



BIODIVERSITY OF CROATIA

SECOND REVISED EDITION

State Institute for Nature Protection
Ministry of Culture – Republic of Croatia
Zagreb, 2009

Biodiversity of Croatia

Published by:

State Institute for Nature Protection, Ministry of Culture - Republic of Croatia

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Language editing:

“Zanella Translation Services”

Artwork by:

mtg-topgraf Ltd., Velika Gorica

Printed by:

mtg-topgraf Ltd., Velika Gorica

Edition:

500 copies

ISBN: 978-953-7169-74-9

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WILD
&
DOMESTICATED TAXA

INTRODUCTION

Due to its specific geographical position on the dividing line between several biogeographic regions and due to its characteristic ecological, climatic and geomorphologic conditions, **Croatia is one of the richest European countries in terms of biodiversity.** The great diversity of land, marine and underground habitats has resulted in a wealth of species and subspecies, including a significant number of endemics.

Unfortunately, there is still not a comprehensive inventory of Croatian biodiversity, particularly of the invertebrate taxa. **New species and subspecies are being discovered each year.** Over the past five years, 198 new taxa of terrestrial invertebrates, 146 taxa of freshwater invertebrates and 20 taxa of marine invertebrates have been registered in Croatia. Fish species new to science were discovered and described - Radović's goby (*Knipowitschia radovici*) in 2005, Imotzki spined loach (*Cobitis illyrica*) in 2007, and Jadova loach (*Cobitis jadovensis*) in 2008. They were all discovered in the Adriatic drainage basin and are endemic. This indicates that the true biodiversity in Croatia is even greater than the existing data present.

The number of known species in Croatia is around 38,000 though the estimated number is far higher – from 50,000 to over 100,000. This is a very significant number for a relatively small country.

One of the reasons for the **large number of endemics** in Croatia, and especially tertiary relics, is the fact that this area was not greatly affected by glaciation. The main centres for endemism of flora are the Velebit and Biokovo mountains while endemic fauna is most represented in underground habitats (cave invertebrates, the olm), the islands (lizards, snails) and the karst rivers of the Adriatic drainage basin (minnows and gobies).

Croatia contains significant populations of many **species that are threatened at the European level.** These are connected to preserved large areas of their habitats. Vast mountain beech and fir forests are rich in bear, wolf and lynx populations. Large wetland complexes with alluvial forests are important breeding, migration and wintering sites for European waterbirds and for wetland birds nesting in forests, such as the white-tailed eagle, black stork and lesser spotted eagle. The wealth of marine biodiversity, in combination with the immense diversity of islands and cliffs with endemic life forms, gives the Croatian coastal area international significance.

Although Croatian nature is of high value, many of its components are **threatened.** The Red List of Threatened Species, within the analysed groups (vertebrates, butterflies, dragonflies, cave fauna, vascular plants and fungi) lists 2,235 threatened taxa. All these taxa are **strictly protected** by the Ordinance on Proclamation of the Wild Species as Protected and Strictly Protected enacted in July 2009. This Ordinance



Endemic genus and species - Velebit degenia (*Degenia velebitica*) has been registered only on three sites in Croatia and nowhere else in the world (photo: S. Bogdanovi)

divides species of conservation interest into strictly protected and protected, in accordance with relevant international legislation (the Bern Convention, Birds and Habitats directives).

The most significant **threat to wild species** is habitat loss and degradation. Even today, there is great pressure to convert natural habitats into building or intensive agricultural land. Additionally there is significant habitat fragmentation occurring, especially through construction of roads and other traffic corridors. Besides these threats, excessive exploitation through hunting, fishing and forestry, intensive agriculture, pollution of water, soil and air as well as introduction of allochthonous species are also of great concern.

Radović's goby (*Knipowitschia radovici*) was discovered in the Neretva drainage basin in Croatia and described in 2005. There are nine species of this genus in the Mediterranean area, most are endemic. They live in isolated freshwater habitats vulnerable to human threats and therefore need protection of their habitats.



