited. In the fissures of the rocky soil, even in the middle of summer, the temperature can sometimes be only a few degrees Celsius. The flora and fauna are markedly different. Several years ago a strong wind devastated the spruce forest in this groove and many of the spruces were blown down. Their torn roots exposed shallow humus soil – a kind of mountain black earth particularly favourable for bilberries (*Vaccinium myrtillus*) and cranberries (*Vaccinium vitis-idaea*), an abundance of mosses and a beautiful ornament of these forests - the blue alpine clematis (*Clematis alpina*).

Topping the road above Leska and the groove with the spruce forest is a rarely visited peak – Travnik (1,158 m). In order to



■ *Alpine species: the single-flower knapweed (Centaurea uniflora subsp. nervosa) was discovered only recently on Guslica.*

climb this peak, special permission from the Park Authority must be sought, as the peak is outside of the marked tracks. It is known as one of a dozen singing grounds of the capercaillie or wood grouse (*Tetrao urogallus*) on Risnjak. The capercaillie is, along with the hazel grouse, the most endangered species of forest hen in Croatia and needs absolute peace. Among the stone blocks of the Travnik peak there grows a fir forest on calcareous blocks (*Calamagrostio-Abietetum*), which we encounter also on other sites of Risnjak and in Gorski kotar. The ornaments of the forest on Travnik are the enchanting orange-red flowers of the Carniolan lily (*Lilium carniolicum*). Its leaves are constantly being eaten by bright red lily beetles (*Lilioceris lili*).

The deep dolines or sinkholes under Travnik feature a particular living world. Snow lasts here for a long time and cold air builds up. This environment is favoured by some representatives of the alpine flora - the *Heliosperma pusillum* and the



■ Grassy bells (*Edraianthus graminifolius*) are an important alpine grasslands-species on wind-exposed ridges.

moss *Drepanocladus uncinatus*. Old broken beeches that have not completely decomposed or collapsed attract xylophagous insects, for example the rhinoceros or stag beetle (*Sinodendron cylindricum*) and enable the development of huge breeding grounds of Dryad's saddle fungus (*Polyporus squamosus*). In another doline, the entire shaded slope is covered by a thick layer of perennial honesty (*Lunaria rediviva*) whose violet flowers release a pleasant scent at the time of flowering. From this spot, or from Markov brlog, we can reach Janjičarska vrata and climb onwards to the important crossroads of Medvjeđa vrata (1,289 m). Within reach of Medvjeđa vrata we come to the upper belt of the forest – sub-alpine beech forests, easily recognisable by their sabre-shaped trunks. The snow lasts a long time here, its drifts are thick and press on the lower part of the tree trunks. These forests are bright, with lots of grass, and there are pretty flowers as well: Christmas rose (*Helleborus macranthus*), yellow oxeye daisy (*Buphthalmum salicifolium*),

spotted orchid (*Dactylorhiza maculata*) and many others. Finally, on the cliffs of Mali Južni Risnjak (1,448 m) a magnificent view opens up of the peak of Veliki Risnjak (1,528 m) and the climbers' lodge underneath it. Here we find ourselves in the belt of dwarf mountain pine (*Pinus mugo*), which is another world, completely different from the spacious forests of Risnjak that we have seen so far. In the summer we are fascinated by the colours and smells of multitudes of the most diverse alpine flowers.

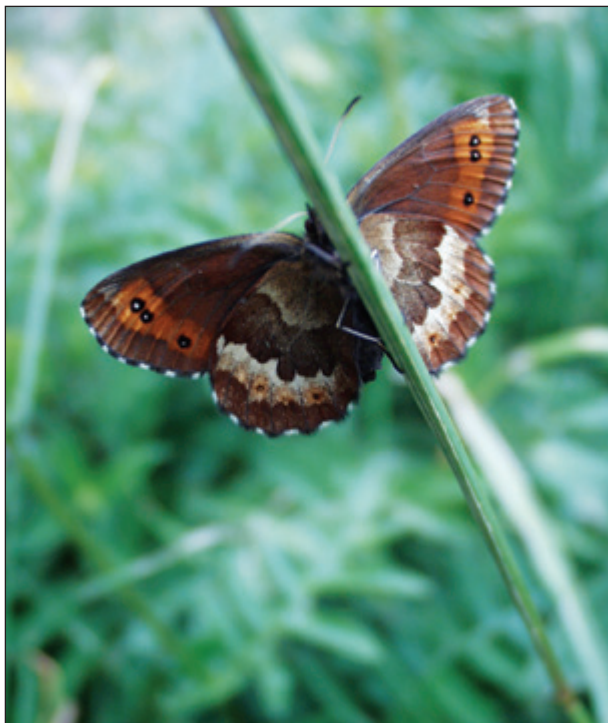
In the sub-alpine flora of Risnjak the following plants stand out with the beauty of their flowers: alpine eryngo (*Eryngium alpinum*), hairy alpenrose (*Rhododendron hirsutum*), silvery yarrow (*Achillea clavennae*), alpine aster (*Aster alpinus*) and yellow gentian (*Gentiana symphyandra*). The spring brings out the beauty of Clusius gentian (*Gentiana clusii*), alpine pasqueflower (*Pulsatilla alpina* ssp. *alpina*), globe-flower (*Trollius europaeus*) and many other species. In cold areas, shortly after the snow melts, we see a sudden blossoming of the violet long-flowered primrose (*Primula longiflora*) and alpine snowbell (*Soldanella alpina*). On the rocks we see a development of the association of spleenwort and Hayek's catchfly (*Asplenio-Silenetum hayekianae*), in which many alpine plants are represented, among them the edelweiss (*Leontopodium alpinum*) and the rare plant, *Saussurea discolor*. A characteristic association with alpine traits thrives on the rocks in a deep sinkhole below the peak of Risnjak – the valerian and daisy star-aster (*Valeriano elongatae-Asteretum bellidiastri*).

Medvjeda vrata and the Risnjak peak can be also reached from Gornje Jelenje via Vilje. In the vicinity of this route is the famous Viljska ponikva sinkhole, around 200 metres deep. It is here that the phenomenon of sinkholes on Risnjak is best seen. Due to temperature inversion here we find species and communities characteristic of high mountain areas - remnants from colder time periods. The sinkhole is overgrown with dwarf mountain pine deep inside the forest belt, so that, as we descend into the hole, we encounter vegetation that we might expect to see climbing towards the mountaintop. In the top part of Risnjak and Snježnik we find a number of beautiful and interesting sinkholes, mostly overgrown with dwarf mountain pine, but also presenting numerous other vegetational particularities. As the sinkholes are a prominent feature of the Risnjak National Park, the Park Authority has chosen to represent this phenomenon on its official logotype.

On the north-western and northern side of Risnjak there are several broad valleys with meadows surrounded by mountain spruce forest. Spruce forests have developed here due to frost conditions with frequent chills and very low temperatures favourable for spruce growth. The valleys of Lazac and Šegine are filled with glacial deposits, which indicates that the surroundings of Risnjak during the ice ages were covered with glaciers. Glaciers formed on plateaus underneath Radeševo and Smrekovac and after a short course deposited morenic material in the above valleys. The peak of Risnjak probably emerged above these small glaciers as a distinct nunatak. An important area west of the Risnjak peak, apart from the above-mentioned Smrekovac, are the rocks Bijeje stijene. They represent a wild mountain crest surrounded by the last primeval forests of Risnjak.

The extension, which included the Snježnik mountain group, enriched the park with several beautiful peaks and a characteristic vegetation of grass communities – grasslands. Their development depends on exposure to the winds and the snow cover. The most exposed of the crests provide a habitat for communities of the sedge *Carex firma*, while the somewhat more protected positions are overgrown with grasslands of evergreen sedge (*Carex sempervirens*) and narrow-leaved moor-grass (*Sesleria juncifolia*). In the warmest of habitats we find the grasslands of Bosnian fescue (*Festuca bosniaca*). In total, we find here about a dozen communities of grasslands and vegetations of tall herbs. These communities attract botanists due to the unusually rich and interesting mountain flora and the mixture of floral influences of the Alps and the Dinaric range.

The peak of Snježnik (1,506 m) is reached most easily from Platak (1,111 m), by crossing over Radeševo ski centre. Just underneath the peak is a climbers' lodge. This is probably the most beautiful sightseeing point in the whole group. Particularly impressive are the views from Snježnik to the surrounding peaks: Risnjak, the grassy ridge tops of Međuvrhi and Guslica, while in the distance one can see the Slovenian Snežnik, Obruč, Učka and Rijeka bay with its islands. In fair weather one can see Velebit, and when the sky is clear, the peaks of the Alps, at a distance of 120 km. Snježnik can also be approached from the direction of Risnjak, e.g. over Cajtige. A particularly attractive approach is the one from Lazac by the old Frankopan road over the Srebrna vrata, or by a direct climb



■ *Ringlet butterflies (Erebia) belong to alpine fauna.*

over the slopes of Snježnik, overgrown with shrubs, bypassing the snow-covered hole of Snježnica.

Towards the west the park stretches over the peaks of Međuvrhi (1,460 m) and Guslica (1,490 m) all the way to the isolated and somewhat solitary Planina (1,426 m). The natural harmony of these peaks is disturbed only by the deserted military building on the top of the Guslica.

The extension of the park towards the source of the Kupa is important because of the preserved aquatic world of the Kupa, and also because of the communities of the lower mountain belt. This enables us to follow the complete vegetational profile of Gorski kotar inside the national park. From the very source – a typical karst spring situated in a deep valley – throughout its upper course Kupa shows the prominent characteristics of a fast mountain stream with numerous rapids and a partially canyon-like appearance. The right side of the Kupa valley is steep, while on the left side there are several

hamlets on cleared grassland. In the vicinity of the source is the impressive Sušica ravine, which joins the Kupa valley from its left side. This impressive formation lies downstream of the Kupa source towards the hamlet of Kupari. The Sušica source is a line of gullies which fan out under Gerovo. A vegetational particularity of this ravine are the thermophile forests of hop hornbeam with winter heath (*Erico-Ostryetum*). (A detailed description of the hydrological phenomenon of the source of the River Kupa is found separately in this publication.)

Tour

As a starting point for visits to the National Park, it is best to choose the motel in Bela Vodica (Crni Lug), where both accommodation and all necessary information can be obtained. In the offices of the Park Authority one can find expert guides who will lead visitors through the more demanding and less accessible parts of the park, such as the primeval forests of Bijele stijene or the Sušica ravine above the source of the Kupa. Such areas are not open to individual visits due to strict protection. Immediate experience of the natural elements can be enjoyed in the well-known Schlosser's climbers' lodge under the peak of Risnjak, at 1,418 m, as well as in the climbers' lodge on the top of Snježnik. Visitors are advised to obtain advance information about the conditions and supplies in the lodges from the Park Authority or at the Platak Mountaineering Club. Visitors are also advised that, in spite of the relatively low altitude of the mountains in the park, sudden changes of weather are possible, while in the sinkholes and valleys, temperatures below zero degrees Celsius can be expected all the year round! In the Park Authority it is possible to buy a map of the National Park showing the marked paths and points of interest. Anyone interested in a longer stay, a winter tour on a motor sled or in organised animal watching should notify the Park Authority in advance.

ADDRESSES

- The Risnjak National Park Authority, Bela Vodica 48, 51 317 Crni Lug; tel.: +385 (0)51 836 133; fax: +385 (0)51 836 116, e-mail: np-risnjak@ri.htnet.hr
- Platak Mountaineering Club, Korzo 2a/III, 51000 Rijeka; tel.: +385 (0)51 335 637, information phonenumber 098 849 508

VRAŽJI PROLAZ – ZELENI VIR

There are two utterly unique natural phenomena in the Gorski kotar region, formed over thousands of years by clear, fast-flowing mountain streams cutting canyons through the carbonite rocks: Vražji prolaz (“Devil’s Passage”) and Kamačnik near Vrbovsko. Both have been made accessible by the hard labour of Gorski kotar’s people, resulting in attractive walking trails with little bridges and galleries spanning the canyons’ torrid waters and potholes, some of them partially cut into the solid rock. An interesting technical cultural monument can also be found in the nearby Zeleni vir – the small Munjara hydroelectric power station constructed in 1921 whose water supply basin is located inside a cave that also contains a source. From above the cave a picturesque waterfall cascades down... All these interesting sites and many more can be found within the small area of the reserve.

Category of protection: special reserve - geomorphological

Year of proclamation: 1962

Document proclaiming protection: Decision number 7/9 – 1962, Institute for Protection of Nature, Zagreb

Area: 200 ha

Location: area of the Municipality of Skrad (Gorski kotar)

Altitude: 302-650 m

Below the railway station in Skrad, a 350 m-deep valley cuts into the land, surrounded by forests and steep, in parts rocky slopes. One of the most beautiful canyons in the Gorski kotar region is located here – Vražji prolaz or the Devil’s Passage. Near Kupjak, a few brooks arise from water-impermeable rock and create a fan shape as they pour down onto the larger stream, known as the Jasle. The stream flows further into an area of carbonate rocks from which a deep and impressive canyon has been carved. In some spots the walls of the canyon are quite craggy and closed in, while below them the stream foams away, eroding more rock and creating new potholes and small waterfalls.

Through the canyon part a path has been partially cut into the rock and partially placed on pillars above the stream. This path has been designed and constructed in a style similar to the path in the Kamačnik canyon near Vrbovsko. One interesting detail of the canyon is the cave of Muževa hižica – but in order to visit it, one’s own lighting is required.

Snow remains in the shaded areas of the canyon sometimes up till late spring. Damp rocks are covered with a particular



Flora: winter heath (*Erica carnea*), grey hawkbit (*Leontodon incanus*), alpine butterwort (*Pinguicula alpina*), daisy star-aster (*Aster bellidiastrum*)



Fauna: stoneflies (*Plecoptera*), caddisflies (*Trichoptera*), fire salamander (*Salamandra salamandra*), brown trout (*Salmo trutta m. fario*), bullhead (*Cottus gobio*)



Vegetation: interesting thermophile forest of European hop-hornbeam and winter heath (*Erico-Ostryetum*)



Special site of interest: Munjara hydroelectric power station constructed in 1921, cave with a source and a waterfall



■ The waterfall in Zeleni vir tumbles down a seventy-metre high rock and in front of the entrance to the cave.



■ The small Munjara hydroelectric power station, built in 1921, is a kind of monument of technical culture.

flora. Here the rare insect-eating Alpine butterwort (*Pinguicula alpina*) and daisy star-aster (*Aster bellidiastrum*) can be found as well as a whole series of other flowering plants, ferns and especially various species of mosses adapted to shaded and damp conditions. The community of these habitats is most likely the remnant of former colder ages – a kind of Ice Age relict. On rocks in the higher, more sun-exposed areas we find thermophile flora and forests of European hop-hornbeam and winter heath (*Erico-Ostryetum*) with a series of interesting species that are normally found in similar habitats on steep slopes in the valleys of montane rivers.

Inside and around the stream we find the fauna associated with clear waters; there are numerous fire salamanders (*Salamandra salamandra*) and many tiny invertebrates.

In the immediate vicinity of Vražji prolaz there is another natural site of interest– Zeleni vir. Below a 70-metre-high rock, over which a picturesque waterfall cascades, an opening leads



■ *The gorge's humid rocks host a few habitats of the insect-eating plant alpine butterwort (Pinguicula alpina) – a relict from the Ice Age.*

into a cave with a spring inside it. Before its waters leave the cave area, the spring forms a pond enclosed by an artificial concrete dam built for the purpose of supplying the small hydroelectric power station with water. The rock above the cave is geomorphologically very interesting because it forms an overfold of the Mesozoic sediments. Along with the hydrological phenomena, this is one of the reasons why this area has been proclaimed a geomorphological reserve.

To reach the cave with the source, one has to pass through a “curtain” of water drops. The water drops come from the waterfall as it tumbles down the rock to the side of the cave. Constant dampening of the surrounding soil contributes to the luxuriant greenery of the vegetation.

A few minutes' walk upstream, Curak brook from Zeleni vir and Jasle brook from Vražji prolaz flow together into Iševnica brook, which then runs towards the village of Iševnica where it flows into the River Kupica. Not far from where the Curak and Jasle meet, there is an interesting hydroelectric power plant named Munjara, built in 1921, potentially a valuable monument of technical culture, which receives its water through a pipeline from the cave pond within Zeleni vir. A mountaineering lodge is located here as well, accessible by the road from Skrad. However, it is certainly more interesting to follow the marked walking trails leading down to Zeleni vir or to Vražji prolaz.

Tour

The starting point for the visit is the village of Skrad, located on the old Rijeka – Zagreb road. There is a railway station and bus stop in Skrad and from there the narrow, steep, winding and partially asphalt road leads visitors up to the mountaineering lodge at the entrance to the reserve. You can also reach Zeleni vir from Brod na Kupa (state border!) by an asphalt road that leads towards Skrad and then branches off near the village of Planina Skradska towards Zeleni vir. Alternatively, you can take the road that leads from the village of Ložac alongside the stream of Curak to a parking area from which there is another 20-minute walk up the path along the stream to the mountaineering lodge.

The reserve is managed by Croatian Forests Ltd. – Forest Administration Delnice, Forestry Skrad, which takes care of the hikers trails and bridges and offers accommodation and supplies in the mountaineering lodge at the entrance to the reserve.

ADDRESS

- Hrvatske šume (Croatian Forests Ltd.) Zagreb – Forest Administration Delnice, Forestry Skrad, Goranska 21, 51311 Skrad; tel.: +385 (0)51 810 688
web address: www.zeleni-vir.com

GLAVINE – MALA LUKA (KUNTREP)

Although proclaiming the ornithological reserve has not satisfactorily solved the problem of Krk's dwindling population of griffon vultures, the existence of this reserve is justified by its magnificent landscape and many other natural phenomena. If a form of efficient protection capable of providing real protection and care for the griffon vultures, as well as to the other rare species of birds, reptiles, amphibians, invertebrates and endemic plants and their communities and to the uniquely beautiful landscapes were to be obtained in the future, this reserve might be able to preserve inestimable natural riches for the future.

Category of protection: special reserve - ornithological

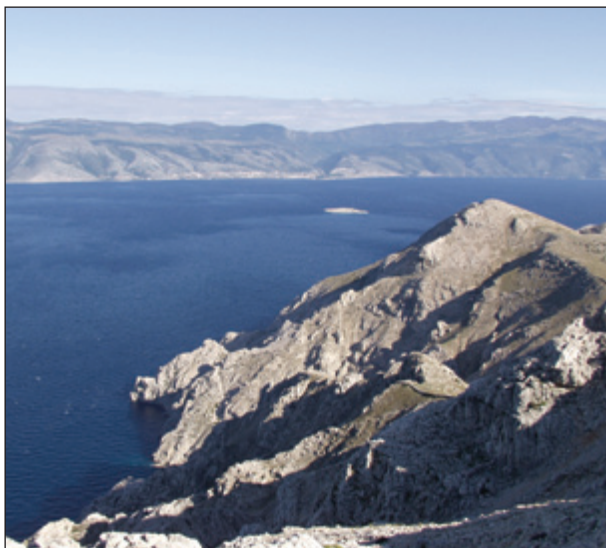
Year of proclamation: 1969

Document proclaiming protection: Decision on Proclamation, Official Gazette of the Municipality of Rijeka, issue 1/1970 and Decision of the Republic Institute for Protection of Nature, number: Up/I^o 26-1970

Area: 1,000 ha

Location: area of the Municipality of Baška (island of Krk)

Altitude: 0 - 475 m



- *The cliffs of the ornithological reserve drop steeply to the sea and continue beneath the surface, forming impressive landscapes both above and below.*

As a turning point in the protection of birds, ornithologists single out the Decision of the Assembly of the Municipality of Krk dated 30th December 1969 that declared the area from the promontory of Glavine to Mala luka along with the coastal belt one kilometre-wide to be a special ornithological reserve. This was the origin of the natural reserve for the protection of the griffon vulture (*Gyps fulvus*) on the island of Krk, the first of its kind in the world! From that time on, significant changes occurred in Krk's griffon vulture population, though it is quite paradoxical that the changes occurred in a negative rather than positive direction! Since then the population of Krk's griffons has decreased. Naturalists active in the study and protection of Croatia's last population of griffons have called attention to the fact that unauthorised poisoning to eliminate bears and dogs that were causing damage to flocks of sheep have reduced the population of Krk's griffons almost to extinction level. During the 1990s the number of griffon vultures fell from fifty to only ten birds. Such a decrease represents a special danger, because griffons searching the terrain for carrion depend on each other and they always hunt in packs. In the event of a decrease in number, griffons from nearby populations join together, in this area with the ones from the island of Prvić, but the day when that population also decreases to less than ten birds, can be assumed to be the end for Krk's griffons.