Photo: M. Kovačić

	Total no. of known taxa	No. of endemic taxa	Endemic taxa / %
Plants	8,871	523	5.90
Fungi	4,500	0	0.00
Lichens	1,019	0	0.00
Mammals	101	5	4.95
Birds breeding/total	233/387	0	0.00
Reptiles	41	9	21.95
Amphibians	20	7	35.00
Freshwater fish	152	17	12.00
Marine fish	442	6	1.36
Terrestrial invertebrates	15,228	350	2.30
Freshwater invertebrates	1,850	171	9.24
Marine invertebrates	5,655	0	0,00
TOTAL	38,266	1,088	2.84

	Total no. of taxa	Threatened taxa (RE/CR/EN/VU/DD)	Threatened taxa (RE/CR/EN/VU/DD)/%
Vascular plants	5,636	223	3.96
Fungi	4,500	314	6.98
Lichnes	1,019	46	4.51
Mammals	101	8	8.00
Birds breeding/total	233/387	95	23.69
Reptiles	41	15	36.58
Amphibians	20	7	35.00
Freshwater fish	152	78	51.32
Marine fish	442	59	13.35
Butterflies	180	11	6.10
Dragonflies	71	18	25.35
Stoneflies	82	17	20.73
Ground Beetles	820	136	16.59
Underground	694	27	3.89
TOTAL	14,145	1,054	7.45

Data on total number of known taxa, endemic taxa and threatened taxa in Croatia - for threatened taxa numbers for five main IUCN categories (out of seven) are given. IUCN categories - EX-extinct; RE-regionally extinct; CR-critically endangered; EN-endangered; VU-vulnerable; NT-near threatened; LC-least concern, DD-data deficient



Polyps of *Parazoanthus axinellae* - a cnidarian representative of rich biodiversity of the Adriatic Sea (photo: NP Telašćica, D. Petricioli)

PLANTS

PLANTS

According to the available data, Croatian flora consists of **8,871 known taxa**, while certain estimates put this number at almost 10,000 taxa. The ratio of plant species to territory puts Croatia amongst the three European countries richest in flora (with Slovenia and Albania).

No. of taxa in main groups of plants

group	no. of known taxa	estimated no. of taxa	known (%)
algae	2,597	3,717	69.87
mosses	638	700	91.14
vascular plants	5,636	6,000	93.93
TOTAL	8,871	10,417	85.16

It is presumed that up to 15% of the plant taxa in Croatia has not yet been registered. While the list of vascular plants is mostly complete, the mosses have not yet been inventoried due to a lack of specialised researchers. Algae are well known in certain areas while in others, there is virtually no data (central Adriatic, watercourses, caves, etc).

No. of taxa in main groups of vascular plants

GROUP		No. of TAXA	
ferns		96	
spermatophytes (seed plants)	gymno- sperms	<i>Cycadophytina</i>	7
		<i>Coniferophytina</i>	40
		total	47
	angio- sperms	<i>Magnoliopsida</i>	4,446
		<i>Liliopsida</i>	1,047
		total	5,493
	total		5,540
vascular plants - total		5,636	

Of the total number of known plant taxa, as much as 5.93% is **endemic**. The highest endemism is among vascular plants (total number of 364 taxa) and algae (152 known endemics).

A particularly large number of endemic plants can be found on the Adriatic islands and in high mountain areas of the Biokovo and Velebit mountains. Among the mountain endemics, there are a large number of tertiary relics. The screes of the Central Velebit area are habitats of the well-known endemic species Velebit degenia (*Degenia velebitica*).

Island endemics have mostly developed due to isolation. The most island endemic taxa belong to genus *Centaurea*.



Biokovo bellflower (*Edraianthus pumilio*), endemic species of the Biokovo Mountain (photo: A. Alegro)



Velebit degenia (*Degenia velebitica*) grows on screes of the Velebit Mountain (photo: T. Nikolić)



Endemic Dubrovnik knapweed (*Centaurea ragusina*) inhabits crevices of the steep coastal cliffs (photo: SINP)

No. of endemic taxa in main groups of plants

GROUP	NO. of TAXA	ENDEMICS	
		No.	%
algae	2,597	152	5.85
mosses	638	7	1.72
ferns	96	2	2.08
gymnosperms	47	1	2.12
angiosperms	5,493	364	6.63
TOTAL	8,871	526	5.93

The Croatian **Red book** of threatened vascular plants comprises 760 taxa which represents 13.48% of Croatian flora. The main cause of threat to Croatian flora are habitat loss or degradation due to the anthropogenic impacts, mostly through agriculture, exploitation, industry development, tourism, infrastructure and settlement construction, habitat drainage, irrigation, etc. Loss of natural habitats is a cause of threat for 62% of Croatian threatened taxa. The greatest impacts are from degradation or loss of water dependent habitats. Many specialized species dependent on habitats influenced by vegetation succession are also threatened, such as the species of bog and sand habitats.



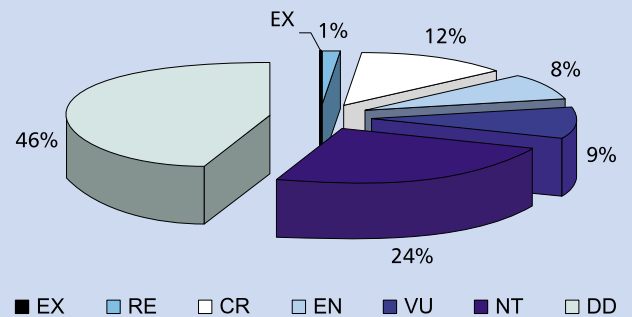
Critically endangered common butterwort (*Pinguicula vulgaris*) on fens along the Dretulja River near Plaški (photo: SINP)

According to the Nature Protection Act (*Official Gazette* no. 70/05 and 139/08), strictly protected species comprise 809 plant taxa (including 37 species listed on Annex II of the Habitats Directive), while protected species include 331 taxa.



Upright water clover (*Marsilea quadrifolia*), one of 37 plant species listed on Annex II of the Habitats Directive in Croatia (photo: SINP)

Share of individual threat categories in the total number of threatened taxa of vascular plants



Adriatic wrack (*Fucus virsoides*), endemic brown alga of the Adriatic Sea (photo: D. Zavodnik)



Red bog moss (*Sphagnum rubellum*) found on protected Blatuša bog (photo: SINP)

FUNGI AND LICHENS

The estimated number of **fungi** in Croatia is 20,000 which is 3.5 times more than the estimated number of vascular flora species. However, fungi are by far the most poorly researched group of organisms in Croatia. To date, 4,500 fungi species have been recorded, representing only 20% of the estimated number.

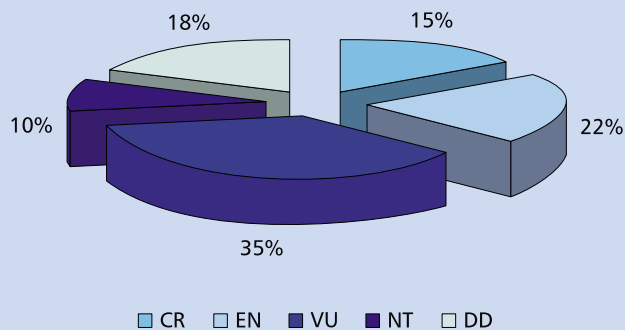
Almost a quarter of Croatian fungi species live in symbiotic communities with algae or cyanobacteria – **lichens**. The total number of known lichen species in Croatia is 1019.

The Croatian **Red List of Threatened Fungi** includes 349 species. The Croatian **Red List of Threatened Lichen** includes 56 species.