However, griffon vultures are not the only ornithological prize of this reserve. Other birds that are endangered in Europe nest

Flora: Dalmatian knapweed (*Centaurea dalmatica*), Istrian bluebell (*Campanula istriaca*), Rijeka thistle (*Carlina fiumensis*), Jacquen's drypis (*Drypis jacquiniana*)



Fauna: griffon vulture (*Gyps fulvus*), short-toed eagle (*Circaetus gallicus*), peregrine falcon (*Falco peregrinus*), common kestrel (*Falco tinunculus*), European shag (*Phalacrocorax aristotelis desmarestii*), eagle owl (*Bubo bubo*), blue rock thrush (*Monticola solitarius*), rock thrush (*Monticola saxatilis*), stone curlew (*Burhinus oedicnemus*)



Vegetation: endemic communities of rocks (*Campanulo-Centaureetum dalmaticae*) and screes (*Drypetum jacquinianae*), rocky pastures (*Festuco-Koelerietum*)



Special site of interest: not far from the peak of Diviška there is a picturesque freshwater pond with rare and endangered water fauna





■ The stony promontory of Glavine is the most northerly point of the reserve.

here too, such as the short-toed eagle (*Circaetus gallicus*), peregrine falcon (*Falco peregrinus*), common kestrel (*Falco tinnunculus*), European shag (*Phalacrocorax aristotelis desmarestii*), eagle owl (*Bubo bubo*), blue rock thrush (*Monticola solitarius*), rock thrush (*Monticola saxatilis*) and a few rare birds of the coastal cliffs. There is another ornithological point of interest and particular value to this area because of which a widening of the protected area has been requested – on the plateau reaching from the cliffs' edge towards the Baščanska kotlina depression, comprising also the peak of Diviška, nests the endangered bird, the stone curlew (*Burhinus oediconemus*). The golden eagle (*Aquila chrysaetos*), which nests nearby, also uses this reserve for hunting.

Visitors may not always be lucky and notice the reserve's birds immediately, but a willingness to wait will certainly be rewarded. The landscape of the reserve is truly impressive! Picturesque cliffs and stone canyons stretch across the north-western side of the island of Krk from the promontory of Glavine to the bay of Mala luka for a distance of approximately ten kilometres. The largest are the rocks of Butinj and Kuntrep and between them is the magnificent Jasenova canyon, one kilometre long and no wider than twenty metres. All around to a height of 300 or even 400 m magnificent cliffs stretch towards the horizon with screes below them. The endemic flora and vegetation liven up these seemingly deserted and lifeless cliffs

and screes. It is particularly beautiful to see some endemic plant species in full blossom in their habitat – for example the blue blossoms of the Istrian bluebell (*Campanula istriaca*), purple flower heads of the Dalmatian knapweed (*Centaurea dalmatica*) pressed against the rock, raised hackles of the flowering Jacquin's drypis (*Drypis jaquiniana*), flowering heads of the Rijeka thistle (*Carlina fiumensis*) protected by spines and other plants which the sheep cannot reach.

As a contrast to the wild and steep terrain of the cliffs, the upper edge of the reserve is characterised by a calmer and flatter but nevertheless deserted landscape of pastures. Some parts of this bare plateau in the southern part of the island of Krk have even been described as “lunar landscape”! The landscape here is intersected by long dry stone walls (shepherds' boundary lines) reaching into the far distance. At one intersection of these dry stone walls an unusually picturesque pond named Diviška is located. It is significant in terms of natural science because of its rare fauna and it also plays a significant role in the conservation of life and biodiversity in this waterless karst area.

Tour

The reserve can only be reached on foot, or by boat from the sea. The nearest settlements are Baška to the south and Vrbnik to the north. The channel of Vinodol divides the eastern



■ Diviška Pond – a small freshwater oasis in waterless karst that plays a very important role in preserving local biodiversity.

part of the island of Krk, where the reserve is located, from the opposite mainland side where the town of Novi Vinodolski is located. Arriving by boat is a special experience because from sea level it is possible to experience dramatically the immediate magnificence of the steep bare slopes and the cliffs descending vertically to the sea. The cliffs continue into the sea depths, also hiding some underwater caves... However, it is necessary to warn about the occasional bad weather conditions – this is the area of the harshest Adriatic *bora*, a wind that can be particularly troublesome for smaller vessels. Sailors should bear in mind that approaching the nesting griffons in their boats can endanger the griffons' young, scaring them and making them fall into the sea or making their elders too fearful to feed them. (This is why the reserve should also be enlarged to include the belt of sea up to 500-metres wide and speedboats should be prohibited!) From the land side the nearest point of approach is from the area of Žanac between Treskavac and Bašćanska Draga along a very rough unpaved road that ends not far from the reserve and Diviška pond. Diviška can also be approached along the hiking trail over the "lunar landscape" from Baška.

ADDRESS

- Municipality of Baška Tourism Office, Kralja Zvonimira 114, 51523 Baška; tel./fax: +385 (0)51 856 544 tel.: +385 (0)51 856 817, e-mail: tz-baska@ri.t-com.hr, infooffice@tz-baska.hr, web address: www.tz-baska.hr

ISLAND OF PRVIĆ

Many special natural features, especially the rare flora and fauna which cannot be found on any other Adriatic island and above all the unusual and seemingly deserted rocky landscape of this uninhabited island battered by heavy gusts of the bora wind and salty water, are the reason for its proclamation as a special reserve. Some naturalists are even of the opinion that this island deserves proclamation in the category of a new national park in the Kvarner archipelago!

Category of protection: special reserve - ornithological

Year of proclamation: 1972

Document proclaiming protection: Decision on the Proclamation of the island of Prvić with coastal waters and Grgurov channel a special botanical-zoological reserve, Official Gazette of the Municipality of Rijeka, issue 10/1972 and Decision of the Republic Institute for the Protection of Nature number: Up/I^o 38-1973 of 6 September, 1973


Area: 7,000 ha (part of the surface comprises the nearby maritime zone)

Location: area of the Municipality of Baška (island of Krk)


Altitude: 0 - 357 m




■ View of the island of Prvić from Bag pond on the island of Krk; Velebit in the background.



Flora: 351 species of flowering plants and ferns; narrow-leaved moor grass (*Sesleria juncifolia*), alpine daphne (*Daphne alpina*), hawksbeard (*Crepis chondrilloides*), some endemic woodruff species (*Asperula*) and other rare species



Fauna: griffon vulture (*Gyps fulvus*), golden eagle (*Aquila chrysaetos*), peregrine falcon (*Falco peregrinus*), short-toed eagle (*Circaetus gallicus*), eagle owl (*Bubo bubo*), European rabbit (*Oryctogalus cuniculus*), European green toad (*Bufo viridis*), Dalmatian algyroides (*Algyroides nigropunctatus*), Dalmatian wall lizard (*Podarcis melisellensis fiumana*)



Vegetation: rocky pastures, vegetation of rocks and scree, nitrophile and halophile communities



Special sites of interest: ornithogenic and halophile biocenoses on the cliffs

Prvić is an island of unusual, almost mountainous characteristics with many steep cliffs, cuttings and gorges, even though it rises only 357 metres above sea level. According to these characteristics the island could be considered as a kind of continuation of the mountain slopes of the highest peaks of the island of Krk – Obzova and Bag. And truly, it is characterised by the main features of these highest areas of the island of Krk – barren landscape, eroded soil, rocky terrain, vertical cliffs, exposure to the *bora* wind, salt and other natural particularities. The island of Prvić is naturalistically even more interesting, because of its isolation and because it is a rather small and uninhabited island.

The picturesque landscape of Prvić follows the visitor wherever he goes around Baška. Particularly beautiful is the view from the Zarok area and from the beach of Baška, and it is even more beautiful if one climbs to the panoramic elevation on the peak of Bag – where Prvić is then in plain view. Behind Prvić sticks out the bluish ridge of Mount Velebit. It is from that mountain that some montane species came to Prvić and have survived here for thousands of years.

The peculiarities of Prvić can even be noted under the sea, where one can encounter attractive undersea landscapes and a colourful wealth of coralligenous communities. Many interesting sites are also gathered on the land of the island. Because of these, and mainly because of the cliffs of the north-eastern part, Prvić along with the appertaining maritime zone and the cliffs of

the islands of Goli Otok and Sv. Grgur have been proclaimed a special botanical-zoological reserve.

Even though Prvić has been officially proclaimed a reserve, there are no warning signs that it is a protected area. Due to its difficult accessibility, unfavourable maritime characteristics (the notorious *bora* wind from Senj), steep coastline and difficult anchorage, its unique plant and animal world as well as the archaic characteristics of its landscape have been preserved up till the present time.

It is believed that the island was much more wooded not so long ago, an idea only affirmed today by some meagre remains of the holm oak (*Quercus ilex*), black pine (*Pinus nigra*), common fig (*Ficus carica*) and some stunted bushes. The flora of the island counts 351 species of flowering plants and ferns among which many valuable endemic species of the Kvarner area. On the peak north cliffs, mostly exposed to the strong *bora* wind, some montane species grow, such as narrow-leaved moor grass (*Sesleria juncifolia*), alpine daphne (*Daphne alpina*), narrow-leaved hawksbeard (*Crepis chondrilloides*) and others.

On Prvić some very particular plant communities have developed, for example around the birds' nesting areas. Because of the salty soil and the *bora* wind, the unique communities that have adapted to these extreme habitats are also significant.

Some rare and endangered bird species nest here, such as the golden eagle (*Aquila chrysaetos*), peregrine falcon (*Falco peregrinus*), short-toed eagle (*Circaetus gallicus*), eagle owl (*Bubo bubo*) and out of a more significant colony of the griffon vultures (*Gyps fulvus*) only 10-15 pairs are left. Among the mammals, here we find the European rabbit (*Oryctogalus cuniculus*) as well as sheep flocks held by inhabitants of Baška. Significant among amphibians and reptiles are the European green toad (*Bufo viridis*), Dalmatian algyroides (*Algyroides nigropunctatus*), Dalmatian wall lizard (*Podarcis melisellensis fiumana*) and others. The medicinal common sage (*Salvia officinalis*) provides a valuable pasture for bees, and in the hot period of the year tourists visiting the island's pastures are greeted by numerous grasshoppers leaping around in the sparse covering of grass. The fauna of the invertebrate of this island is poorly known.

Within the wider protected area of the island of Prvić, the spatial plan for the County of Primorje and Gorski kotar has also identified the islands of Sv. Grgur and Goli Otok as protected landscape. Whilst Goli Otok, meaning Bare Island, is very deforested (as the name implies) and characterised by similar natural



■ *Narrow-leaved hawkbeard* (*Crepis chondrilloides*) – a remnant of the Mediterranean-mountainous flora.

features as the island of Prvić (however in a somewhat poorer form – for example it has less plant species than Prvić, only 307), the island of Sv. Grgur is the most wooded among the islands of the Senj archipelago, but with only 193 plant species living there.

Tour

The starting point for visiting Prvić is Baška, where one can arrive by boat. Visitors however should be warned about the steep, hard-to-access coast and the frequent gusts of the *bora* wind, which have helped give the island the epithet of one of the least accessible islands in the Adriatic. On colder days, when the cold *bora* is blowing, the coasts of Prvić and of the nearby Goli Otok are the only ones among the Adriatic and Mediterranean islands that occasionally get frozen with ice deposits more than one metre thick!

ADDRESS

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web address: www.tz-baska.hr

ORNITHOLOGICAL RESERVES ON THE ISLAND OF CRES

- Northern: area between the bay of Fojiška and the bay of Pod Predošćica (Kruna)
- Southern: area between the bay of Mali Bok and the bay of Koromačna (Pod Okladi)

The griffons are magnificent birds with a wingspan from 2.40 to 2.80 metres. To view them flying over the island of Cres is an unforgettable sight, as packs of them search the terrain for food. The griffons of Cres are a phenomenon among the populations of the Kvarner islands because their number has not decreased; in fact, over the last few decades it has even increased. This fact is partly thanks to the efforts of the Institute of Ornithology of the Croatian Academy of Science and Arts and also of the numerous volunteers organised within the Eco-Centre Caput Insulae-Beli Association.

Category of protection: special reserves - ornithological

Year of proclamation: 1986

Document proclaiming protection: Decision on Proclamation of Two Special Ornithological Reserves on the Island of Cres, Official Gazette of the Municipality of Cres-Lošinj, issue 2/1986

Area: 550 ha Fojiška – Podpredošćica and 900 ha Mali Bok - Koromačna

Location: area of the Town of Cres (island of Cres)

Altitude: 0 - 370 m

Flora and vegetation: endemic flora of the cliffs (*Campanulo-Centaureetum dalmaticae*) and screes (*Drypetum jacquini-anae*)

Fauna: griffon vulture (*Gyps fulvus*), golden eagle (*Aquila chrysaetos*), peregrine falcon (*Falco peregrinus*), short-toed eagle (*Circaetus gallicus*), eagle owl (*Bubo bubo*)

Special sites of interest: nesting of griffon vultures on the cliffs immediately above the sea



By decision of the Assembly of the Municipality of Cres-Lošinj dated 26 February 1986, two special ornithological reserves were proclaimed comprising the coastal area between the bay of Fojiška and the bay of Pod Predošćica on the northern part of the island of Cres and the coastal area between the bay of



■ *Typical geomorphology and landscape of the reserve – a steeply broken off cliff above the sea and a flat karst plateau in the background, veined with shepherds' dry stone walls.*

Mali Bok and the bay of Koromačna in the central part of the island of Cres.

The ornithological reserves were established on the basis of ornithological studies made at the beginning of the 1980s, which were the basic documents for preserving the largest remaining population of griffon vultures in Croatia. During the following years, up till today, very extensive ornithological studies were made in that area, participated in by many scientists from the Institute of Ornithology of the Croatian Academy of Science and Arts, and led by Dr. Goran Sušić. Thanks to the efforts made to protect the griffons, their number on the island of Cres started to increase again after a significant decrease all around this part of Europe in the 1970s and 1980s.

The increase in the number of griffons led to enlargement of the nesting area to include also the cliffs of the eastern coast of the island of Cres, which are not part of the reserve. A consequence has been for example that the number of their nests outside the northern reserve is now higher than the number inside it. A nice example of this phenomenon is the cliff on the promontory of Kruna near Beli where there were no griffons at all at the time of proclamation of the reserves, so it never entered within the limits of the reserve, whilst today a few pairs nest on this cliff. The situation is similar for the promontory of Munt near Merag, as well as with for the cliffs under Vodice. This is why it is neces-

sary to extend the boundaries of the reserve to the entire cliff area on the eastern coast of the island of Cres.

For easier understanding, it has been suggested that the northern reserve be named “Kruna” (according to the first in the range and the most important cliff with griffons’ nests, celebrated in the song of A.V. Mihičić: *At Kruna near my village/ the eagles nest/tempests they defy...*), and the second one “Pod Okladi” which is the name used in Orlec and Belej for the part of the island where the largest rocks with griffons’ nests are located.

The griffon vulture (*Gyps fulvus*) is one of the four species of vultures living in Europe, but is the only one still inhabiting Croatia. The remaining three species: monk vulture (*Aegypius monachus*), bearded vulture (*Gypaetus barbatus*) and Egyptian vulture (*Neophron percnopterus*) have become extinct across Croatia in the last few decades. The island population inhabiting the islands of Kvarner is unique because here the griffons nest on vertical cliffs immediately above the sea – sometimes only 10 metres above sea level. At the same time, the islands of Kvarner are the last habitat of this species in Croatia, home to the most northerly natural European population of griffon vultures.

The cliffs which the griffons inhabit are also unusually interesting from the landscape point of view; however, this means they also attract nautical tourists, who sometimes threaten the grif-



■ Detail from the Koromačna cove – the most southern part of the reserve.



■ *Insects play an important role in the food chain of the reserve – the endemic grasshopper Prionotropis histrix.*

fons with the approach of their vessels and speed boats, by diving or by standing right under their nests – sometimes causing the young ones to fall into the sea and drown. Poisoning is the second large unresolved problem. During the course of 2002 alone, more than 20 young griffons died of, what is a real hypothesis, poisoning. The last mass poisoning occurred on the island of Rab, when 21 griffons were poisoned. The recovery of the population is a slow process because each pair only manages to breed one young bird every two years, and it takes 5-6 years for a young griffon to become sexually mature. During this period of “adolescence” the mortality of the young wandering off for long distances reaches as high as 90%!

Tour

Because of the sensitivity of the area, a tour of the reserve should be controlled and only made under professional supervision. We advise visitors, if they want to visit the reserves (Bird Watching!), to turn for professional assistance and guidance to the Eco-Centre Caput Insulae Beli Association in Beli on the island of Cres. Here they will obtain all the necessary information and should not miss the opportunity to visit the permanent exhibition about griffon vultures and the natural wealth of the island of Cres in the old school building in Beli where this Eco-Centre is located. The educational eco-paths located around the wooded northern part of the island of Cres, in the area called Tramuntana, are also worth exploring and they too are maintained by the Eco-Centre.

ADDRESS

- Eco-centre Caput insulae Beli, Beli 4, 51559 Beli, island of Cres; tel.: +385 (0)51 840 525
e-mail: caput.insulae@ri.htnet.hr
web address: www.caput-insulae.com

DUNDO FOREST

Dundo Forest may be listed among the most beautiful, well-preserved holm-oak forests in the Mediterranean. It probably has the longest tradition of conservation and protection of forests on today's generally deforested Adriatic islands. Hopefully, it will become a site of study for many future generations of foresters and natural scientists, while nature lovers continue to enjoy the primordial realm of its Mediterranean forest.

Category of protection: Forest Vegetation Special Reserve

Year of proclamation: 1949

Document proclaiming protection: Decision to Declare the Dundo Forest on Rab Island a Protected Natural Rarity; No. 32/49; The State Institute for Conservation of Natural Rarities

Area: 106 hectares

Location: area of Town of Rab (Rab Island)

Altitude: approx. 0 - 80 m

Flora: holm oak (*Quercus ilex*), manna ash (*Fraxinus ornus*), phillyrea (*Phillyrea latifolia*), heath tree (*Erica arborea*), European mastic (*Pistacia lentiscus*), strawberry tree (*Arbutus unedo*), common myrtle (*Myrtus communis*), wayfaring tree (*Viburnum tinus*), hardy cyclamen (*Cyclamen repandum*), common smilax (*Smilax aspera*), evergreen rose (*Rosa sempervirens*), asparagus acutifolia (*Asparagus acutifolius*), and black bryony (*Tamus communis*)



Fauna: little owl (*Athene noctua*), yellow-necked mouse (*Apodemus flavicollis*)



Vegetation: evergreen forest of holm oak and manna ash (*Orno-Quercetum ilicis*)



Special features: old downy oak trees (*Quercus pubescens*)



Rab Island's most exceptional natural attraction – the Dundo Forest, or “Dundovo” as the residents of Rab call it – is located on the south-western peninsula of Kalifront, where it descends from an altitude of approximately 80 metres down to the seaside in Kristofor cove. It has a rich and intriguing history in relation to forestry and conservation, and has, rightfully, often been referred to as one of the most beautiful, best-preserved holm-oak forests in the Mediterranean region.

Holm oak trees (*Quercus ilex*) as high as 15-20 metres, with trunks one metre in diameter at chest level, and three metres in circumference, used to form dense forests until World War II, when the most outstanding 150-200-year-old trees were cut down. Today, a few of the old trees still stand around the forester's cabin, evoking images of this Mediterranean forest's former appearance.

The importance of the Dundo Forest, which was initially owned by the church and subsequently taken over by the State, to the development of tourism on the island was quickly recognised. As early as the period immediately after World War I, it became regarded as a "nature park". Following World War II, the forest gained protection as a "natural phenomenon"; while in 1963, the Parliament of the People's Republic of Croatia adopted the Dundo Forest Protection Act under which the forest was managed as a nature reserve. According to current categories of natural area protection, the forest falls into the category of 'special forest vegetation reserves'.

Even today, the Dundo Forest remains beautiful and unique. Botanically, it belongs to the evergreen forest of holm oak and manna ash. Apart from holm oak, this forest's vegetation also includes manna ash (*Fraxinus ornus*), phillyrea (*Phillyrea latifolia*), heath tree (*Erica arborea*), European mastic (*Pistacia lentiscus*), strawberry tree (*Arbutus unedo*), true myrtle (*Myr-*



■ Aerial photograph of the wooded part of the Kalifront peninsula with the Dundo reserve.



■ The mastic tree (*Pistacia lentiscus*) is one of the most important species in the undergrowth of the evergreen Dundo forest.

tus communis), wayfaring tree (*Viburnum tinus*), and quite a lot of common smilax (*Smilax aspera*), evergreen rose (*Rosa sempervirens*), asparagus acutifolia (*Asparagus acutifolius*), black bryony (*Tamus communis*), and others.

In some places, the forest soil is deeper, mostly red, or to a lesser extent, eutric brown soil. Elsewhere, the soil is shallow, allowing calcareous rock to protrude to the surface, which is one of the reasons for the minor variations in composition and appearance of the forest. The eutric brown soil is exceptionally favourable for the growth of heath trees (*Erica arborea*), and there are several downy oak trees (*Quercus pubescens*) that according to certain records had been planted rather than sprang up of their own accord.

The best time to visit Dundo Forest is in spring when it is at its most fascinating. If we were to visit Dundo Forest at the beginning of the tourist season, for example in May, it would no longer be blossoming – it is more colourful earlier in the year when the heath tree and the hardy cyclamen are in blossom. Even then, however, the forest would be full of fresh greenery from the low plant cover and bushes, while the holm oak tree would have unfolded its new green leaves, with their grey felt underside. In spring, it is best to visit Dundo Forest at dusk when all is calm, yet various faint, unfamiliar (and to visitors unaccustomed to the eumediterranean forest, odd) sounds and



■ Small grassy clearings inside the forest contribute to the landscape and biological diversity – flowers of a rare orchid *Serapias* sp.

noises still carry through the forest, one of which is the cry of the little owl (*Athene noctua*). One would also hear vague noises coming from the treetops, much like the patter of rain, which would actually be a “hail” of tiny creatures falling or descending to the ground. The few grass clearings and the meadows surrounding the forester’s cabin add a special appeal to the area, which also shelters rare varieties of orchids such as the *Serapias* sp.

Tour

The road to Dundo Forest leads from the town of Rab through the village of St. Euphemia, while there is also a hiking trail that leads to the forest, designed by Ante Premužić.¹ Unfortunately, until now, the great potential of Dundo Forest as a tourist attraction has not been exploited properly although tourist itineraries of Rab Island do include the Kalifront trails.

1 Ante Premužić (1889 – 1973) a forestry expert, who had an exceptional knowledge of karst regions, designed and laid down several trails on Rab island, as well as the famous “Premužić Trail” for tourists on Velebit.

ADDRESS

- The Town of Rab Tourism Office, Trg municipium Arba 8, 51280 Rab; tel.: +385 (0)51 771 111
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DEBELA LIPA – VELIKA REBAR

Forest reserves should be places where we can still experience the atmosphere of the primordial forest and the undisturbed natural harmony of its communities; the inextricable entanglement of ancient trees, sprouting shoots, undergrowth, fern, moss, insects and fungi upon rotten trees... To people accustomed to neatly tended forests, where every old, ailing or dried-up tree is removed immediately, the appearance of such a forest may seem somewhat chaotic. However, if we look a little closer, we will see that everything is just beautifully “arranged” and in its right place. When we follow the hidden, barely visible tracks of the pristine forest’s wildlife, the magnificence of nature overwhelms us. Here, there are no logging tracks nor sounds of chainsaws – on the ground lie many felled trees gradually decaying into humus... Here each animal, plant, or fungus lives out its primal life cycle, while occasional natural disasters or perhaps even catastrophes have their own way of replenishing the forest.

Category of protection: Forest Vegetation Special Reserve

Year of proclamation: 1964

Document proclaiming protection: Decision No. 169/5 – 1964 MK/MZ, Institute for Protection of Nature, Zagreb

Area: 179 hectares

Location: area of Delnice and Lokve (Gorski kotar)

Maximum altitude: 959 m

The Debela Lipa – Velika Rebar Forest Reserve lies north of Lokve in the mountainous region called Velika Rebar. The reserve comprises two central forest associations of Gorski kotar – the mixed fir-beech forest (*Abieti-Fagetum dinaricum*), and the fir forest with small-reed (*Calamgrostio-Abietetum*), popularly known as the fir forest on calcareous blocks.

The fir-beech forest grows throughout the highland belt, and from an economic perspective is the most valuable forest of Gorski kotar. The fir forest with small-reed chooses only specific habitats – calcareous blocks – and is characterised by a most fascinating landscaping. Both these forests have developed in the Debela Lipa – Velika Rebar reserve as typical associations of trees and low plant cover. The relative preservation of the forest vegetation within the reserve gives it its exceptional charm. Here there are no logging trails; only ailing trees or trees attacked by parasites that could represent a threat to

Flora: silver fir (*Abies alba*), Wych elm (*Ulmus montana*), blue-eyed Mary (*Omphalodes verna*), hart's tongue fern (*Asplenium scolopendrium*), and many other varieties of fern, moss, and lignicolous (living on wood) fungi



Fauna: forest birds and mammals, an abundance of xylophagous (feeding on wood) invertebrates



Vegetation: mixed silver fir-beech forest (*Abieti-Fagetum* s.l.), and silver fir forest on calcareous blocks (*Calamagrostio-Abietetum*)



Special feature: expressed karst relief with forest rocks and calcareous blocks



the surrounding woods are felled. An abundance of mycoflora (fungi) and fauna associated with dry and rotten wood thrives on the many dried and torn down trees. Nevertheless, it is a wonderful experience to hike through the forest of old silver fir and beech, where no saw has been used for a great number of



■ Dead trees are important for preserving biodiversity in forest reserves.



■ *Small worlds in a rotten tree – myceliums of fungi and larvae.*

years and where there are no roads or trails. Passing through the forest reserve, the visitor is left with a unique impression, resulting from sheer admiration of this primordial, unspoilt forest.

The low plant cover of the reserve mostly includes blue-eyed Mary (*Omphalodes verna*), an endemic species central to the fir-beech forest in a karst environment. The large quantity of lignicolous (living on wood) fungi species and xylophagous (feeding on wood) invertebrates is associated with fallen, dried-out trees. Some of our most proficient mycologists have indicated how important protected areas are for the conservation of rare lignicolous mycoflora. In tended forests, these rare species of fungi would have no chance of surviving.

On smaller south-facing areas of the very rocky terrain with huge calcareous blocks, we come across the second significant forest association – the silver fir forest with small-reed. This occupies smaller patches, but also comprises typical flora and fauna. While passage through the mixed silver fir-beech forest is relatively easy, here the rugged terrain calls for more effort in exploring the forest. The rocks are covered with moss and fern, while moss *Ctenidium molluscum* covers larger areas alongside the rocks. In some places, hart's tongue fern (*Asplenium scolopendrium*) is very widespread. This is the precise purpose of forest reserves – to preserve biodiversity whilst allowing the visitor to experience a spiritual connection with the natural realm of the forest. Indeed, reserves should also serve scientif-



■ *Detail from a forest: layer of moss.*

ic purposes, primarily those of forestry and biological research. The reserve area contrasts with the surrounding forest terrain, where there are many steep trails ravaged by erosion, as well as forest roads; on the forest floor there are plenty of branches and wooden debris left over from logging, while the cleared areas are full of various alien plants and forest weed.

Tour

The forest road to the reserve starts from Lokve and leads to the small Lazac farm, while the final section requires climbing through a roadless area toward the reserve. Because of this roadless tract and the difficult terrain, we recommend going with a domestic guide familiar with the area.

ADDRESS

- The Municipality of Lokve Tourism Office,
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tel./fax: +385 (0)51 831 250
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THE GLAVOTOK HOLM OAK FOREST

Krk Island is the home of two protected evergreen-forest special reserves (Košljun and Glavotok) and, more unusually, both are associated with Franciscan monasteries and its diligent inhabitants. The Glavotok Holm Oak Forest is listed among protected natural assets as a forest vegetation reserve! This is a little out of the ordinary, because the forest was planted artificially; in fact, according to current nature-protection regulations in Croatia, the status of a forest park would suit it better.

Category of protection: Forest Vegetation Special Reserve

Year of proclamation: 1969

Document proclaiming protection: Decision to declare the islet of Košljun and the Glavotok Holm Oak Forest a forest vegetation reserve, Rijeka Official Gazette, No. 9/1969

Area: 1 hectare

Location: area of Town of Krk (island of Krk)

Altitude: approx. 0 - 18 m

Flora: holm oak (*Quercus ilex*), manna ash (*Fraxinus ornus*), common smilax (*Smilax aspera*), spiny butcher's broom (*Ruscus aculeatus*), Italian arum (*Arum italicum*), a variety of the chanterelle mushroom (*Cantharellus pallidoamethysteus*)



Vegetation: holm oak and manna ash forest (*Orno-Quercetum ilicis*)



Special features: St. Mary's Franciscan Monastery, old stone pine tree (*Pinus pinea*) near the monastery

The evergreen forest of holm oak (*Quercus ilex*) is located on the headland of Glavotok, directly by the sea, and not far from the Third Order Franciscan Monastery of St Mary's. It is completely in contrast with the deciduous forest naturally adjoining it from the eastern side of the headland. The holm oak forest occupies 1.84 hectares and is detached from the surrounding terrain by a dry stone wall. An uninformed visitor might assume this forest to be indigenous, but in fact, it was planted. The forest's average age today is about 130 years, and the holm oak trees reach a height of up to 12 metres. Detailed phytocenological research suggests the forest belongs to the manna ash and holm oak association (*Orno-Quercetum ilicis*),



- *Holm oak forest on Glavotok on the island of Krk looks like a small evergreen island surrounded by deciduous sub-Mediterranean trees.*



- *In the immediate vicinity of the evergreen holm oak forest, there are beautiful deciduous downy oak forests (*Quercus pubescens*) – a detail of the forest soil in winter.*



- *In the undergrowth of holm-oak forest grow numerous bushes of spiny butcher's broom (*Ruscus aculeatus*).*

moreover to the extreme-northerly variety that lacks numerous elements of a typical association. Looking at the forest from the access road to Glavotok or from the sea, it appears as a solitary evergreen island. In the layer of trees, apart from holm oak, there are very few manna ash trees (*Fraxinus ornus*), although many can be found in the layer of bushes. This layer also includes a few bushes of bay-tree laurel (*Laurus nobilis*), and spiny butcher's broom (*Ruscus aculeatus*) provides a thick drape below the trees. Here, we can also find a few bunches of common smilax (*Smilax aspera*), and at ground layer wild madder (*Rubia peregrina*), Italian arum (*Arum italicum*), and other. The fungi are especially interesting because here we can find certain rare Mediterranean species. Toward the shoreline, there are a few planted black pines (*Pinus nigra*). These pines add to the forest diversity, however, their poor development is most probably due to their unsuitable environment directly beside the sea. South and south-west of this complex are the colourful gardens and olive-groves of the Franciscan monastery, while the terrain to the east is overgrown with deciduous woods of downy oak and oriental hornbeam, common to this part of Krk Island.

Tour

To reach the protected forest reserve, take the road along the coast heading towards the campsite at Glavotok or from the Franciscan monastery, where all good-willed visitors are made more than welcome and offered rest for the night, if need be. Once at their estate, an old picturesque stone pine tree (*Pinus pinea*), situated by the coast is something worth seeing. A visit to the deciduous forest on the other side of the protected natural reserve is also a good choice, since there you can marvel at the specimens of very old downy oaks (*Quercus pubescens*), with unusually shaped crowns resulting from the specific forestry method used when growing them.

ADDRESS

- The Town of Krk Tourism Office, Vela placa 1, 51500 Krk; tel.: +385 (0)51 212 414
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UČKA

Whereas the national park mainly represents the primordial or just insignificantly changed eco-system, the nature park bears more traces of human interference. There are a few permanently inhabited villages (and a few abandoned ones too!) in Učka Nature Park, whose residents have left their mark on the land. Their farming, however, had not spoiled the land but rather added to the landscape's beauty and bio-diversity. The development of as many as 10 different types of grassland communities on Mounts Učka and Čičarija, with numerous rare and endangered species, is directly linked to the traditional agricultural activities. However, even the forests of the well-known sweet chestnut, for example, were actually planted and represent a kind of orchard. Place names in the area above Mošćenička Draga (Perun, Trebišća, Petrebišća, Petehova peć) are actually remainders of the ancient Slavic roots of our predecessors. Therefore, the struggle to keep the local inhabitants in the park area must not be abandoned, since it is vital that they continue their traditional stock farming and agriculture, and preserve their traditions and old trade mastery.

Category of protection: Nature Park

Year of proclamation: 1999

Document proclaiming protection: The Law of Declaration of Učka Nature Park (*Narodne novine* Official Gazette issue 45/99).

Area: 14,600 ha (6,420 ha is located in the County of Istria)

Location: The park includes part of the Učka and Čičarija massif in Istria; the area of the Town of Opatija and Lovran, Matulji and Mošćenička Draga municipality in the County of Primorje-Gorski kotar. In the other direction, the park includes the areas of Kršan, Lanišće and Lupoglav municipality in the County of Istria.

Altitude: 60 -1,401 m

Main peaks: Učka: Vojak 1,401 m, Suhi vrh 1,333 m, Sisol 835 m; Čičarija: Planik 1,272 m (the highest peak of Čičarija), Brložnik 1,093 m

Most parks in Croatia are located in the mountainous areas. Učka and a part of Čičarija were given the status of a Nature Park in 1999 and they represent the only nature park in the County of Primorje-Gorski kotar. Učka is the 8th out of altogether 10 nature parks in Croatia, sharing this status with the mountains of Medvednica, Biokovo, Velebit, Papuk and Žumberak with Samoborsko gorje. This nature park covers the area of 146 km², and its main peculiarity is that Čičarija, and even more so Učka with its peak Vojak, stand as isolated Mediterranean mountains, with extensive beech forests growing



- The top ridge of Mount Učka offers lots of distinctive geomorphological, landscape and biological features – the rocks and the sub-alpine beech forest.

Flora: Tommasini or Učka bellflower, (*Campanula tommasini-ana*), Justin's bellflower (*Campanula justiniana*), Istrian bellflower, (*Campanula istriaca*), narrow-leaved moor grass (*Sesleria juncifolia*), autumn moor grass (*Sesleria autumnalis*), mountain ragwort (*Senecio abrotanifolius*), stemless lousewort (*Pedicularis acaulis*), blue lungwort (*Pulmonaria australis*), Trieste gentian (*Gentiana tergestina*), cowslip primrose (*Primula columnae*), mountain lousewort (*Pedicularis hoermaniana*), common peony (*Paeonia officinalis*), carniolan Lily (*Lilium carniolicum*), orange lily (*Lilium bulbiferum*), wild gladiolus (*Gladiolus illyricus*), yellow gentian (*Gentiana symphyandra*)



Fauna: golden eagle (*Aquila chrysaetos*), Horvath's rock lizard (*Iberolacerta horvathi*), alpine or black salamander (*Salamandra atra*), grasshopper *Saga pedo*, endemic snail *Medora albescens*



Vegetation: beech forests, hop-hornbeam forests (*Seslerio-Ostryetum*), oriental hornbeam forests (*Quercu-Carpinetum orientalis*), planted coniferous cultures – black pine (*Pinus nigra*) and spruce (*Picea abies*), an exceptionally diverse grassland vegetation, endemic vegetation of rocks and screes



Special features: the tower at Vojak, the peak of Učka, educational trails, the Vela draga geomorphology reserve (in the Istrian part of the park), Banina ravine and sweet chestnut forests, mostly outside the park.



Note: the Park is managed by the Učka Nature Park Public Authority, founded in September 1999.



■ Endemic Učka or Tommasini bellflower (*Campanula tommasiniana*) grows only on Učka and nowhere else in the world!

above the sub-Mediterranean area. Vojak itself includes a marvellous belvedere commanding a magnificent view of Rijeka Bay and the islands behind it, and further on all the way to Velebit. Looking in the opposite direction, as if laid out on a palm of a hand, one can rejoice in viewing the panorama of Istria, and if the weather is really good, an unhindered view of the peaks of the Alps opens up. Although the largest part of the park harbours forests, the presence of numerous rocky pastures, abundant meadows, rocks, screes, torrential ravines, sinkholes, karst pits and caves intensify its diversity. The complexity of Učka's geological structure is very interesting, since there is a semi-circular impermeable flysch layer below the peak, which leads to the creation of numerous water sources.

The beech forests belong mostly to the *Sesleria autumnalis-Fagetum* association, which is typical for coastal mountains situated between the Mediterranean and the continental areas. One will also come across various thermophile species here: autumn moor grass (*Sesleria autumnalis*) is the dominant type of grass, which is sporadically distributed across the forest floor. The forests in the sinkholes and valleys are marked by more continental features, with an abundance of spring flowers, while the sub-alpine beech woods prevail only at Učka's highest peaks, Vojak and Plas. Here one will find dwarf mountain pine (*Pinus mugo*), however, this species has been planted artificially. The grasslands, rocks and screes are home to

many rare wildlife species. The rock and scree communities, respectively, frequently exhibit endemic features, which means they can only be found at Učka and nowhere else in the world. One of the most significant (steno-) endemic species in this area is the Tommasini or Učka bellflower (*Campanula tommasiniana*), which, together with some other species of bellflowers, forms an endemic community of Učka and Justin's bellflower (*Campanuletum tommasinianae-justiniana*) in rock openings. The alpine, karst and sub-Mediterranean flora elements intertwine here, so one can behold an auricula (*Primula auricula*) or an edelweiss (*Leontopodium alpinum*) in the immediate proximity of a Mediterranean representative, such as a fritillary (*Fritillaria orientalis*) or winter savory (*Satureja montana*).

The flourishing of rare and endangered plants with beautiful blossoms lends a vivid colourfulness to the mountain meadows at the flysch layer below the top of Učka. These plants belong to the association of the hairy viper's grass and spotted hawkweed (*Scorzonero-Hypochoeretum maculatae*). This floral abundance deserves special attention because due to decreased farming, these areas become overgrown by forest veg-



■ Large areas of the slopes in the Mediterranean-mountainous belt of Učka and Čičarija are covered with hop hornbeam forests and coppices (*Ostrya carpinifolia*).

etation. The deforested parts also add to Učka Nature Park's landscape diversity, which is why this area is such a popular destination for great numbers of both trekkers and tourists.