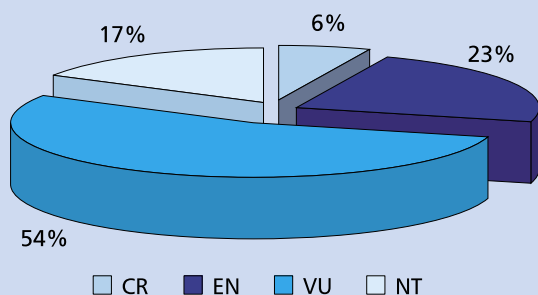
The main causes of **threat** to fungi and lichens in Croatia are habitat loss and fragmentation, environmental pollution, inadequate fungi collecting and lichens collecting which are used, for example, in pharmaceutical industry.

Under the Nature Protection Act, 314 fungi and 32 lichen species as well as all species of genus *Usnea* and *Bryoria*, are strictly **protected**. 20 mushrooms, 12 truffles, 10 lichen species and all species of genus *Cladonia* are protected, and their commercial use is regulated.

Share of individual threat categories in the total number of threatened taxa of fungi



Share of individual threat categories in the total number of threatened taxa of lichens



Caesar's mushroom (*Amanita caesarea*) - this famous culinary speciality has been threatened by overcollecting and it was strictly protected in 1999 (photo: S. Posavec)



One of specialized fungi inhabiting bogs (photo: SINP)



Lichen *Lobaria pulmonaria* is collected for pharmaceutical industry (photo: SINP)

MAMMALS

With 101 mammal species, 90 of which are autochthonous, Croatia is among 8 European countries with the greatest mammal diversity. Mountain areas, covered by vast forest complexes, are inhabited by all three large European carnivores (bear, wolf and lynx) and the diversity of Croatian bat fauna includes 34 species. Among the marine mammals, only the bottlenose dolphin (*Tursiops truncatus*) is a resident species but a variety of cetaceans have been registered in the eastern Adriatic area. The monk seal no longer breeds in the Adriatic; however individual animals are occasionally reported.

The total number of regional mammal **endemics** is relatively small. Several species in Croatia have more or less genetically isolated populations and are thus potentially endemic, but the exact number of endemic species is yet to be determined through further genetic research.

Some 14% of Croatian mammals (14 species) are considered threatened and 6% (5 species) are regionally extinct.

Causes of **threat** to Croatian mammals are primarily habitat loss and fragmentation, hunting, poaching, destruction of bat colonies and excessive use of pesticides. Recent intensive work on motorway construction may have greatly affected large carnivore populations. This problem has been dealt with successfully by building "green bridges", crossing corridors for animals.



'Green bridge' over the highway enables animals to cross this barrier that crosscuts their habitat (photo: \. Huber)



Wolf (*Canis lupus*), one of the three large carnivores of Croatia (photo: B. Krstinić)

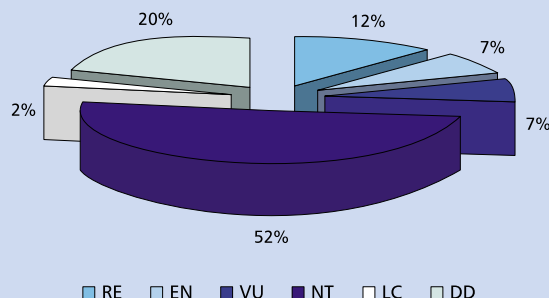
Amongst the most threatened mammals are the bottlenose dolphin, 6 bat species and the last island population of the European mole.

Several species are data deficient but there is indication that they could be threatened, such as the common dolphin, otter, relic species of Martino's snow vole and five bats, including two recently described new species: Balkan long-eared bat and Alpine long-eared bat.



Bottlenose dolphin (*Tursiops truncatus*) is the only resident Croatian marine mammal (photo: D. Holcer)

Share of individual threat categories in the total number of threatened taxa of mammals



BIRDS

Croatia's ornithofauna is amongst the richest in Europe when considering the 78 bird species which breed in Croatia and are threatened at the European level. The total number of bird species is 387 and of these, 233 breed on Croatian territory.

Croatia's ornithofauna includes 140 species listed in Annex I of the Birds Directive. There are 38 sites that satisfy BirdLife International Criteria for Important Bird Areas for Europe, covering 40% of Croatian territory. They all qualify for NATURA 2000 sites which indicate Croatia's great responsibility for the protection of European ornithofauna.