The borderline position between Istria and the littoral area (Primorje), the closeness of the sea and Učka's specific vegetation make this area very interesting especially with respect to the altitudinal distribution and features of the local fauna. One of the highlights is the enclave of the relic Horvath's rock lizard (*Iberolacerta horvathi*), a species of the alpine-dinaric distribution. Another is the rare alpine or black salamander (*Salamandra atra*).

Most of the rare animal species inhabit the grassland areas and rocks and screes, while the hollow trunks hide rare species of bats. Large mammals, such as bear, lynx and wolf, otherwise common in Gorski kotar, have been seen around, and sometimes smallish herds of deer may be sighted.

Numerous water springs on the flysch layer are today utilised mainly for water-supply purposes, while the remaining natural sources and their streams are important for vegetation and animal habitats. One of the most exquisite aquatic habitats is the stream of Banina, with still insufficiently explored wildlife. Another such habitat is a watercourse in the Mošćenička draga valley, near the abandoned picturesque hamlet of Trebišće.

The mountains of Učka and Čičarija also harbour some interesting caves. During the construction of the Učka tunnel, a valuable karst fauna with endemic species of cave beetles was discovered in an underground cavity.

One site well worth visiting is the Vojak peak with a belvedere, at an elevation of 1,401 m. One can take the local asphalt road from the Poklon pass almost all the way to the top.

In the wider area there are more points of interest: Sedlo, a grass-covered sinkhole of Dol, a rocky peak of Suhi vrh, famous for its wealth of alpine flora, the rocks of Bijeje stijene with a thermophile forest of hop-hornbeam, probably the highest of its kind at Učka, Topol spring located in the heights, whose flow has decreased since the recent construction of a logging trail... Griffon vultures (*Gyps fulvus*) and ravens (*Corvus corax*) occasionally fly over the rocks of Učka's peaks and rest on them, as if they too are indulging in the unforgettable views of the seemingly limitless landscapes below.

The flysch grasslands around the top of Učka are nowadays partially covered by thicket. A very rich flora is found in the vi-



■ *Fritillary* (*Fritillaria orientalis*) – a decorative, rare and interesting species on Učka.

cinity of the hamlets of Vela Učka and Mala Učka. Mountain lousewort (*Pedicularis hoermaniana*), common peonies (*Paeonia officinalis*) with large blossoms, carniolan lily (*Lilium carniolicum*), orange lily (*Lilium bulbiferum*), wild gladiolus (*Gladiolus illyricus*), yellow gentian (*Gentiana symphyandra*), are only some of the flora rarities. The small flysch springs that seep away soon after they emerge, are visited by European toads (*Bufo bufo*), and yellow-bellied toads (*Bombina variegata*) at hatching times. Among rare water insects that live at the springs there are some species of caddis flies (*Trichoptera*), which build conic houses out of tiny attached pebble grains.

Motorists can easily visit the ravine and the village of Lovranska Draga with a small, but very attractive waterfall above it. Around waterfall rocks there grow few rare yew trees (*Taxus baccata*), and even rarer for Učka, maidenhair fern (*Adiantum capillus-veneris*). Although only a couple of yew trees are left now (there may be a few more, but their habitat is rather inaccessible), their shoots are populated by yew-gall midge (*Taxomyia taxi*).

In very close proximity to Lovranska Draga is an old forest of popular sweet chestnut, locally called *marun*. There are just a few such forests in Učka Nature Park. This forest flourishes in deep, weathered soil – the relic red soil (“terra rossa”), and is unique for its particular wildlife, including a great number of



■ Ground beetle in a shaded valley above Moščenička Draga.

fungi. Above the waterfall looms the rocky peak of Grnjač, which provides a wonderful view to the eastern side of the Učka ridge and its beautiful hop-hornbeam woods. Učka hides a few swampy and freshwater environments, and the black alder (*Alnus glutinosa*) grove at Rečina is one worth seeing, as well as the lovely waterfall of Banina.

Another remarkable valley is the one above Moščenička Draga. Here you can find the abandoned village of Trebišće, a spring and a brook with some rare animal species and small travertine deposits. The screes below Perun, a hill named after a god of thunder in ancient Slavic mythology, lend views of the beech forests with unusually bent trunks, underneath which spurge laurel (*Daphne laureola*) is widespread.

The forest contains a lot of felled trees, and one of the interesting insects here is the rare long-horn beetle *Prionus coriarius*.

Brgud-Bodaj is a rounded grassy ridge, covered with narrow-leaved moor grass (*Sesleria juncifolia*).

A mountain trail along the ridge leads southward, in the direction of the Prodol saddle and the southern Učka ridges, Šikovac and Sisol being among the most attractive, beautiful and wild. Provretnica is a natural gap in the Sisol rocky ridge.

The Sisol rocks and the Prodol grasslands host rare flora and fauna. The rocks are populated by the endemic Istrian bellflower (*Campanula istriaca*) along with some other representa-

tives of sub-Mediterranean rocky flora. In recent years some chamois (*Rupicapra rupicapra*), Croatia's rare alpine antelope, have been spotted here; we hope they will acquire a safe and permanent home in this nature park.

Brložnik peak is situated in the northern part of the park. Not long ago it was the last remaining primeval beech forest in this part of Učka, and today it is hardly reachable due to numerous cliffs, sinkholes, cracks and expressed karst relief. Vela Sapca and Mala Sapca should perhaps be singled out as homes of the rare wild iris (*Iris illyrica*) and wild daffodil (*Narcissus radiiflorus*).

Since Učka Nature Park partially spreads over the County of Istria, landscapes on this side are worth discovering as well. A pearl among them is the Vela draga geo-morphological reserve above Vranje village, characterised by sheer cliffs and towering vertical rocks – it is real bait for true rock climbers.

Tour

Nature lovers have a variety of possibilities for exploring the park's beauties of nature, flora and fauna, cultural heritage and unique and unforgettable landscapes. In this short report we could only briefly mention some of them. They can be approached by different roads, therefore visitors are recommended to obtain more information from the Učka Nature Park Authority, which manages the park. The park has issued a highly recommended tourist map with marked hiking trails.

ADDRESS

- Učka Nature Park, Liganj 42, 51 415 Lovran;
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e-mail: park.priode.ucka@inet.hr

LOKVARKA CAVE

Karst terrains around Lokve feature an entire series of surface and underground karst phenomena. It is intended to connect them up with trails into an integral karst park. One of the most important components of this network is Lokvarka cave – the biggest and most beautiful underground karst phenomenon in this group.

Category of protection: nature monument – geomorphological

Year of proclamation: 1961

Document proclaiming protection: Decision number 83/11 – 1961, Institute for Protection of Nature, Zagreb

Location: area of the Municipality of Lokve (Gorski kotar)

Entrance altitude: approximately 780 m

Length of underground channels: researched so far – 1.2 km

Depth: so far known – 270 m

Temperature: +8°C

Flora and fauna: some species of fungi, cave spider *Parastalita stygia*, diplopoda *Brachydesmus inferus inferus*, cave beetles *Thyphlotrechus bilimeki* and *Parapropus sericeus stilleri*, cave leech and others



The entrance to Lokvarka cave is located on the slope of the wooded hill of Kameniti vrh, approximately one kilometre east of Lokve. The cave has been described by some Croatian geologists as one of the “most beautiful caves of the Croatian karst”. The entrance to the cave was discovered accidentally in 1911, while stones were being extracted from a small quarry. That same year the cave was visited and researched by Dr. Josip Poljak. The following year some pathways, wooden bridges and railings were set down in order to open up the cave for tourists. The paths within the cave were first renovated in 1935 and then again in 1961 and 1974, when iron bridges replaced the wooden ones and electric lighting was introduced.

A detailed investigation and mapping of the cave was made in 1954 by the members of the Željezničar Spelaeological division. More recent studies, joined by members of the Biospelaeological Society from Zagreb together with some other spelaeological societies, were organised in 1998 and 2003. After cleaning and



■ *Calcite formations in Lokvarka cave.*



■ *A detail from the middle part of the cave.*

widening the narrow parts, the spelaeologists were able to reach a depth of -270 m and discover some new areas within the cave. The investigations will need to continue as unexplored parts of the cave still extend further underground. The current total length of the cave, including the recently discovered channels, amounts to approximately 1.2 kilometres.

The cave has a few galleries, i.e. levels, of which three are open to visitors. Other galleries, because of access difficulties, are only open to spelaeologists and they will probably not be made open to visitors.

The last level to be discovered during recent investigations is particularly interesting because of the presence of a spacious channel with an underground stream. This channel is filled with 25-30-ton stone blocks covered with dark silt.

The cave is characterised by nice stalactites and stalagmites as well as by endemic cave fauna. Among cave animals, important are the cave spider *Parastalita stygia*, the diplopoda *Brachydesmus inferus inferus*, cave beetles *Thyphlotrechus bilimeki* and *Parapropus sericeus stilleri*, cave leech and others.

Tour

A road from Lokve leads to the mushroom-shaped ticket booth, the starting point for organised visits to the cave. Lokve's surroundings are also rich with other interesting caves and karst phenomena, rendering feasible the idea of establishing an integral cave park connected by educational paths. The following interesting caves and karst phenomena should be included in the project: Ledena pećina cave on the furthest edge of the Lokvarsko polje field, the Hirčeva pećina cave in the area of Bukovac, located on the southern part of Lokve in the immediate vicinity of the Sljeme road tunnel (this cave was recently opened for visits), the Golubinjak half-cave on the south-eastern part of the Lokvarsko polje field, the Ledenica cave on the south-eastern side of the Golubinjak, the Pinora ponor, the Medvjeđa pećina cave, the deep Kamerkin dol sinkhole, located immediately along the old Rijeka-Zagreb road, and a few others.

ADDRESSES

- Municipality of Lokve Tourism Office, Rudolfa Strohala 118, 51316 Lokve; tel./fax: +385 (0)51 831 250
e-mail: tzo-lokve@ri.htnet.hr
- Pepe cod Tourist Agency, Šetalište Golubinjak 50, 51316 Lokve; tel.: +385 (0)51 831-278, GSM: 091 507 41 51

GOTOVŽ PONOR NEAR KLANA

Underground fissures into which torrents or even entire karst rivers disappear have always captured the imagination of people who visit such natural phenomena. One such site is definitely the Gotovž ponor. Unfortunately, its recent history is not one of the finest, with waste waters getting diverted into it ...

Category of protection: nature monument – geomorphological

Year of proclamation: 1969

Document proclaiming protection: Decision Up/I⁰ 31 – 1969, Republic Institute for Protection of Nature, Zagreb

Location: area of the Municipality of Klana

Entrance altitude: 560 m

Measured ponor depth: 320 m



Fauna: cave beetle *Typhlotrechus bilimeki clanensis*

The Gotovž ponor is located approximately 14 kilometres to the north of Rijeka and approximately 1 kilometre east of the village of Klana with its entrance located at an altitude of 560 metres. The torrent of Klana's Ričina dives into this ponor. The measured depth of the ponor is 320 m. It is a terrace-shaped cave with many smaller and three larger shafts, but only the main channel has been investigated, and many lateral channels have remained unexplored. The ponor is also known in biospelaology, because it is the "locus typicus" of the cave beetle *Typhlotrechus bilimeki clanensis*, which has been found and described here.

The first people to explore the ponor were Italian speleologists in the 1920s. They reached the bottom and measured its depth of 420 m. Later speleological investigations have shown that the depths measured by Italian researchers were greater than the actual ones and that the already investigated caves needed to be measured again. Therefore, in 1959 Croatian speleologists organised an investigation of the Gotovž ponor in which as many as 74 researchers participated. The research was interrupted, however, with the sudden arrival of torrential waters, but the actual depth of the ponor this time was estimated to be approximately 320 m. Recently, the ponor has been explored by members of the Estavela speleological association. Nowadays, the investigations are also rendered more difficult, and for a certain period were com-



■ Entrance to the Gotovž ponor

■ Dry bed of Ričina right before it sinks into the ponor.



pletely impossible, because of the polluted Klana sewage waters flowing into the ponor. Today these waters are being cleansed by a water treatment plant.

Tour

The entrance to the ponor is not difficult to find if one turns into the Klanjsko polje field from the Klana – Studena road below the former military premises and follows the bed of the Ričina torrent. Not far from the water treatment plant, the entrance to the ponor is found, in the shape of a vertical crevice in the rock on the edge of the Polje field.

ADDRESS

- Estavela Spelaeological Association, Pelini 77, 51215 Kastav; GSM: 091 722 07 89
e-mail: alen.kapidzic@ri.htnet.hr

ZAMETSKA CAVE

The town of Rijeka has been constructed on a karst terrain full of subterranean cavities. Some time ago, during excavation for the foundations for the city's gas plant, even a proteus or olm (*Proteus anguinus*) was found beneath Rijeka! The Zametska pećina cave, discovered right in the city area, has all the necessary prerequisites to be opened up for visitors.

Category of protection: nature monument – geomorphological

Year of proclamation: 1981

Document proclaiming protection: Decision to Proclaim Zametska Cave a Geomorphological Nature Monument, Official Gazette of the Municipality of Rijeka, issue 21/1981

Location: area of the City of Rijeka (Zamet)

Entrance altitude: 140 m

Measured length: 200 m



Fauna: cave beetle

Zametska pećina cave is located in the locality of Malonji within the suburb of Zamet, only a few kilometres from the centre of Rijeka. It is 200 metres long and belongs among the more interesting formations of Croatian karst due to its underground morphology and calcite forms. According to their morphology,



■ *Calcite formations in the front part of the cave.*



■ *The entrance to Zametska cave is sealed with an iron grille due to frequent devastation and waste disposal.*

the underground areas of this cave can be divided into the following main parts: the entrance with its steep shaft, the widening in the shape of halls, the low channel with smaller widenings and the lateral narrow channels with fallen boulders. The cave is also interesting in respect of its animal world because it is a habitat for some species of underground invertebrates. It was discovered in the 1920s and has been scientifically explored on several occasions. At the moment, the entrance to the cave has been sealed in order to prevent unauthorised visits, rubbish dumping or destruction of stalactites and stalagmites. Projects have been planned to open the cave to the public and all the efforts of the Public Authority for Managing the Protected Natural Resources of the City of Rijeka are moving in that direction.

ADDRESS

- Eneo Public Authority for Managing the Protected Natural Resources of the City of Rijeka, Titov trg 3, 51000 Rijeka; tel.: +385 (0)51 209 450

SOURCE OF THE RIVER KUPA

The vauclysian spring of the Kupa is the most beautiful natural jewel within Risnjak National Park and visiting it is worth the effort because visitors will be richly rewarded with an unimagined experience of primal nature.

Category of protection: nature monument - hydrological

Year of proclamation: 1963

Document proclaiming protection: Decision number 187/13 – 1963, Institute for Protection of Nature, Zagreb

Location: area of the Town of Čabar (Gorski kotar)

Area: 10 ha

Altitude: 321 m

Depth of vauclysian spring: greatest depth investigated – over 80 m

Water temperature: 5-6° C

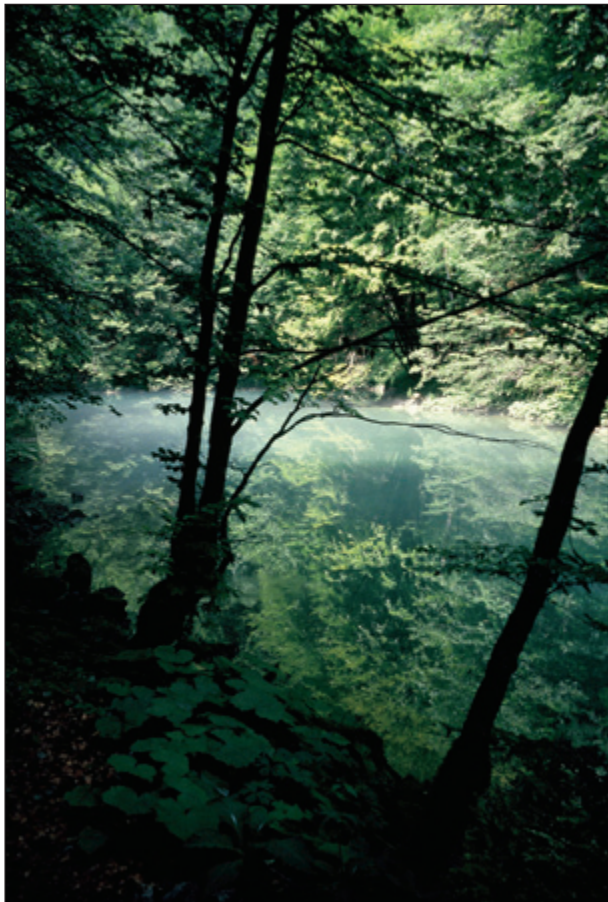


Flora: alpine butterwort (*Pinguicula alpina*), alpine aster (*Aster bellidiastrum*), Kalnik moor grass (*Sesleria kalnikensis*), mosses



Fauna: European grayling (*Thymallus thymallus*) and numerous cold and clear waters invertebrates

The source of the Kupa is a first-class hydrological and landscape phenomenon. Because of its beauty and the wilderness of its nature, it leaves a strong impression on the memory for a long time. It is located within the boundaries of Risnjak National Park. Cramped below one-hundred-metres-high vertical rocks, the source has the shape of a small oval lake approximately 50 metres wide. The tarn is filled with still and clear water of a greenish colour and lies at an altitude of 321 metres. It is a vauclysian spring, the largest of its kind in Croatia. Its water gushes from the unknown depths of local geological structures and it drains from the wider area of Mount Risnjak, abounding in fissured and karstic limestone sediments into which abundant precipitation waters flow. Even though the source has not yet been entirely explored, previous studies indicate that it is over 80 metres deep. It has been determined that the water rises from two separate channels, similar to vertical wells. A depth of over 80 metres has been determined in the deeper and narrower channel, whilst a depth of 57 metres has been determined for the wider one. The low and constant water temperature of 5-6° C, and human limitations when div-



■ *Karst spring of the River Kupa*

ing in deep cold waters, have prevented complete insight into the morphology and nature of the source. Colouring has proven the subterranean connection of the Malenca gorge and the gorge of the Velika Voda stream near Crni Lug with the Kupa source. The average outflow of the source is approximately 1,200 l/s, whilst the maximum quantities of water are not measurable. Such a generous outflow of water results from the special distribution of geological structures including faults, water-permeable rocks and a barrier of water-impermeable rocks.

The small lake is characterised by the fauna of clear montane spring waters, especially by numerous invertebrates. During

summer months along the shore, swarms of true flies (*Diptera*), a species of tiny dark flies can be seen. Hunting for insects, European graylings (*Thymallus thymallus*) rise occasionally to the smooth surface of the water, rippling its calmness for an instant. The small lake is completely surrounded by dense woods and the moist rocks overhanging its surface are covered with luxuriant and various mosses. In the crevices of the rocks grow alpine plants, perhaps even remnants of the Ice Age – such as 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 flora particular to them, including endemic species of Kalnik moor grass (*Sesleria kalnikensis*).

Tour

The easiest way to reach the source of the Kupa is to follow the marked mountaineering path from the village of Razloge. A pleasant stroll through the beech forest lasts for approximately half an hour with careful attention only being needed on the steeper parts in order to avoid slipping on damp leaves. In more dangerous areas the National Park Authority has put up a wooden railing and a pathway. In the lower area, near the source, the path passes through the dry bed of the torrent named Krašićevica, which is impassable in case of abundant precipitation when it carries large amounts of water. The source is also accessible from the opposite side from the direction of Kupari.

ADDRESS

- Risnjak National Park Authority, Bela Vodica 48, 51 317 Crni Lug; tel: +385 (0)51 836 133, Fax: +385 (0)51 836 116, e-mail: np-risnjak@ri.htnet.hr

OLD YEW TREE IN MEĐEDI

In the Gorski kotar region, there are several very old yew trees. It is often difficult to determine their age, but they may be among the oldest living things of the County of Primorje-Gorski kotar. Among the nature monuments, only the yew-tree in Međedi is protected.

Category of protection: nature monument

Year of proclamation: 1965

Document proclaiming protection: Decision number 17/1-1965, MK/MZ, Institute for Protection of Nature, Zagreb

Type of tree: yew (*Taxus baccata*)

Location: area of the Town of Vrbovsko

Altitude: approximately 615 m



■ This is a female yew tree whose seeds are surrounded by an edible fleshy covering (aril) on which birds feed.



■ Yew needles are arranged on branches on the plain – like fir needles.



■ Protected yew tree in Međedi

Yew trees have become a rarity everywhere throughout the Gorski kotar region, as well as in Croatia and around Europe. The reason for this is the widespread cutting of the yew for its much appreciated, decorative and hard reddish wood. An old yew (*Taxus baccata*) grows in the village of Međedi and is protected as a nature monument. Međedi is a village of but a few houses located on a very nice sun-exposed area above the village of Vučinići near Moravice. The old yew tree is located near the road along an orchard, on richly fertilised soil, resulting in the lush growth of nettles below the tree crown. The top of the yew and some of the branches have dried out for unknown reasons. There are no recent dendrometrical data for the yew, but in 1964, during the process of obtaining its status of protection, the yew was measured. The diameter at breast height measured 76 cm, the circumference 258 cm, and the height 15 m. It is a female yew tree that produces a large number of seeds surrounded by a fleshy scarlet covering – the aril – a favourite food for birds, who assist with the spreading of the seed. Apart from the yew tree, some old pear trees in the nearby orchards are also interesting.

Tour

Međedi village is located in the area of the town of Vrbovsko and can be reached from the village of Vučinići: leave the Zagreb-Rijeka road in Vučinići, take the local road in the direction of Topolovice Moravičke and then turn right to Međedi at the intersection for Topolovice. The old yew can be easily noted because it is located not far from the road, very near to the houses.

ADDRESS

- Town of Vrbovsko Tourism Office, I. G. Kovačića 44, 51326 Vrbovsko; tel./fax: +385 (0) 51 875 984
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OLD OAK TREE NEAR SV. PETAR ON THE ISLAND OF CRES

As an individual protected tree specimen, the old oak near Sv. Petar has a symbolic meaning. Numerous legends and stories are connected with this tree. A tempest in 2003 nearly destroyed it and its crown had to be pruned and trimmed of some old branches in order to restore stability because its trunk had cracked...

Category of protection: nature monument

Year of proclamation: 1997

Document proclaiming protection: *Službene novine* Official Gazette, issue 23/97

Type of tree: downy oak (*Quercus pubescens*)

Age of tree: estimated at more than 400 years

Location: area of the Town of Cres (Tramuntana)

Altitude: approximately 250 m



Surrounding vegetation: sub-Mediterranean forests of oriental hornbeam and downy oak (*Querco-Carpinetum orientalis*)



■ The old oak tree in Sv. Petar after the treatment.

The old oak near Sv. Petar on the northern part of the island of Cres, at the location named Tramuntana, grows alongside the road that connects the local Križić - Beli road with the village of Sv. Petar. It is an extraordinary specimen of oak whose age is reckoned at more than 400 years. The diameter at breast height is 565 centimetres and there is a large cavity at the foot of the trunk. The tree was damaged during bad weather on several occasions and during one of these, in the autumn of 2003, cracks developed on the trunk and the tree's stability was threatened. The earlier height of the oak was approximately 15 metres, the crown spread over approximately 22 metres, and some branches were 25 to 55 centimetres in diameter. Now the tree has been partially consolidated and the stability has been restored, but the tree remains significantly changed in the shape of its crown, which has been pruned away in order to reduce the danger of further decline. These interventions were professionally performed by the staff of Cres Forestry.

In the past, the shape of this oak was most probably influenced significantly by the method of tending the forests on the island of Cres, when at regular intervals the branches of old trees were trimmed for firewood. Botanical research performed by forestry experts has shown that this is a specimen of a downy oak (*Quercus pubescens* subsp. *pubescens*). As many as five species of oak, very diverse in their forms, grow at Tramuntana - perhaps they even partially cross-breed. The forests of deciduous downy oaks and bitter oaks are important for the sub-Mediterranean zone of vegetation, covering the northern part of the island of Cres. The old oak was protected in 1997 as a nature monument – individual tree specimen.

Tour

From the main Cres road, turn towards the ancient town of Beli at the attractive belvedere of Križić. Approximately half way to Beli, look very carefully for the turning towards the village of Sv. Petar on the right-hand side of the road. The old oak is not far from this turning.

ADDRESS

- Caput Insulae Beli Eco-centre, Beli 4, 51559 Beli, Island of Cres; tel.: +385 (0)51 840 525
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OLD OAK TREES IN GULJANOV DOLAC NEAR CRIKVENICA

The oaks in Guljanov dolac are probably the oldest specimens of their species in the area of Crikvenica. Over a wider area, there are probably more specimens of these trees, but these ones have been preserved from oblivion, along with the historically valuable area of Kotor above Crikvenica, thanks to the diligence and efforts of the Association of the Inhabitants of Crikvenica.

Category of protection: nature monuments

Year of proclamation: 2002

Document proclaiming protection: *Službene novine* Official Gazette, issues 3/02 and 6/02

Type of trees: downy oaks (*Quercus pubescens*)

Age of trees: approximately 350 and 400 years

Location: area of the Town of Crikvenica (Kotor)

Altitude: 134 m



Surrounding vegetation: small sub-Mediterranean forests of oriental hornbeam and downy oaks (*Querco-Carpinetum orientalis*) and dry sub-Mediterranean grasslands

On the northern side of the hill of Kotor, on the edge of the picturesque, grassy Guljanov dolac, there are two centennial downy oaks. Their value has been recognised by the members of the Association of the Inhabitants of Crikvenica, who, among other things, also take care of the natural resources of their area. As a result of their great efforts to protect the oaks, at the beginning of 2002 the County Assembly of the County of Primorje-Gorski kotar decided to protect the oaks within the category of nature monument – individual tree specimen. Dendrologic examination of the old oaks has been entrusted to forestry experts. Within the phase of preparing the professional background information for the proclamation of protection, it has been determined that these trees belong to the down oak species (*Quercus pubescens*) whose forests once covered the entire sub-Mediterranean part of the coastal area but are today mostly either devastated or degraded. The age of the oaks has been roughly estimated at between 350 and 400 years, but these figures should be taken with caution because it was not possible to determine the exact age due to the lack of precise instruments. It is even possible that the trees are older. The diameter at breast height of the older tree is 121 centimetres, the height 17.5 metres, the wood-stock 9.88 m³ and the

crown surface 180 m². The younger tree's diameter at breast height is 92 centimetres, the height 17.0 metres, the woodstock 5.49 m³ and the crown surface 140 m². According to the claims of the Association of the Inhabitants of Crikvenica, these are the oldest specimens in the area of Crikvenica and this alone should be the reason for their protection. Unfortunately, Guljanov dolac is today neglected, as is the entire hill of Kotor. Numerous archaeological findings and the picturesque abandoned settlement of Kotor are evidence of a former eventful past. They give a significant cultural-historical importance to this entire area, an importance that, along with the



■ *The older of the two oaks in Guljanov dolac. Bees probably used to swarm in the cavity in the trunk.*

old oaks, nature monuments, has not yet been sufficiently evaluated and exploited.

Tour

There are four ways to reach the historically significant hill of Kotor, Guljanov dolac and the old oaks. These ways are in fact ancient pedestrian paths that have been rescued from oblivion. They have been cleaned, landscaped and marked thanks to the efforts of the Association of Inhabitants of Crikvenica. One of these old paths rises steeply from the Kotor road in Crikvenica over the deserted settlement of Kotor, then along the walled-in pond (in local idiom known as *kalac*) which in the past was used for water supplies, past the interesting ruins of the little church of St. Trinity from the 16th century and finally, over thicket-covered pastures to Guljanov dolac and the protected oaks. In the opposite direction, the old path descends along the quarry of Podbadanj and arrives at the stream of Kričina with its twenty-metre-high waterfall. Here we have already entered into the area of Vinodol, which is, for its natural beauty and tumultuous history, a story in itself ...

ADDRESSES

- Association of the Inhabitants of Crikvenica, pp 17, 51260 Crikvenica; tel.: +385 (0)51 785 358
- Town of Crikvenica Tourism Office, Trg S. Radića 1, 51260 Crikvenica; tel.: +385 (0)51 241 051
e-mail: tz-grada-crikvenice@ri.htnet.hr
web address: www.tzg-crikvenice.com
- Municipality of Novi Vinodolski Tourism Office, Bribir 8, 51253 Bribir; tel.: +385 (0)51 248 730
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LISINA

Lisina is a protected karst landscape next to the spacious protected area of Učka Nature Park. It belongs to the mountainous areas of the Ćićarija chain of mountains and is almost entirely wooded with beautiful thickets of littoral beech forest. Only in some small areas is it spotted with picturesque meadows and grassy forest glades. It has a long tradition of being visited by day-trippers. The forest resources of the mountain have always attracted the local inhabitants as well, who were traditionally busy collecting firewood, burning charcoal and hunting edible dormice.

Category of protection: protected landscape

Year of proclamation: 1997

Document proclaiming protection: *Službene novine* Official Gazette, issues 8/97 and 12/97

Area: 1,394 ha

Location: area of the Municipality of Matulji (Ćićarija)

Altitude: 600 – 1,241 m

Flora: autumn moor grass (*Sesleria autumnalis*), martagon lily (*Lilium martagon*), stemless lousewort (*Pedicularis acaulis*), blue lungwort (*Pulmonaria australis*), dark blue spring gentian (*Gentiana tergestina*), cowslip (*Primula columnae*); plenty of fungi, especially boletes (*Boletaceae*)



Fauna: edible dormouse (*Myoxus glis*), roe-deer, foxes, badgers, hares, martens, plenty of forest birds, occasionally deer and boars



Vegetation: littoral beech forest with autumn moor grass (*Seslerio-Fagetum*), to a lesser extent European hop-hornbeam forest (*Seslerio-Ostryetum*) and planted coniferous cultures – black pine (*Pinus nigra*), silver fir (*Abies alba*) and spruce (*Picea abies*)



The protected landscape of Lisina is a spacious karst wooded area in the mountainous areas of the Ćićarija, which is a continuation of Učka Nature Park. The area of Lisina with its mountaineering lodge and meadows surrounded by luxuriant littoral beech forests is a favourite of hikers and mountaineers and the starting point for numerous attractive walks to the nearby peaks and natural sites. One of the most interesting peaks in this wooded mountain landscape is the peak of Crni vrh (1,037 m). Over its picturesque ridge leads a mountaineering path starting south-west of the Lisina lodge. The ridge



■ Hop hornbeam (*Ostrya carpinifolia*) grows in the lower areas of the Lisina forest.

is rather rocky with a few smaller compact forest rocks where – even at this altitude – some representatives of thermophile Mediterranean-montane forests grow: European hop-hornbeam (*Ostrya carpinifolia*), manna ash (*Fraxinus ornus*) and others, mixed with representatives of the beech forests. Among rare plants, the protected martagon 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 characterised by many forest sinkholes, smaller forest rocks and deep pits in which the snow remains until late spring. These areas are rarely visited by mountaineers or day-trippers, although there are several forestry paths in this very interesting landscape. More visited is the area of Vodičke griže (1,143 m) with the renowned source of Vodice at its foot. This is the favourite point for hikers during the summer heat when the extremely cold spring water offers delicious refreshment. There is only a ten-minute walk from the source to the peak of Vodičke griže. The peaks of Lisina (1,183 m) and Gomila (1,241 m) are

probably the most visited mountaineering destinations within the protected landscape, but the views from these points are limited because of a thick beech forest. To the north, there is the peak of Lepi (1,014 m) afforested with coniferous forests. The furthest south-eastern part of the protected landscape is the peak of Beljač (787 m), partially covered with planted black pine forest. Whilst other areas of the protected landscape of Lisina are mostly covered with beech forests, the area of Beljač is in the belt of thermophile European hop-hornbeam. Therefore, the flora here is somewhat different to the flora elsewhere in this area. Grassy surfaces play a significant role in preserving biodiversity in protected landscapes, but there are only few such areas here. The meadows in the vicinity of the Lisina mountaineering lodge are mostly neglected and covered with thicket. Some of the rare plants covering these grasslands can be noticed as early as spring. Amongst others, these are for example the Tertiary relict stemless lousewort (*Pedicularis acaulis*) and blue lungwort (*Pulmonaria australis*), which also grow on the grasslands of Učka. In the forests of Lisina are some well-known habitats of the edible dormouse (*Myoxus glis*), which the local inhabitants gather up during the traditional hunt in autumn.



■ Autumn moor grass (*Sesleria autumnalis*) is the most frequently found grass in the forest communities of Lisina.



■ *The spindle tree (Euonymus latifolius) has a decorative value when its fruits mature.*

Tour

The protected landscape of Lisina is the immediate continuation of the northern border of Učka Nature Park. Visitors who arrive from Poklon on Učka and climb the peak of Planik, the highest point of Čićarija, often end their walk on Lisina and then take the bus from the village of Zvoneća. The entire tour takes 7-8 hours of moderate walking and is somewhat demanding in terms of orientation, but there are mountaineering marks. Those who climb Crni vrh from Lisina can descend down the picturesque grassy glade of Mala Sapca towards Rukavac or Veprinac. Lisina mountaineering lodge can be reached by gravel roads from the villages of Rukavac, Zvoneća or Veprinac. Since the lodge is temporarily closed, visitors interested in Lisina should find accommodation on the Liburnian Riviera (for example in Opatija, approximately 15 km from the Lisina lodge!), and make use of the bus routes to the villages at the foot of Lisina - Zvoneća, Rukavac and Veprinac. The diligent

mountaineers of Matulji have recently traced out and marked the mountaineering-tourist trail through the most beautiful area of Lisina. This is called the “Lisina path” and passes over all the most important mountain peaks; it has ten control points and covers a length of approximately 30 kilometres of air distance.

While in this area, one should also visit some other interesting landscapes and cultural-historical sites like the locally significant terraces in the village of Zvoneća or the ancient little town of Veprinac, located on the belvedere hill above Opatija. The ancient town of Kastav, full of interesting attractions and legends, is also worth a visit. In the small nearby coastal town of Volosko, the scientist Andrija Mohorovičić¹ was born, the discoverer of the Earth's discontinuity, which was named the “Moho” in his honour. To the north of Kastav is the spacious karst forest of Lužina, especially attractive to trekkers, recreationists, and all nature lovers. In the spatial plan for the County of Primorje-Gorski kotar the forest has been proposed for protection in the category of protected landscape. The cave of Sparožna, located within this area, has a long tradition of being visited – going back to the times of the Austro-Hungarian Monarchy. It has not been electrified, but a path has been laid down within the cave. The key to it is held by the members of the Estavela Spelaeological Society from Kastav.

1 Andrija Mohorovičić (1857–1936), one of the most prominent world seismologists of his time, meritorious for discovering the thickness of the Earth's crust; the lower border plate of the crust, separating it from the Earth's mantle, has been named the “Mohorovičić discontinuity”.

ADDRESSES

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KAMAČNIK

The Kamačnik is a watercourse of incredible beauty, making its way through a canyon cut from Jurassic limestone. It roars through the canyon over a series of small waterfalls and foaming potholes, especially when its waters have become swollen after the rain or melting of the snow. In the upper part of its valley, formed of dolomite rock, the river is a bit calmer and is fed by a few smaller tributaries. Its particular value is the picturesque karst vauclosian spring of unknown but definitely significant depth, as well as the preserved plant and animal world of its clear mountain waters. The visitor will enjoy its natural beauties, rapids and small waterfalls, calm flow and clear water, forests, flora and fauna even though the canyon has recently been spanned by a bridge of the Rijeka - Karlovac motorway.

Category of protection: protected landscape

Year of proclamation: 2002

Document proclaiming protection: *Službene novine* Official Gazette, issue 23/02

Area: 74.44 ha

Location: the area of the Town of Vrbovsko

Altitude: 370 – 600 m


Length of water flow: 3.2 km

Kamačnik is a 3.2-kilometre-long right tributary of the River Dobra. Its mouth is south of Vrbovsko, not far from the railway station, with an inn nearby. This represents the starting point for a touristically very attractive part of the Kamačnik: a canyon, approximately one kilometre long. This canyon, cutting deeply into carbonate rock, is characterised by a series of rapids, potholes and small waterfalls that form a tangled network of passages shaded by the rocks. A well-kept hiking path, similar in style to those of the *Vražji prolaz* special geomorphological reserve near Skrad, leads visitors over a series of wooden galleries and small bridges. The part of the flow between the source and the canyon is somewhat calmer, with smoother-shaped lateral banks, so different from the lively stream running through the canyon. Such a geomorphological image is the reflection of the geological structure: the source area and the part of the flow up to the canyon are formed from more crumbly, but less permeable dolomite and limestone of the Liassic age (Early Jurassic), whilst the canyon cuts into lime-


stone of the Dogger epoch (Middle Jurassic). It is these lithological differences that cause variations in the morphology of the Kamačnik valley. The source of the Kamačnik is 405.4 m above sea level, whilst the confluence with the River Dobra occurs at approximately 370 m above sea level. The geological structure described also directly influences the inclination of the bed of the Kamačnik from the source to the mouth. A fall




■ The swollen waters of Kamačnik.