Some species highly threatened in Europe are represented with significant populations in Croatia. This is mostly due to the large areas of preserved habitats. There are still large wetland

complexes along the lowland Drava and Sava Rivers that are extremely important for the breeding of wetland species such as the spoonbill, herons and terns, the white-tailed eagle, black and white stork and lesser spotted eagle. Globally threatened species like the corncrake, dependent on large wet grasslands, or the ferruginous duck which nests along the old oxbows and extensive fishponds, are very well represented in Croatia. Natural and artificial wetlands, especially carp fishponds, represent internationally important migration and wintering sites for European waterfowl. Large complexes of beech and fir forests in the mountain areas of Croatia are important for numerous owl species, woodpeckers, the capercaillie, golden eagle and others. The coastal area is also inhabited with certain important species like the griffon vulture, the Eleonora falcon, Audouin's gull and others.



Spoonbill (*Platalea leucorodia*) inhabits Croatian carp fishponds and natural wetlands (photo: B. Krstinić)



Peregrine falcon (*Falco peregrinus*) breeds in the middle of the Croatian capital Zagreb (photo: M. Cukrov)



Corncrake (*Crex crex*), the globally threatened bird of wet meadows (photo: S. Harvancik)



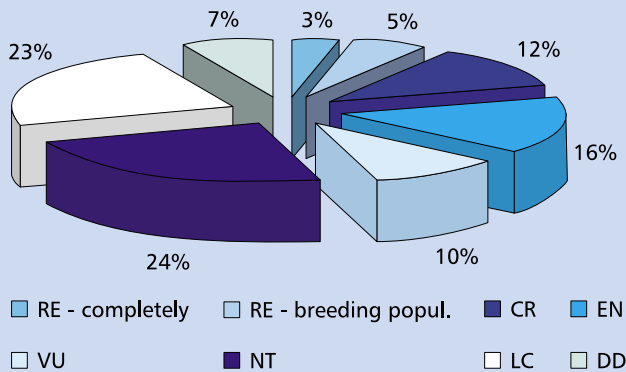
Croatian carp fishponds are extremely important for globally threatened ferruginous duck (*Aythya nyroca*) (photo: D. Krnjeta)

Unfortunately, almost half of the bird species have been listed on the Croatian **Red List of Birds**, with 86 species classified as threatened and the rest are classified as near threatened or species of least concern.

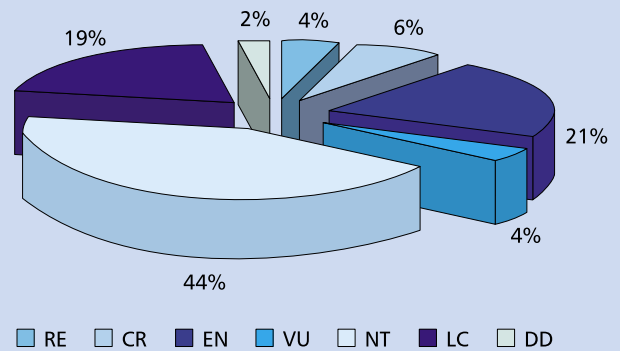
One of the most common threats to the Croatian ornithofauna is uncontrolled hunting and poaching. This affects as much as 78.4% of threatened bird species.

43.2% of threatened birds are affected by the disappearance of wetlands, especially in the coastal part of the country. Wetlands are still being converted into arable land, and the result is an irreversible loss of valuable habitats for a variety of threatened birds.

Share of threat categories of breeding birds



Share of threat categories of non-breeding birds



REPTILES AND AMPHIBIANS

Among the 41 species of **reptiles** in Croatia, 9 are endemic. The most diverse part of Croatia, in terms of reptiles, is Dalmatia. Lizards are richest in endemics, especially represented on the islands, and these reptiles are particularly threatened. Namely, the isolation of island populations makes them exceptionally vulnerable. Additionally, there is a great threat from the possible introduction of predators and competitive reptile species.