Flora: yew (*Taxus baccata*), butcher's broom (*Ruscus hypoglossum*), spurge-laurel (*Daphne laureola*), alpine epimedium (*Epimedium alpinum*), nettle-leaved speedwell (*Veronica urticifolia*), forest colt's foot (*Homogyne sylvestris*)



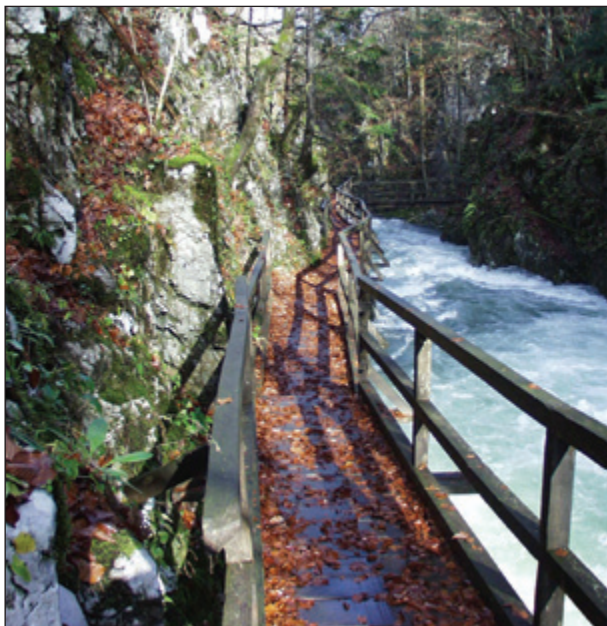
Fauna: endemic subterranean crustacean of the *Monolistra* sp., stoneflies (*Plecoptera*), caddisflies (*Trichoptera*), fire salamander (*Salamandra salamandra*), brown trout (*Salmo trutta* m. *fario*)



Vegetation: beech forest in montane altitude belt (*Lamio orvalae-Fagetum*) with elements of thermophile forest of European hop-hornbeam (*Ostrya carpinifolia*)



Special site of interest: vauclusian spring of unknown depth



■ *In the canyon, the path leads over picturesque bridges directly above the water.*

of approximately 10 m characterises the source area and all the flow up to the canyon, whilst a fall of more than 20 metres is measured for the last kilometre, i.e. the canyon. The larger fall of the bed in the canyon increases its visual attractiveness because of the large number of cascades and because of the canyon's steep, narrow sides. In contrast to this is the calmer flow of the stream with small deposits of pebbles and a milder relief upstream towards the source area. The Kamačnik flows into the River Dobra over a smaller waterfall. On the western side there is stratified limestone, and the initial part of the canyon and the surrounding area are covered with lush forest. A few picturesque spruces are planted along the access road leading to the ruined walls of a large sawmill, built at the beginning of the 20th century but which burned down soon afterwards. The ruins do not disfigure the location, on the contrary, they lend it a certain romantic atmosphere. Not far from there the path reaches the first rocky narrowing by a little wooden bridge. The rapids and ponds within the erosional pits 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. Dark mosses thickly cover the bed and rocks of the

canyon in spots. Old beeches, uprooted by old age, lie decaying along the path, providing undergrowth for the numerous forms of animal life and fungi that live on dead trees. On the rocks overhanging the bed of the murmuring stream, the dark evergreen crowns of yew trees (*Taxus baccata*) can be noted here and there. The flora here comprises many plant species. On the rocks, alpine rose (*Rosa pendulina*), nettle-leaved speedwell (*Veronica urticifolia*) and sand rock-cress (*Cardaminopsis arenosa*) grow, while in shaded spots the forest colt's foot (*Homogyne sylvestris*) is common. Beech forests in the valley of the Kamačnik grow in more humid habitats and belong to the montane type of beech forest (*Lamio orvalae-Fagetum sylvaticae*) in which alpine epimedium (*Epimedium alpinum*) and the protected butcher's broom (*Ruscus hypoglossum*) are noticeable, whilst the protected spurge-laurel (*Daphne laureola*) is rare. On the other hand, on the sun-exposed rocky sides of the valley, some representatives of the thermophile flora with European hop-hornbeam (*Ostrya carpinifolia*), manna ash (*Fraxinus ornus*), whitebeam (*Sorbus aria*), wild service tree (*Sorbus torminalis*) and other species are present. On one dolomite rock, the spring heath (*Erica carnea*) grows luxuriantly. Somewhere near the point where the stream exits the canyon and enters the calmer part of the valley, the canyon is arched over by a bridge of the new motorway. In the upper part of the valley, on the left side, the dolomite slope is moistened by small lateral springs, and the swampy terrain is covered with purple moor grass (*Molinia* sp.) along with some rare species of sedge. In terms of ecology, of particular value is the area in which lateral torrential streams below the village of Japići join the Kamačnik from the left. These form the broadened part of the valley covered with fragments of willow thickets (*Salix* sp. div.) and alder groves (*Alnus glutinosa*). In the upper part of the valley, small sources arise from half-caves situated in lateral gullies. At this point we are already in the source area of the Kamačnik. A one-hour walk from the entrance to the canyon takes one to an unusual, depression-like area surrounded by semi-circular steep slopes and covered with beech forest and plenty of ferns. This is the spring of Kamačnik, a typical rising karst spring in which the water emerges from a hole from an unknown depth. The water gushes from a large depth, but spreads calmly and flows slowly, the same way as along the entire upper part of the valley. Expert hydrologists still have an interesting task to perform here, i.e. measuring and studying the spring of Kamačnik in



■ Detail of the ruined sawmill at the entrance to the canyon.

detail. The spring area is also interesting for its still-to-be-discovered endemic underground fauna. During the biological reconnaissance done so far, a subterranean crustacean of the species *Monolista* has been noted. The flow is also worthy of protection because of the conserved fauna at the bottom of the clear mountain rivulet, as well as for the ichthyofauna because this is an important shelter for brown trout (*Salmo trutta m. fario*), a nearly threatened species because of the permanent danger of pollution in the River Dobra. Representatives of invertebrates here include stoneflies (*Plecoptera*) and caddisflies (*Trichoptera*) whose larvae live in the clear water of the Kamačnik. At a certain time of the year colourful salamanders (*Salamandra salamandra*) may often be seen in the canyon and sometimes grey herons (*Ardea cinerea*) come flying to the banks of the upper part of the valley.

Tour

A visit to the Kamačnik during high-water season is a unique experience. The water resources of the Kamačnik vary significantly during the year, but the spring area and flow of the Kamačnik make one of the most important water contributions to the River Dobra, especially during the period of rains, when they are full of water. Being a typical karst flow of water, a part of the Kamačnik sporadically disappears beneath the canyon, which results in a rather meagre flow during the dry period. The entrance point to the Kamačnik canyon can be reached by an asphalt road from Vrbovsko railway station, whilst for the tour from the inn situated where the Kamačnik joins the River Dobra up to the spring, a slow one-hour walk will be sufficient.

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LOPAR

The Lopar peninsula has had a very turbulent geological history, especially in more recent times, with its interesting sand pyramids formed by the effects of water and the wind. Plenty of fossils from the Eocene epoch can be found on this peninsula, as well as traces of Palaeolithic and Mesolithic hunters in the form of spears, scrapers, axes and arrows. These are made from hard and rare types of stone not natural to the island of Rab, and therefore they are evidence of the ancient migrations of hunters' groups during the Stone Age. It is planned to connect the belvederes and geological points of interest around the peninsula by a network of educational geological trails into a "Geopark" covering the wider area of the island of Rab, with the aim of teaching visitors about events from the area's geological history.

Category of protection: protected landscape

Year of proclamation: 1969

Document proclaiming protection: Decision no. Up/I⁰ 35-1969 Republic of Croatia's Institute For Nature Protection, Zagreb and Official Gazette of the Municipality of Rijeka, number 19/1969

Area: approximately 100 ha

Location: the area of the Town of Rab

Altitude: 0 - 87 m



■ Richly varied landscapes on Lopar – the flysch headland of Stolac covered with grass.

The Lopar peninsula is situated on the north-eastern part of the island of Rab and is probably its most interesting and striking part. Being made of Eocene flysch marl and sandstone, it has developed a very interesting and indented coastline. In its interior there are hills and torrential gullies whose relief has been intensified by deforestation of the terrain in the past. Intense processes of erosion, weathering and dredging have articulated the relief of the peninsula, even though the relief is actually rather low because the peaks of the hills do not exceed a height of 87 metres. In shaping the relief, an important role was probably played by eolian erosion and sea abrasion, so the peninsula today, with its series of sea coves and promontories, looks like a hand with long, out-stretched fingers.

There are cliffs and small flysch islands along the coast, which is, similar to the coast of Rab's Gonar peninsula, a unique phenomenon in this part of the Adriatic.

Eocene flysch rocks are very crumbly and here and there are covered with sandy Quaternary deposits, in some places even up to 15 metres thick! As a result of intense dredging and weathering, strange microrelief forms have been formed in these sediments, such as earth pyramids, towers and pillars that are continuously changing their shape. More durable are those shapes of earth pyramids which have a protective "cap" of vegetation on top, whilst others fray rather quickly and disappear.

Flysch sediments impermeable to water hide some sources of potable water, which is one reason for the early population of this area. Near one such rich source, artefacts from the Palaeolithic and Mesolithic eras have been found, i.e. stone objects in the shape of spears, scrapers, axes, arrows and similar. The interesting thing about these artefacts is that they were made out of hard and rare types of stone not natural to the island of Rab.



Flora: common myrtle (*Myrtus communis*), mastic tree (*Pistacia lentiscus*), rockroses (*Cistus* sp.) and numerous other species of Mediterranean flora



Vegetation: eumediterranean macchia and garrigue, rare vegetation of shore sand plants



Special sites of interest: sand pyramids, fossils and other geological and archaeological items of interest

This indicates the ancient migrations of Palaeolithic hunters who carried such stones with them from very distant areas.

In other areas even older geological remains can be seen – fossils of nummulites, shells of molluscs and snails originating from the time of formation of Lopar's rocks, i.e. the Eocene epoch. Especially numerous are the nummulites whose lenticular-shaped petrified corpuscles one centimetre in diameter cover entire parts of the rocks in this area.

Some flysch stones along the shore are strangely corroded with small holes covering their surfaces, whilst others display a net-like surface structure, which is also characteristic of some rocks beneath the sea.

The vegetation of Lopar is interesting too. Immediately by the shore, bushes of common myrtle (*Myrtus communis*) grow on the ground, their shapes formed by the salt water and the cold *bora* wind that blows harshly in this area. This is why on the cliffs and flysch shore the vegetation of halophytes is nicely developed. The commonest are plantain (*Plantago holosteum*) and milkwort (*Reichardia picroides*), whilst at sandy locations within the valleys a species of the grass *Agropyrum mediterraneum* is found. Further inland, groups of western bracken fern can be noted (*Pteridium aquilinum*), whilst the hills are covered by evergreen macchia and garrigue and by a few pastures. In May, the green colour of the grazed grass on those few pastures, as



■ *Myrtle shrubs (Myrtus communis) protect flysch and sandy soil from further weathering and erosion.*



■ In spring, the fragrant Mediterranean vegetation of Lopar blossoms with many colourful flowers – a *cistus* (*Cistus* sp.).

well as on the Stolac peninsula, contrasts with the uniform appearance of the surrounding landscape. These pastures are characterised by gentle hair grass (*Aira capillaris*), and some sandy areas are covered with rabbit tail grass (*Lagurus ovatus*). Early in the morning, above the pastures, swarms of tiny flies can be seen flying low like an arrow over the shore, and swallows (*Hirundo rustica*) rushing into them.

Tour

During a visit to Lopar, the unique sandy beaches of Crnika bay are worth calling at; they are very crowded with tourists during the high season but these are the very places where the last remnants of the rare and interesting sand flora and vegetation unique to the Kvarner area struggle to survive. The area is accessible by car or by local bus from the town of Rab, although further towards the hinterland and the coast of the Lopar peninsula one should continue on foot. Due to the abundance of geologically interesting features here, the “Island of Rab Geopark” project is now in progress, whose principal role will be to present the numerous geological particularities of the Lopar peninsula to a wider public. It is intended that the entire Lopar peninsula will be proclaimed a “Geological Garden” with a large number of marked geo-points, geo-paths, geo-belvederes, info-points and info-centres. Along with other geologically interesting locations on the island, this will enable the Island of Rab to be put forward as a candidate for “Geopark” status within the European Geoparks Network.

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JAPLENŠKI VRH

The people of Delnice are exceptionally lucky to have their town surrounded by so much natural beauty. Included in this is the forest park of Japlenški vrh. There is always something to see or discover in it and each visit provides a new experience: in springtime the many spring blossoms, the scent of cyclamen in summer, an abundance and diversity of mushrooms in autumn and the tracks in the snow of many animals in winter.

Category of protection: forest park

Year of proclamation: 1953

Document proclaiming protection: Decision no. 26919-1953, State Secretariat For National Economic Affairs, Zagreb (register no. 39)

Area: 171 ha

Location: the area of the Town of Delnice (Gorski kotar)

Altitude: 750 - 842 m

The hill of Japlenški vrh is 842 m high, covered in beech and fir forest and rises immediately above Delnice. It is a well-known recreational area for the people of Delnice, criss-crossed by a network of walking paths and with a ski jump at the bottom, providing a nice view over Delnice. Not far from the ski jump is the Lovački dom hotel; below, the forest area continues into the old Delnice park, so the protected area is directly connected with the town. From the Lovački dom one can start a circular walk on the paths around Japlenški vrh, or climb to the hilltop following one of the paths. In order to realise the beauty and uniqueness of the forest area of Japlenški vrh, one

Flora: dwarf honeysuckle (*Lonicera xylosteum*), spurge-laurel (*Daphne laureola*), turk's cap lily (*Lilium martagon*), cyclamen (*Cyclamen purpurascens*), blue-eyed Mary (*Omphalodes verna*), deadnettle (*Lamium orvala*), chalk comb-moss (*Ctenidium molluscum*), fungi widely represented

Fauna: larger number of central-European forest birds and mammals; the brown bear (*Ursus arctos*) often visits the area

Vegetation: beech forest with fir (*Abieti-Fagetum*), smaller areas of neglected montane meadows





■ Overgrown grassy clearings on Japlenški vrh.

should certainly head for the south slope where a beautiful and luxuriant beech forest with fir (*Abieti-Fagetum dinaricum*) grows, including some specimens of old fir trees. The soil here is rather rocky and covered with moss, especially with the species *Ctenidium molluscum* of a light-green colour, which clings firmly to the rocky base. In this part of the forest there are also numerous bushes of dwarf honeysuckle (*Lonicera xylosteum*). In summertime, after the rain, the perfume of numerous blossoms of cyclamen (*Cyclamen purpurascens*) hangs on the air. Some old firs also grow on the eastern slopes of Japlenški vrh, but rather sparsely; however, there are plenty of stumps remaining from uprooted firs, and beech is more common. From Lovački dom one can head directly to the top over the south-east slope. There are also some old fir trees here, but still they are not as numerous as on the previously mentioned southern slope. Beneath these old trees individual bushes of the protected spurge-laurel (*Daphne laureola*) can be found, and a



■ Forest association of beech and fir, typical of Japlenški vrh forest park.

few rare specimens of the Turk's cap lily (*Lilium martagon*) and the cuckoo pint (*Arum maculatum*). At the top is a small round wooded glade shaded by tall beeches that mostly limit the view. Only through the treetops, every now and then, can one see the forests on the Drgomalj mountain ridge to the north. The peak plateau is covered with a luxuriant layer of deadnettle (*Lamium orvala*), blue-eyed Mary (*Omphalodes verna*), sweet woodruff (*Asperula odorata*), sanicle (*Sanicula europaea*), hellebore (*Helleborus* sp.) and other forest plants. Descending on the other side, towards the northern foothill, one arrives at a picturesque grass-covered glade. It seems that the meadow here is not mowed any more because certain bushes of juniper (*Juniperus communis*) have largely overgrown the area. Among grasses, the most common here, as for other untended meadows in the Gorski kotar region, is the tor grass (*Brachypodium pinnatum*), and of the more distinguished blooming plants, individual turfs of Fritschi knapweed

(*Centaurea fritschii*), willow gentian (*Gentiana asclepiadea*), willow leaf ox-eye (*Bupthalmum salicifolium*), common valerian (*Valeriana officinalis*), lady's bedstraw (*Galium verum*), cross gentian (*Gentiana cruciata*) and others can be found, which bring the glade to life and provide food for hymenoptera and butterflies when in bloom. On Japlenški vrh, as well as elsewhere in Gorski kotar, there is a huge variety of mushrooms to be found whilst more difficult is noticing representatives of the forest fauna. The jays, finches, nuthatches and many other bird species that fly into Delnice Park can also be seen here. Even though Japlenški vrh is located near the town of Delnice, one should still be careful of bears, which often descend to the town in search of food. Along the Lovački dom, a part of forest area has been fenced off with wire and turned into a small zoo, which the Croatian Forests company has populated with fallow deer (*Dama dama*) and mouflons (*Ovis musimon*).



■ Red dwarf honeysuckle (*Lonicera xylosteum*) grows on the slopes of Japlenški vrh.

Tour

The starting point for visiting the Japlenški vrh is the Lovački dom above Delnice, which can be reached by car by turning right from the Zagreb-Rijeka motorway (arriving from Delnice), or within a few minutes' climb uphill by path - up the steps from Delnice. From Delnice, the traditional "Lovers' Lane" leads from the town park along the fence of the zoological garden before arriving at the road for the Lovački dom. Visitors to Delnice looking for forest peace and nice views will probably be interested in climbing to Veliki Drgomalj (1,154 m) whose long forested ridge overlooks the field of Delnice on the one side and the valley of the Kupa on the other. On the Drgomalj massif, it is worth visiting the cave of Hajdova hiža above the valley of Mala Belica. One obligatory destination for day-trippers is Petehovac (Štimčev vrh), a hill that rises to the south-east of Delnice and is characterised by great views, a mosaic of montane meadows surrounded by forests, and a mountain lodge.

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GOLUBINJAK

Anyone looking to enjoy the beauty and magnificence of Gorski kotar's forests without getting worn out by long tours or walks should definitely visit the forest park of Golubinjak. This small area contains many of the natural features important for forest life developed on carbonate karst.

Category of protection: forest park

Year of proclamation: 1961

Document proclaiming protection: Decision number 116/3 – 1961, Institute For Protection of Nature, Zagreb

Area: 51 ha

Location: area of the Municipality of Lokve (Gorski kotar)

Altitude: approximately 730 - 800 m

Flora: alpine rose (*Rosa pendulina*), alpine clematis (*Clematis alpina*), willow-leaf ox-eye (*Telekia speciosa*), alpine enchanter's nightshade (*Circaea alpina*), Austrian leopard-bane (*Doronicum austriacum*), rare ostrich fern (*Matteucia struthiopteris*) and other species of ferns and mosses on rocks – the *Neckera crispa* and others



Fauna: edible dormouse (*Myoxus glis*), squirrel (*Sciurus vulgaris*), many forest birds, butterflies, ground beetles, spiders



Vegetation: beech forest with fir (*Abieti-Fagetum*), fir and spruce forest on calcareous blocks (*Calamgrostio-Abietetum piceetosum*), fragments of vegetation of carbonate forest rocks (*Moehringio-Corydaletum*) and vegetation of tall herbs (*Telekietum speciosae*)



Special sites of interests: fir – the queen of the forest and some interesting microclimatic, karst and spelaeological phenomena and distinctive features (Golubinja pećina cave and Ledena pećina cave, frost areas and others)



Golubinjak, a wooded area of unusual beauty, is located approximately one kilometre to the east of the centre of Lokve, below the railway station. This forest of old firs and spruces covers the steep, jagged and indented rocks looming at the edge of a smaller field. The plateau is a natural continuation of the Lokvarsko polje field from which water probably overflowed from the stream of Lokvarka and disappeared underneath rocks. The young spruce forest planted on a portion of the field



■ In front of a wooded background of old firs and spruces, neat grassy meadows are ideal for recreational purposes.

is the remainder of the cultivation of spruce seedlings from a forest nursery-garden that was once located in this area. The northern portion of the field is a picturesque meadow and the eastern portion is arched over by a motorway viaduct. An eating establishment is located between the spruce forest and the meadow. Traditional gatherings are sometimes organised here, among which the most famous is the competition for foresters. The Golubinjak forest has a long tradition as an excursion area for the people of Lokve, but the proximity of the railway station means many excursionists even come from a much wider area to visit it. This is the reason for covering the labyrinth of rocks with a complete network of



■ One of the attractions of the forest park is the old fir – the queen of the forest.

hiking trails, leading visitors to especially interesting natural details. Amongst the rocks, there are numerous karst phenomena – the Golubinja pećina and the Ledena pećina caves, natural stone gates, a belvedere on an isolated rock and many others. On the monolithic rock above the cave of Golubinja pećina, an alpine climbing area has been located. The surroundings are nicely decorated; on a spacious meadow in the fields, there is the park of wooden figures and the open-air sculpture studio. The forest and the rocks are the basic phenomena of Golubinjak forest park. Forest associations belong mostly to two different plant associations – on the rocky part the fir forest with small-reed in which spruce is also abundant (*Calamagrostio-Abietetum piceetosum*), known also as the fir and spruce forest on calcareous blocks, whilst on the terrain with less rocks and more soil the typical fir and spruce forest is developed (*Abieti-Fagetum dinaricum*). Fir and spruce forest on calcareous rocks differs from beech and fir forest in having a more intense underbrush – generally it is greener and lighter with numerous little bushes of bilberry (*Vaccinium myrtilus*), sweetberry honeysuckle (*Lonicera caerulea*), alpine rose (*Rosa pendulina*) and the alpine clematis (*Clematis alpina*), as well as the grass small-reed (*Calamagrostis* sp.). Among the rocks and within the forest numerous sinkholes can be found with luxuriant ferns and tall herbs growing at their bottoms. In these habitats the most noticeable is the association of yellow oxeye (*Telekietum speciosae*), composite flower with large yellow blossoms similar to small sunflowers. The rare ostrich fern (*Matteucia struthiopteris*) has been found in one of the sinkholes. The area at the foot of the rocks is full of fissures and fallen stones around which freezing air circulates, so these micro-sites represent a quite frosty area, where cold air can be felt even on the hottest days in the summer. Such areas are covered with particular plant life with lots of mosses and ferns, and among blooming plants we can find some species that are not present in the surrounding terrain. Alpine enchanter's nightshade (*Circaea alpina*), forest colt's foot (*Homogyne sylvestris*), wood stitchwort (*Stellaria nemorum*), Austrian's leopard bane (*Doronicum austriacum*) and others can be noticed here. The rocks are covered with a particular association of *Moehringio-Corydaletum* with species of mossy sandwort (*Moehringia muscosa*), yellow bleeding heart (*Corydalis ochroleuca*), bluebell (*Campanula* sp.). Regarding mosses, many rocks are covered with lush layers of *Neckera crispa*. The animal world is represented by numerous forest species,



■ Yellow blossoms of the Austrian's leopard bane (*Doronicum austriacum*) bloom in frosty places much later than elsewhere.

for example edible dormice (*Myoxus glis*), squirrels (*Sciurus vulgaris*), many forest birds, butterflies, ground beetles, spiders and other invertebrates. Within the forest park, special sites of interest are the Golubinja pećina and the Ledena pećina caves which can be reached along forest paths, and an old fir – the queen of the forest located at the foot of the rocky defensive wall along the path towards Lokve railway station.