The most threatened reptile species in Croatia are the critically endangered green turtle (*Chelonia mydas*) and Caspian terrapin (*Mauremys caspica*).

The main cause of threat to marine turtles in the Adriatic Sea is accidental catch in fishing nets. Also, they are endangered by a reduction of feeding areas (posidonia beds) and algal blooms.



Caspian terrapin (*Mauremys caspica*) is a species threatened at European level; in Croatia it can be found only in few ponds and small watercourses of the Southern Dalmatia (photo: SINP)



Olm (*Proteus anguinus*), an endemic species of Dinaric karst (photo: B. Jalžić)

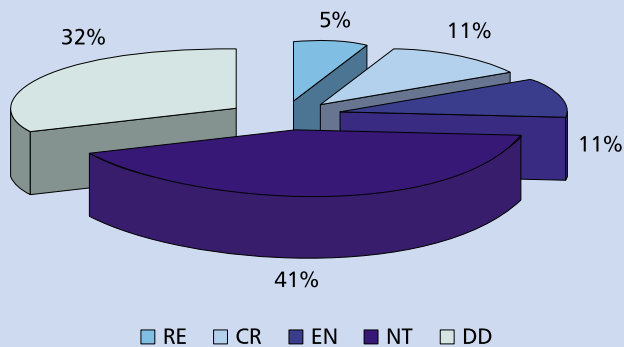


Leopard snake (*Elaphe situla*) lives in the coastal part of Croatia (photo: M. Mrakovčić)

Twenty species of **amphibians**, including 7 endemics, have been recorded in Croatia. When considering amphibian fauna, the western part of the Pannonian lowland is the richest area of the country.

Six amphibian species and one subspecies are listed in the Red Book of Amphibians and Reptiles in Croatia (2006). Olm

Share of individual threat categories in the total number of threatened taxa of Reptiles

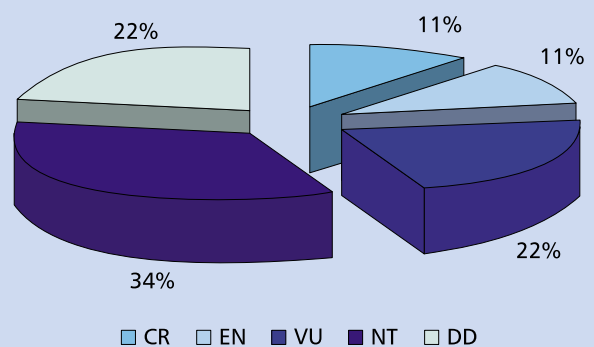


Sharp-snouted Rock Lizard (*Lacerta oxycephala*) is an endemic species of the East Adriatic (photo: SINP)

(*Proteus anguinus*), an endemic species of Dinaric karst, is threatened at the global level, while all other amphibians are endangered on national level.

The most common cause of threat to amphibians is habitat degradation or fragmentation. All amphibian species are protected under the Nature Protection Act.

Share of individual threat categories in the total number of threatened taxa of Amphibians



Hermann's tortoise (*Testudo hermanni*), although strictly protected, is threatened by collecting for illegal trade (photo: SINP)



Common toad (*Bufo bufo*) hidden in the bog moss of the Blatuša bog (photo: SINP)

FRESHWATER FISH

With 152 freshwater fish species in the rivers and lakes, 18 of which are Croatian karst endemics, Croatia is one of the most diverse countries in Europe in terms of ichthyology. This species diversity is the result of the country's geographic position, covering two drainage basins (Adriatic and Black Sea) and the presence of distinct karst habitats.

The Black Sea (Danube) Basin (covering 62% of the territory) is inhabited by 83 fish species, while the number of species in the Adriatic Basin (covering only 38% of the territory) is as high as 86 species.