Tour

The forest park can be reached by car if you turn right after the sign for Golubinjak from the old Rijeka – Zagreb road, before the junction for Mrkopalj. Lokve railway station is in the immediate vicinity of the forest park and from there an attractive footpath leads towards Golubinjak and further on towards Lokve. On the opposite side, along the road from Lokve to Golubinjak, in the levelled Lokvarsko polje field, a centennial alley nominated for preservation is worth noting, as well as the Lokvarka brook ponor – known in local idiom as the Pinora. The forest park is managed by Croatian Forests, Forest Administration Delnice, Forest Office Lokve, and their eating establishment offers refreshments and the opportunity to buy entrance tickets.

ADDRESSES

- Hrvatske šume (Croatian Forests Ltd.), Zagreb – Forest Administration, Branch Delnice, Forest Office Lokve, Šetalište Golubinjak 6, 51316 Lokve, tel.: +385 51 831 322
- Municipality of Lokve Tourism Office, Rudolfa Strohala 118, 51316 Lokve; tel./fax: +385 (0)51 831 250
e-mail: tzo-lokve@ri.htnet.hr

KOMRČAR

The luxuriant greenery of the crowns of Aleppo pines and other Mediterranean plants in Komrčar Park characterises the immediate vicinity of the ancient town walls of Rab. This pearl of nature right alongside the town of Rab is a result of the vision and diligent work of Pravdoje Belia, one-time forestry superintendent of Rab.

Category of protection: forest park

Year of proclamation: 1965

Document proclaiming protection: Decision number 35/4 – 1965 MK/MZ, Institute for Protection of Nature, Zagreb

Area: 10 ha

Location: area of the Town of Rab (island of Rab)

Altitude: approximately 0 - 40 m

Flora: agave (*Agave americana*), Spanish broom (*Spartium junceum*), Australian laurel (*Pittosporum tobira*), mastic tree (*Pistacia lentiscus*)



Fauna: cleopatra butterfly (*Gonepteryx cleopatra*)



Vegetation: indigenous forest of holm oak (*Orno-Quercetum ilicis*), planted forest of Aleppo pine (*Pinus halepensis*)



■ Komrčar forest, located on a hill close to the coast in the immediate vicinity of the old town of Rab.

The forest park of Komrčar – the “green pearl” of Rab – grows north-west of the defensive walls of the old town of Rab. This was once a desolated area. In 1890 Pravdoje Belia¹, the forestry superintendent from Rab initiated the process of afforesting the desolated pasture terrain. He planted it with Aleppo pine and maritime pine, and later on he also started importing indigenous species of evergreen vegetation. The afforestation ended in 1905.

Extraordinary specimens of Aleppo pine (*Pinus halepensis*) of up to 90 cm in diameter and up to 30 m in height can still be found today within the forest park. Unfortunately, every year some trees are brought to the ground by storms while torrents sweep away the soil, creating landslides and gullies on the steep flysch slopes of Komrčar.

The glades created are quickly afforested naturally with young pines, but the forest park nevertheless demands constant attention, care and renovation. Based on the idea of Pravdoje Belia, a network of hiking trails stretches through the forest park. In 1974, to mark the occasion of the 90th anniversary of organised forestry on the island of Rab, the monument bust at the start of the path was erected in his honour.

The air of the forest park is fragrant with the evaporating sap of coniferous and evergreen plants and is particularly intense in May when Spanish broom (*Spartium junceum*) and Australian laurel (*Pittosporum tobira*) are in blossom.

The flora of Komrčar is more intense on its sun-exposed slope along the Sea Promenade of Father Odorik Badurina, because the habitats in this area are more heterogeneous than in the more shaded internal areas of the forest. Agaves (*Agave americana*) grow here, contributing to the exotic atmosphere of this part of the forest park. In the undergrowth of pines, wild madder (*Rubia peregrina*) is widespread and in May it blooms with many tiny, plain yellow-greenish flowers. The peak of the forest park as well as its part that is not exposed to sun are shaded by a thick forest of holm oak (*Quercus ilex*). In the sun-facing glades, wall brown (*Lasiommata megera*) butterflies rest and fly away when approached, while in shaded areas another species of butterfly – speckled wood (*Pararge aegeria*) – can be found resting on leaves in the shade or in a sunbeam, or whirling around in couples. Another interesting butterfly is the cleopatra (*Gonepteryx cleopatra*), a typical representative of Mediterranean fauna.

1 Pravdoje Belia (1853 – 1923), forestry expert, meritorious for afforestation of many areas of the island of Rab.



■ Endemic fern Kvarner spleenwort (*Asplenium hybridum*).

On the peak plateau of the forest park, spiders weave their web threads from one holm oak to another, and every now and then, little reddish or greenish caterpillars descend from the trees hanging by a silky thread to pupate on the ground where they are sometimes eaten up by blackbirds (*Turdus merula*).

Large sulphurous-yellow flower heads of the fluffy urospermum or golden fleece (*Urospermum delechampii*), a species of composite flower that leaves a particular impression on visitors not used to eumediterranean flora, are a real decoration of scarce grass glades of Komrčar in May.

Tour

The forest park can be reached in a few minutes from both the old and the new parts of the town of Rab. Visitors who come to Rab in May should not miss the sight of blossoming blue flowers of the Istrian bluebell (*Campanula istriaca*) covering the defensive walls of the old Rab. With a little luck, a rare Kvarner hart's tongue fern or Kvarner spleenwort (*Asplenium hybridum*) having its habitat here, can also be noted.

ADDRESS

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KOŠLJUN

Naturalists have not yet entirely agreed whether the holm oak forest on Košljun was self-grown or planted. The forest has been protected for a long time by the Franciscans and they have managed to preserve it for us. On this little island, these evergreen forests are growing at the boundary of their natural diffusion.

However it may be, this should not prevent us from making each visit to Košljun a first-class natural and spiritual experience.

Category of protection: forest park

Year of proclamation: 1969

Document proclaiming protection: Decision to proclaim the islet of Košljun and grove of holm oak at Glavotok a special reserve of forest vegetation, Official Gazette of the Municipality of Rijeka, issue 9/1969

Area: 6 ha

Location: area of the Town of Krk (island of Krk)

Altitude: approximately 0 - 6 m

A visit to the islet of Košljun is primarily made for its cultural resources and special atmosphere inspired by the friars – Franciscans – and their renowned monastery, a sanctuary and a rich cultural treasury of this part of the island of Krk. The natural resources remain somewhat in the background, even though the islet is protected as a forest park and is characterised by a luxuriant and diverse nature. When visitors step out of the boat onto the soil of this small island, they are welcomed by a statue of St. Francis of Assisi with a tamed wolf, indicating symbolically how wild nature can become man's friend – and this is exactly what happens with nature on Košljun. The centennial forest of evergreen holm oaks shields and protects the monastery and saves the fertile soil that would otherwise be blown away by the wind or washed away by the rain, making Košljun desolated, bare and uninhabitable, like most of the deserted little rocky islands in the Croatian part of the Adriatic. Košljun is a small island, about 68,500 m² (6 hectares and 85 acres), located in the wide but shallow bay of Puntarska draga, whose waters are surrounded by land on almost every side, except for a narrow sea channel – the Buka. The island is young in its formation and today rises only a few metres above sea level. It originated from the sinking of the Adriatic coast after the ice ages. Before the bay of Puntars-



■ Islet of Košljun – aerial photograph

ka draga became completely sunk, a wetland probably existed where the sea is now. Today, on its north-eastern coast groups of common reed (*Phragmites australis*) can still be noticed as the last possible remnants of an earlier wetland. The islet with its lush forest is a peculiar sight in the middle of the bay of Puntarska draga. The forest covers 44,758 m² or approximately 65% of the surface. Studies of the phytocenological composition have shown that the forest belongs to eumediterranean, evergreen association of holm oak and manna ash (*Orno-Quercetum ilicis*), which normally covers only smaller areas of the island of Krk. However, it could be asked whether this type of

Flora: holm oak (*Quercus ilex*), manna ash (*Fraxinus ornus*), laurel (*Laurus nobilis*), spiny butcher's broom (*Ruscus aculeatus*) and 389 more species of higher plants, 151 species of fungi...



Fauna: blackbird (*Turdus merula*), jay (*Garrulus glandarius*), kingfisher (*Alcedo atthis*) is present along the coast of the islet in wintertime



Vegetation: holm oak forest (*Orno-Quercetum ilicis*), halophile vegetation along the coast



Special site of interest: Franciscan monastery from the 16th century and its precious collections



forest is native to Košljun, or if the holm oak (*Quercus ilex*) was perhaps imported subsequently. For now there is no right answer, but it is certain that an important imprint to today's composition and appearance of the forest was left by the inhabitants of Košljun from its earliest history. The holm oaks are today of centennial dimensions, and some specimens reach up to 15 m in height. The manna ash (*Fraxinus ornus*), the second characteristic species, is also common, but its height does not exceed the holm oak's. One particularity of the forest on Košljun is the abundant presence of laurel (*Laurus nobilis*), which is occasionally present in the form of trees, but it is also abundant in the undergrowth. The abundance of laurel indicates deeper, preserved and damper soils, similar to the forests of holm oak on the islands of Brijuni. On Košljun there also grow downy oak (*Quercus pubescens*), field maple (*Acer campestre*) and Montpellier maple (*Acer monspessulanum*) are also present and these deciduous exemplars may indicate the primary deciduous character of the forest. Among climbers or lianas particularly important is the evergreen rose (*Rosa sempervirens*) because it represents a particular type of association. Within the layer of low plant-cover the commonest are the spiny butcher's broom (*Ruscus aculeatus*) and ivy, which in some spots covers the entire surface of the soil. In some places, lichens *Cladonia* sp. div. and mosses are abundant, like the species *Homalothecium lutescens* whose little shiny golden-yellow leaves cover the trees and rocks. It is interesting that the forest on the north-eastern side of the island is much more stunted as a result of continuous gusting of the *bora* wind in these areas. The forest habitats of the island are rich in fungi that were, along with other flora and vegetation, the object of thorough studying by the Franciscan Berard Barčič. Based on this research, Košljun was named the island of fungi. Among interesting fungi are, for example, the trooping funnel cap (*Clitocybe geotropa*), cauliflower fungus (*Sparassis laminosa*), chestnut bolete (*Gyroporus castaneus*), red cage (*Clathrus ruber*) and poisonous species – devil's bolete (*Boletus satanas*), Jack o'lantern (*Omphalotus olearius*), livid pink-gill (*Entoloma sinuatum*), panther cap (*Amanita pantherina*) and many others. The *Tricholomataceae* family is richly represented, as well as lignicole species, especially those on the holm oak. A total of 151 species of fungi have been registered in the forest areas of Košljun. Other types of habitats are also important for the diversity of flora and vegetation of Košljun. In those habitats Father Berard Barčič found 389 plant species (along

with forest flora and flora of imported or allochthonous plants), which is an impressive figure for such a small island. All these plants form plant associations - Father Berard Barčić described approximately ten of them. Some grew here naturally, others are the result of human intervention. On shores made of cretaceous limestone and on low shores influenced by high and low tides, there is the natural vegetation of halophile habitats. This vegetation is represented by the association of glassworts (*Salicornia* sp.) and common sea-lavender (*Limonium angustifolium*). Vegetation of halophile sharp rushes (*Juncus acutus*, *J. maritimus*) and salted damp meadows is also present. Interesting vegetation with narrow navelwort (*Umbilicus horizontalis*) grows on old walls. Among the plants that grow as a result of human intervention, some weed associations on cultivable surfaces are present, as well as ruderal associations, whilst vegetation of the meadows occupies only smaller areas. Košljun is also characterised by heterogeneous fauna that has not been thoroughly researched yet. Blackbird (*Turdus merula*) and jay (*Garrulus glandarius*) are constant inhabitants of the forest, the latter feeding on acorn, but it also attacks young birds in nests. Much richer is the fauna of birds that only inhabit here occasionally. Among the more interesting species, the kingfisher (*Alcedo attis*) should be mentioned which patrols the low shores of islet when catching fish.

Tour

Košljun can be reached by one of the boats permanently connecting it to Punat. Naturalists will pay particular attention when browsing around the naturalist collection in the Franciscan monastery, but other very rare collections are also held by the museum. Anyone wishing to know more about the flora, mycoflora (flora of mushrooms) and vegetation of Košljun should certainly take the booklet by Father Berard Barčić ("The Flora and Vegetation of the Islet of Košljun") with them on the tour!

ADDRESSES

- Košljun Franciscan monastery, 51521 Punat (island of Krk); tel.: +385 (0)51 854 017
- Municipality of Punat Tourism Office, Obala 72, 51521 Punat; tel.: +385 (0)51 854 860, tel./fax: +385 (0)51 854 970, e-mail: info@tzpunat.hr, web address: www.tzpunat.hr

ČIKAT

Today, the island of Lošinj is wooded for the most part. However, it has not always been like this; as elsewhere around the Cres and Lošinj archipelago, deforested rocky pastures were prevalent on this island. The Society for Afforestation and Embellishment of Mali Lošinj has significantly changed the appearance of this part of the island by planting luxuriant Aleppo pine forests. For the large numbers of tourists arriving here every year in search of relaxation and a clear sea, they provide delightful shade and beautifully scented air thanks to resin evaporating from the bark and needles drying.

Category of protection: forest park

Year of proclamation: 1992

Document proclaiming protection: Decision to proclaim Čikat a forest park, Official gazette of the Municipality Cres-Lošinj, issue 11/1992

Area: 236 ha

Location: area of the Town of Mali Lošinj (island of Lošinj)

Altitude: approximately 0 - 62 m



- *Fragrant myrtle (Myrtus communis) brightens up the undergrowth in the forest park.*



Flora: mastic tree (*Pistacia lentiscus*), myrtle (*Myrtus communis*), strawberry tree (*Arbutus unedo*), wayfaring tree (*Viburnum lantana*), tangled honeysuckle (*Lonicera implexa*), heath tree (*Erica arborea*), maritime juniper (*Juniperus oxycedrus*), olive tree (*Olea europaea*), deodar cedar (*Cedrus deodara*), Italian cypress (*Cupressus sempervirens*), stone pine (*Pinus pinea*) and others



Vegetation: planted forest of Aleppo pine (*Pinus halepensis*)

The island of Lošinj is known for its lush greenery and parks, like the Čikat and Pod Javori forest parks, upon which its tourism is strongly dependent. However, it has not always been like that; parts of the island were desolate and bleak right up till the end of the 19th century. The origins of the Čikat forest park date back to the year 1886 when the Society for Afforestation and Embellishment of Mali Lošinj was established. One of the objectives of the society was to afforest the desolate and bleak areas around Mali Lošinj. Under supervision of the renowned naturalist from Lošinj, Professor Ambroz Haračić¹, Čikat and other surrounding areas were afforested within a few years with saplings of Aleppo pine (*Pinus halepensis*) and black pine (*Pinus nigra*). Within six years, 50 hectares of pine cultures were afforested and approximately three-hundred thousand coniferous plants were planted. Haračić encouraged his fellow-townsmen in the afforestation by arguing that the forest would serve the town of Mali Lošinj as a “natural defensive wall, protecting the town and the port from the *bora* wind”.

At the same time, the afforestation process has been connected with the development of tourism on the island. In 1892 Veli Lošinj and Mali Lošinj were proclaimed climatic health resorts. After the period of adjustment, the Aleppo pine suddenly started spreading naturally into the abandoned vineyard areas of the island of Lošinj, after they had been neglected due to the arrival of the phylloxera pest. Even though the pines spread vigorously on their own and look like a completely acclimatised species, it should be noted that here they are actually outside the boundary of their natural diffusion. The efforts of the Society for Afforestation and Embellishment of Mali Lošinj thus bore fruit completely with the later sudden development of tourism and the villas and summerhouses that were built at Čikat with carefully designed gardens laid out around them. A network of paths was constructed, beaches and smaller sports facilities were improved, favouring increased construction activity as the next phase of tourism started to flourish. Favourable ecological conditions – the climate and a deeper soil have facilitated the fast growth of pine forests. Today’s pines reach to 45 to 60 cm in diameter and over 20 metres in height. Such trees have a strong influence on the appearance of the entire landscape. Within the forest park of today, along with the Aleppo pines, stone pines (*Pinus pinea*) can also be found, and along the coast, on the

1 Ambroz Haračić, (1855-1916) famous Croatian naturalist and patriot, founder of the Meteorological station at Mali Lošinj in 1879 where he recorded data for many years. His most important work is “*L' isola di Lussin, il suo clima e la sua vegetazione*” (1905).



■ Along the coastline, a mammoth wasp (*Scolia flavifrons*) flies to the blossoms of Lošinj wild leek (*Allium ampeloprasum* var. *lussinense*).

rocky terrain, black pine has been preserved as well. The growth of exotic deodar cedars (*Cedrus deodara*) and cypresses (*Cupressus sempervirens*) is very luxuriant.

Macchia containing a large number of eumediterranean evergreen ligneous species grows within the Aleppo pine forest, which extends from the bay of Čikat to the Sunčana uvala cove. This macchia includes, for example, the mastic tree (*Pis-*



■ In half-shaded habitats in the forest park, a spider weaves its funnel-shaped web.

tacia lentiscus), myrtle (*Myrtus communis*), strawberry tree (*Arbutus unedo*), wayfaring tree (*Viburnum lantana*), tangled honeysuckle (*Lonicera implexa*), etc. Holm oak (*Quercus ilex*) is rather rare in Čikat; it does not form separate forests, but grows as a smaller tree within pine forests individually or in groups. Among important evergreen trees and bushes, the laurel (*Laurus nobilis*) can also be mentioned, as well as phillyrea (*Phillyrea latifolia*), the heath tree (*Erica arborea*) and maritime juniper (*Juniperus oxycedrus*). A few specimens of olive trees (*Olea europaea*) with their silver crowns also lend a special charm to the landscape. Along the coast, little bushes of sage leaf rockrose (*Cistus salviifolius*) and rosemary (*Rosmarinus officinalis*) enrich the flora resources of the forest park.

Tour

The forest park is situated on the Čikat peninsula, reaching from the cove of Sunčana uvala to its extreme north-western promontory, which together with the islet of Koludarac create the passage of Boka falsa situated at the entrance to the port of Lošinj. The most attractive point for the visit is the sea promenade. The hotels Bellevue and Alhambra are located in this area, as well as some villas, among which the best known is villa Karolina. The promontory of Anuncijata stretches between Sunčana uvala and the port of Čikat and hosts the famous little votive church of the Annunciation of Our Lady.

ADDRESS

- Town of Mali Lošinj Tourism Office, Riva Lošinjskih kapetana 29, 51550 Mali Lošinj;
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POD JAVORI

Spending at least a few hours in the Pod Javori forest park should be every visitor's aim when passing a summer holiday in Veli Lošinj. In summertime, it is best to visit the forest park early in the morning or in the early evening when it is cooler. A visit at other times of the year can also be interesting, with something new to be experienced every time.

From hardy cyclamen in blossom in early spring to cicada concerts in the height of summer when these little creatures welcome us with their deafening clicking from the trees where they shed their skins.

Category of protection: forest park

Year of proclamation: 1993

Document proclaiming protection: Decision to proclaim the area of Pod Javori in Veli Lošinj a "forest park", Official Gazette of the Municipality Cres-Lošinj, number 1/1993

Area: 39 ha

Location: area of the Town of Mali Lošinj (island of Lošinj)




■ *Old exotic coniferous trees in the lower part of the forest park.*


The Pod Javori forest park comprises the forested slopes of the hill of Kalvarija near Veli Lošinj on which archduke Karl Stephan Habsburg planted the gardens for his nearby castle. He chose this location partly because the climatological research conducted on the island of Lošinj by Prof. Ambroz Haračić indicated it was a particularly favourable location, and partly as a possible health resort in the future. Thanks to its climate and vegetation, Veli Lošinj was indeed proclaimed a health resort in 1892, but the very next year, in 1893, the archduke sold off the castle and gardens.

The gardens were designed by garden experts from Vienna who took full advantage of the terrace-shaped slopes of Kalvarija hill. Extensive land reconstruction was carried out by local labourers and craftsmen. It is interesting to see how the problem of supplying water to the gardens was resolved, a vital issue to consider for possible further planting of flowers, shrubs or trees. A reservoir was built on the highest terrace, with its water supplied from an inexhaustible spring. The water was then distributed through a pipeline to the lowest terrace of the garden. This water-supply system no longer exists today and the gardens have to some extent become neglected.

The plant basis of the gardens is made up of indigenous elements of evergreen macchia, which is common and widely distributed across the island of Lošinj. When the gardens were being arranged, the macchia was partially cleared away and large numbers of seedlings of coniferous and various exotic trees were planted. It was designed to be a landscape of changing views with open areas of grassland, thickets of trees, individual tall trees and some dense forest. The high aesthetic value of the park's composition has been preserved up till to-



Flora: mastic tree (*Pistacia lentiscus*), true myrtle (*Myrtus communis*), strawberry tree (*Arbutus unedo*), wayfaring tree (*Viburnum lantana*), tangled honeysuckle (*Lonicera implexa*), heath tree (*Erica arborea*), maritime juniper (*Juniperus oxycedrus*), olive (*Olea europaea*), cedar (*Cedrus deodara*), Mediterranean cypress (*Cupressus sempervirens*), stone pine (*Pinus pinea*) and numerous exotic species of dendroflora



Fauna: birds, crickets and cicadas



Vegetation: planted forest of Aleppo pine (*Pinus halepensis*)



■ A detail of vegetation in the upper part of the forest park – cypresses and Aleppo pines.

day, although many trees have already been blown down by the wind or rotted away. Today, naturally growing vegetation generally takes up too much space and has somewhat displaced the garden's original idea. However, the trees planted at the end of the 19th century are still predominant today in the garden's composition.

Like many other gardens of the 19th century, this one was also created using as much dendrological diversity as possible, planting many species within a small area. Thus, the botanical collection of the archduke's garden included 200 species, a number that was quite impressive for that time! Some other gardens of the 19th century are also distinguished by collections of rare plants from around the world. In our region, such examples would be the gardens of Opatija and the archduke Joseph Habsburg's garden in Rijeka, known today as Nikola Host's Park. Some of that diversity has been preserved up till today.

Among the principal species of trees found today in Pod Javori forest park are the Aleppo pine (*Pinus halepensis*), the most commonly planted species of tree in the wider area around Veli



■ An abandoned skin of a cicada nymph.

Lošinj, then the black pine (*Pinus nigra*), the maritime pine (*Pinus pinaster*), the stone pine (*Pinus pinea*) and some species of cypresses (*Cupressus* sp. div.). These species, along with some habitual species of natural evergreen macchia, are most frequent in the upper, wooded part of the forest park, situated on a slope interlaced by meandering paths. In the lower part of the forest park, in the area descending from the castle towards the entrance, cedars (*Cedrus* sp.), cypresses, coast redwoods (*Sequoia sempervirens*), lime trees, plane trees, and magnolias prevail, while in front of the castle there are also some interesting palms, the sago cycad (*Cycas revoluta*) and various other bushy species. Interesting specimens of dendroflora are marked by plates that indicate their botanical affiliation.

Tour

The castle and gardens have been changing owners and purposes from their very beginnings, but today their original purpose has been restored, i.e. recreation and the treatment of pulmonary and allergic diseases. Today the Veli Lošinj Sanatorium is located within the castle. The entrance to the gardens is less than a few minutes' walk from the old centre of Veli Lošinj and is situated along the main Mali Lošinj-Veli Lošinj road.

ADDRESSES

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- Veli Lošinj Sanatorium, Pod Javori 27, 51551 Veli Lošinj;
tel.: +385 (0)51 236 111
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PARK ALONGSIDE THE CASTLE IN SEVERIN NA KUPI

Unfortunately, the old castle and park of the Frankopan family have today become somewhat forgotten and neglected. A particular point of interest, however, is the beautiful view of the River Kupa and its valley below the castle, and through the forest there are charming paths leading steeply down to the riverbanks.

Category of protection: monument of park architecture

Year of proclamation: 1966

Document proclaiming protection: Decision no. 80/7 – 1966, Republic Institute for Protection of Nature, Zagreb

Location: area of the Town of Vrbovsko (Gorski kotar)

Area: 7 ha

Altitude: approximately 230 m

The castle at Severin na Kupi has an extremely interesting location on a steep, mostly forest-covered, slope on the right 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. Today, both the castle and the park have fallen into a rather neglected condition, sad to say, since this place, so rich with history and situated in such an extremely beautiful natural landscape, has all the prerequisites to become the tourist pearl of the Gorski kotar region.

The historical park surrounding the castle has been built on three levels. The first and highest level is located in the immedi-

Flora: Lawson cypress (*Chamaecyparis lawsoniana*), white pine (*Pinus strobus*), northern red oak (*Quercus rubra*), American arborvitae (*Thuja occidentalis*) and other indigenous and imported trees and bushes

Fauna: blackbird (*Turdus merula*), Eurasian nuthatch (*Sitta europaea*), woodpecker (*Dendrocopus major*)

Special site of interest: old castle of the Frankopan family





■ The old castle in Severin na Kupi.

ate vicinity of the castle. It contains a rather small line of holly trees (*Ilex aquifolium*) covered with bright red berries in the winter, then a few Lawson cypress (*Chamaecyparis lawsoniana*) and horse chestnuts (*Aesculus hyppocastanum*). The most interesting item situated near the entrance to the castle is the belvedere with a well made out of stone 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.



■ In springtime, the forest beneath the castle abounds with different flowers in bloom – hellebore flowers (*Helleborus niger*).

On the south side of the castle, elms (*Ulmus* sp.), yew trees (*Taxus baccata*) and bushes of box (*Buxus sempervirens*) are planted. The second and third levels of the park can be reached by a flight of stone steps. The second terrace is the most valuable part of the park because here the most important group of old trees is located. Impressive specimens of dendroflora are represented by Lawson cypress (*Chamaecyparis lawsoniana*), white pine (*Pinus strobus*), northern red oak (*Quercus rubra*), American arborvitae (*Thuja occidentalis*) and other trees. These are the species originated mostly from North America. Among domestic species, there is an old lime tree (*Tilia platyphyllos*) with a hollow trunk. Nuthatches (*Sitta europaea*) often use their beaks to thrust seeds into cracks in the bark of old Lawson cypress trees in order to extract the edible part of the seeds. The rapid tapping of a woodpecker (*Dendrocopus major*) can regularly be heard from old trees, and during our visit we spotted some roe deer (*Capreolus capreolus*) here as well.



■ View from the park towards the River Kupa.



■ Trunk and bark of Lawson cypress (*Chamaecyparis lawsoniana*).

Tour

The access road along the side of the elementary school at Severin leads to the castle and the park. This road is lined with interesting and ancient common ash trees (*Fraxinus excelsior*), some of which regrettably had to be cut down recently due to their age. On the opposite side, a few winding paths lead steeply downwards from the castle to the valley of the Kupa. In early spring, a particular atmosphere may be sensed while descending these paths down to the river, before the forest has turned green, but when lots of spring flowers are in bloom on the forest floor, especially snowdrops (*Galanthus nivalis*), which in places cover entire slopes.

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ANGIOLINA PARK IN OPATIJA

The end of winter and the first days of spring bring out the beautiful blossoms of camellia within Angiolina Park. Visitors will also remember lush groves of scented laurel and many of the 150-or-so species of other decorative vegetation. At the time of its inauguration, this park was considerably richer in species, especially in those rare and delicate sub-tropical rarities brought from distant lands by seafarers. Fortunately enough, today we can still enjoy its horticultural diversity.

Category of protection: monuments of park architecture

Year of proclamation: 1968

Document proclaiming protection: Decision no. 7/2 – 1968, Republic Institute for Protection of Nature, Zagreb

Location: area of the Town of Opatija

Area: 2.7 ha

Altitude: 10 - 20 m



■ Circular flowerbed in front of Villa Angiolina.

Flora: camellia (*Camellia japonica*), laurel (*Laurus nobilis*), oaks (*Quercus* sp. div.), cedars (*Cedrus* sp. div.), pines (*Pinus* sp. div.), southern magnolia (*Magnolia grandiflora*), coast redwood (*Sequoia sempervirens*), California incense cedar (*Calocedrus decurrens*), golden bamboo (*Phyllostachys aurea*), various palms and another 150-or-so species of mostly exotic dendroflora



The origin of the largest and most important park in Opatija, Angiolina Park, goes back to the middle of the 19th century, or more precisely to 1844, when Higinio Scarpa, a patrician from Rijeka, built his holiday home here, the Villa Angiolina. The very next year he started laying out a garden around the villa, which can be considered as the origin of today's park. Scarpa's seafarer friends then brought in numerous exotic species of flora from around the world. Today the park is still known for its variety of tropical wood specimens, but its most impressive characteristics are the dense groves of laurel (*Laurus nobilis*), which are most common on the northern side of the park. Through these groves a labyrinth of paths meanders with plenty of secluded areas where visitors can repose.

The southern part of the park is characterised by huge, impressive trees and groups of trees, circular flowerbeds and grassy areas. Along the wall of the sea promenade near the circular flowerbed in front of the Villa Angiolina, there are three very old downy oak trees (*Quercus pubescens*) from which some massive branches have had to be cut off due to their age. These oaks have withstood the ravages of time and are regularly the object of admiration. In a particular way they are testimonies to the naturally growing sub-Mediterranean deciduous forests, which, before being cleared by man, once covered the foothills of Mount Učka. Many other centenary oaks grow along the sea promenade and elsewhere in Opatija, but almost every year some tree, pressed in by concrete and surrounded by cars, no longer manages to withstand the pressures of modernity and falls down or has to be cut down because of the threat of its falling. Regrettably, none of these



■ Branches of the coast redwood (*Sequoia sempervirens*).

indigenous species are being replaced with new seedlings.

Amongst the exotic and old specimens of dendroflora it is worth mentioning two southern magnolia trees (*Magnolia grandiflora*) planted in front of the Villa Angiolina, the one on the southern side having a very remarkable appearance. Around the circular flowerbed there grow evergreen holm oaks (*Quercus ilex*) and a very old stone pine tree (*Pinus pinea*).

The most interesting part of the park in botanical terms is a fenced-off area containing some camellia bushes (*Camellia japonica*). In Opatija they spend the winter in the open air and it is these camellias and the mild climate that have earned the town its reputation. The camellias are actually a symbol, a famous landmark of Opatija. They belong to the *Theaceae* family and bloom in colder parts of the year - in wintertime and early spring - with beautiful red blossoms, although white and pink ones can also be seen.

Not far from the camellias, there are some old coast redwood trees (*Sequoia sempervirens*) and towards the open-air theatre there is a picturesque group of Californian incense cedars (*Calocedrus decurrens*). The groups of golden bamboo (*Phyllostachys aurea*) have a somewhat exotic look. A perhaps not so striking but still interesting detail in this section of the park is the group of stalagmites that were brought here from some cave and placed as a romantic element for the park. In recent times, in the crevices of the stalagmites, some stonecrops (*Sedum* sp.), sedges (*Carex* sp.), creeping fig (*Ficus repens*) and other perennials have been planted with the aim of breathing new life into these lifeless mineral formations, normally associated with underground karst areas.



■ Floral splendour throughout the year – a bush of wintersweet (*Chimonanthus praecox*) blooms in winter earlier than the camellias.

The large picturesque rocks and groups of limestone within the laurel groves indicate that the park is located in a karst area. Benches for resting on have been carved out of some of these stones. The soil within the park is a deep red soil (“terra rossa”) that most probably accounts for the luxuriant growth of the laurels and other plants.

Around the monument to Friedrich Julius Schüller, general manager of the Austrian Southern Railways at the end of the 19th century, an exotic group of banana trees (*Musa basjoo*) has been planted. Apart from that, most of the northern part of the park is characterised by a forest of old pines and holm oaks, with remarkable bushes of gold dust Japanese aucuba (*Aucuba japonica*).

Research shows that the parks in Opatija are characterised by a rather rich decorative dendroflora with approximately 150 species, which is only half of the number of species from the time when the parks were first created. This fact demonstrates that old historical parks are delicate and dynamic ecosystems that need permanent attention, care and renovation if we are to conserve their richness and their beauty.

Tour

The parks can be reached in a pleasant few minutes’ walk along the Franz Josef I seafront promenade or along Opatija’s main road from its centre, Slatina, in the direction of the Milenij hotel, St. James’s church and the Kvarner hotel.



■ Bamboos (*Phyllostachys* sp.) are a distinctive feature of the parks in Opatija.

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MARGARITA PARK IN OPATIJA

This park may not be as famous as the Angiolina Park, but its particular charm comes from the fine examples of indigenous forest flora that have been conserved in it – old downy oaks, now accompanied by exotic Californian incense cedars. There are several nice walks from the Margarita Park towards the resort of Vrutki and the Carmen Sylva promenade.

Category of protection: monument of park architecture

Year of proclamation: 1968

Document proclaiming protection: Decision no. 7/2 – 1968, Republic Institute for Protection of Nature, Zagreb

Location: area of the Town of Opatija

Area: 1,8 ha

Altitude: 30 - 40 m

Flora: laurel (*Laurus nobilis*), downy oak (*Quercus pubescens*), Aleppo pine (*Pinus halepensis*), Californian incense cedar (*Calocedrus decurrens*), golden bamboo (*Phyllostachys aurea*), palms

Fauna: relatively rich world of birds from the surrounding forests



Opatija's second park in terms of size and importance is Margarita Park, located on the slope above Slatina. It is located next to luxuriant natural oak forests in the valley created by the stream of Vrutki, which flows down towards Slatina. According to written sources, this park was created at the beginning of the 20th century, but the existence of some very old trees indicates that they were already growing there at the time and have been preserved. Indigenous centennial downy oaks represent a special biological feature of this park. Downy oaks grow mostly in the eastern part of the park where they mix in an interesting combination with some Californian incense cedars (*Calocedrus decurrens*). On the lower level grow two very significant species of the parks of Opatija: laurel and, occasionally, bamboos (*Phyllostachys* sp.). Among the indigenous plants growing in this part of the park we should also mention the acute-leaved spleenwort (*Asplenium onopteris*), a Mediterranean forest species that is fairly rare on the Liburnian coast.

The central part of the park features a nicely maintained grass area surrounded by distinctive gigantic Aleppo pines (*Pinus halepensis*), a holm oak with a luxuriant crown and a small group of palms. Near the grass area grows a strawberry tree (*Arbutus unedo*) that stands out on account of its size and age. It is assumed this tree was planted here at the very beginning of the park's formation. Parts of the park are covered with dense laurel groves. Enclosed within a natural stone barrier and situated among the laurel groves, a repose area known as the Adelheide Ruhe is an interesting romantic element of the park, surrounded by natural stone walls. The park is also characterised by rich bird life. Jays (*Garrulus glandarius*), woodpeckers, blue tits (*Parus caeruleus*), great tits (*Parus major*) and other birds fly into the park from the nearby forest areas on the slopes of the foothills of Čićarija and Učka. But it is blackbirds (*Turdus merula*) who are the unmissable inhabitants of the park and who can often be seen turning over dry leaves on the ground in search of food.



■ A detail of the dendroflora in the central part of Margarita Park.



■ *Palms are sub-tropical elements of the flora in the parks of Opatija and a sign of the mild climate ("a camellia climate"!) in this area, owing to the shelter of Mount Učka.*



■ *Laurel groves (Laurus nobilis) are a recognisable element of the vegetation in the parks of Opatija and the Liburnian coast.*

Tour

The park can be reached in a few minutes' climb from Slatina, the centre of Opatija. When in the park, one should also visit the nearby source of the stream of Vrutki situated in a shaded ravine above Slatina, where a number of small springs emerge from the rock. The site is characterised by a certain romantic wildness, but we must admit it was much more pleasurable to visit it before it became so well known and maintained and had far fewer visitors than today. It is interesting for the travertine deposited on the rocks by dripping water. For determined hikers, we also suggest visiting the Carmen Sylva¹ promenade that passes through the lush vegetation and laurel groves which are so significant for the Liburnian coast.

¹ Carmen Sylva is the literary name of Elisabeth, the Romanian Queen, who often sojourned in Opatija in the company of her consort, King Carol I, and whose literary work was inspired by her stays in Opatija.

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STONE PINE IN THE BAY OF ŽALIĆ ON THE ISLAND OF LOŠINJ

This well-branched stone pine tree is the only specimen of its species protected as a monument of park architecture in the County of Primorje-Gorski kotar.

Category of protection: monument of park architecture

Year of proclamation: 1976

Document proclaiming protection: Decision no. Up/I⁰ 2-1976, Republic Institute for Protection of Nature, Zagreb

Tree species: stone pine (*Pinus pinea*)

Location: area of the Town of Mali Lošinj

In the bay of Žalić near Mali Lošinj there is a beautiful stone pine tree (*Pinus pinea*), which due to its dimensions and appearance is protected within the category of a horticultural nature monument – a rare tree specimen. This stone pine is quite remarkable from the other trees in the vicinity for its uniquely shaped crown and its height.

As a clearly eumediterranean species of pine, the stone pine is not indigenous to the Kvarner islands. It is considered that the only part of the Adriatic where it grows naturally are the sandy terrains on the eastern part of the island of Mljet, whilst elsewhere it has been planted.

Stone pines differ from other species of pines by their umbrella-shaped crown and large round-shaped cones. These contain large hard seeds, pine nuts, whose soft edible kernels are considered a delicacy.

There are some more beautiful stone pine trees on the islands and coastline of the County of Primorje-Gorski kotar, and certainly the most interesting of these is the one near the Franciscan monastery at Glavotok, as well as some fine old specimens in the parks of Opatija and Rijeka.

Tour

The stone pine can be seen in the garden of the villa situated by the bay of Žalić near the Vespera hotel in the wooded area of Sunčana uvala.

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- The Town of Mali Lošinj Tourism Office, Riva Lošinjskih kapetana 29, 51550 Mali Lošinj; tel./fax: +385 (0)51 231 884, 231 547, e-mail: tzg-mali-losinj@ri.htnet.hr



■ Protected pine tree in Žalić bay.



■ Large pine cones with edible seeds - pine nuts.



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