Endemic Croatian freshwater fishes

Visovac trout (<i>Salmo visovacensis</i>)
Zrmanja trout (<i>Salmo zrmanjaensis</i>)
Adriatic salmon (<i>Salmothymus obtusirostris krkensis</i>)
Solin salmon (<i>Salmothymus obtusirostris salonitana</i>)
Croatian dace (<i>Telestes polylepis</i>)
Ukliva dace (<i>Telestes ukliva</i>)
Zrmanja dace (<i>Squalius zrmanjae</i>)
Dalmatian minnow (<i>Phoxinellus dalmaticus</i>)
Cave minnow (<i>Telestes fontinalis</i>)
Croatian minnow (<i>Telestes croaticus</i>)
Jadova minnow (<i>Delminichthys jadovensis</i>)
Krbava minnow (<i>Delminichthys krbavensis</i>)
Dalmatian spined loach (<i>Cobitis dalmatina</i>)
Jadova loach (<i>Cobitis jadovensis</i>)
Imotzki spined loach (<i>Cobitis illyricus</i>)
Vrgorac goby (<i>Knipowitschia croatica</i>)
Mrakovčić's goby (<i>Knipowitschia mrakovcici</i>)
Radović's goby (<i>Knipowitschia radovici</i>)
Dalamtian rudd (<i>Scardinius dergle</i>)
Basak (<i>Rutilus basak</i>)

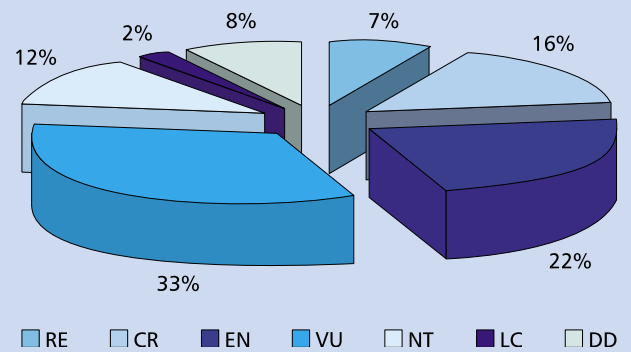


Dalmatian minnow (*Phoxinellus dalmaticus*) - minnows inhabit underground watercourses (photo: P. Mustafić)



European mudminnow (*Umbra krameri*) is NATURA 2000 species; it lives in oxbows along the large lowland rivers (photo: P. Mustafić)

Share of individual threat categories in the total number of threatened taxa of freshwater fish



Mrakovčić's goby (*Knipowitschia mrakovcici*) is one of recently discovered species in Croatian rivers that is new for the science (photo: P. Mustafić)

The Adriatic Basin is distinguished by high species endemism (44 Mediterranean, 40 Adriatic and 18 Croatian), which is the direct result of the diversity of karst habitats.

Freshwater fish are one of the most threatened groups of vertebrates. There are 89 species included in the *Red Book of Freshwater Fish in Croatia* which represents 59% of Croatian freshwater ichthyofauna. Introduction of allochthonous species, pollution, regulation of watercourses and habitat degradation, followed by construction of dams and creation of water accumulations, irrigation, excessive use of water for drinking and industry and uncontrolled fishery have the greatest negative impacts on freshwater fish.



Zrmanja dace (*Squalius zrmanjae*) - an endemic fish of the Zrmanja River (photo: P. Mustafić)

MARINE FISH

442 fish taxa have been recorded in the Adriatic Sea, accounting for 65% of all known fish taxa in the Mediterranean Sea. This number is a subject to constant change. Over the past 15 years, 28 new species have been recorded. Some inhabit the Mediterranean Sea and some come through the Suez Canal from the Red Sea. 384 taxa of Adriatic fish belong to the group of bony fish, 55 to the group of cartilaginous fish and 3 to the lampreys. There are 6 endemic species present in the Adriatic.

When considering the threat status of Adriatic ichthyofauna, 124 fish taxa have been included in the Red Book of Marine Fish of Croatia in 2008 (28.05% of Croatian marine ichthyofauna). The main causes of threat to Adriatic fish are uncontrolled fishery, degradation of important habitats (feeding and spawning areas) like Posidonia beds, estuaries, coastal areas and channels, as well as pollution and eutrophication.

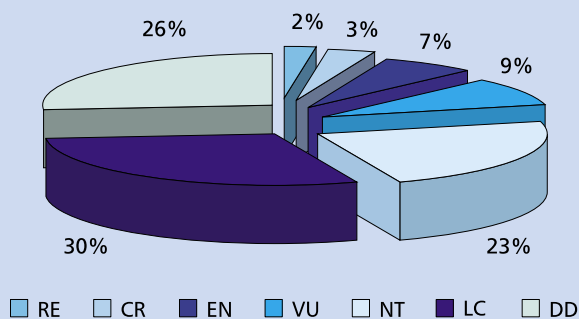
Some of areas with the greatest diversity of marine fish are the waters of the offshore islands and sea straits.

Along with the Nature Protection Act, which incorporates international regulations, marine fish protection and exploitation in Croatia is regulated by the Marine Fisheries Act.



Posidonia beds are rich with fish (photo: A. Žuljević)

Share of individual threat categories in the total number of threatened taxa of marine fish



Small red scorpion fish (*Scorpaena notata*) (photo: NP Telašćica, D. Petricioli)

INVERTEBRATES

To date, 15,228 taxa of terrestrial and 1,850 taxa of freshwater invertebrates have been recorded in Croatia. They are dominant in abundance and diversity, but are insufficiently studied.

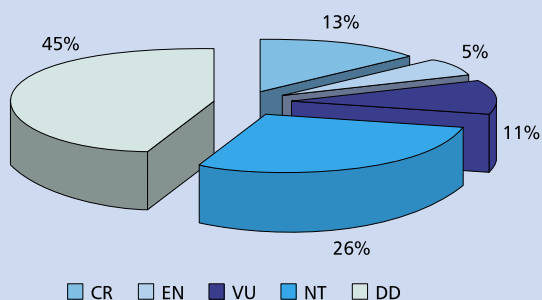
350 taxa of terrestrial invertebrates and 171 taxa of freshwater invertebrates are endemic. Most endemic freshwater species inhabit underground waters.

Considering that Croatia's invertebrate fauna has been inadequately studied, the total number of species and number of endemic species is expected to be much higher. The main causes of threat to particular invertebrate species are habitat destruction and change, all types of pollution and the excessive use of pesticides, introduction of alien species and redundant exploitation and collecting.

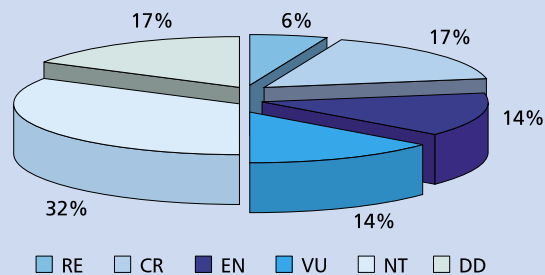
TERRESTRIAL INVERTEBRATES NO. OF TAXA	
Phylum	No. of taxa
Aschelminthes	127
Mollusca	470
Annelida	141
Tardigrada	7
Arthropoda	14,483
Total	15,228

FRESHWATER INVERTEBRATES NO. OF TAXA	
Phylum	No. of taxa
Protozoa	268
Porifera	4
Platyhelminthes	20
Cnidaria	6
Aschelminthes	360
Mollusca	156
Annelida	99
Tardigrada	7
Arthropoda	930
Total	1,850

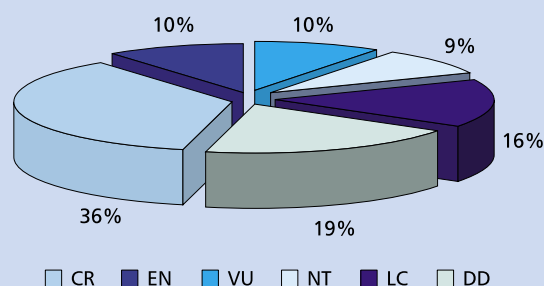
Share of individual threat categories in the total number of threatened taxa of butterflies



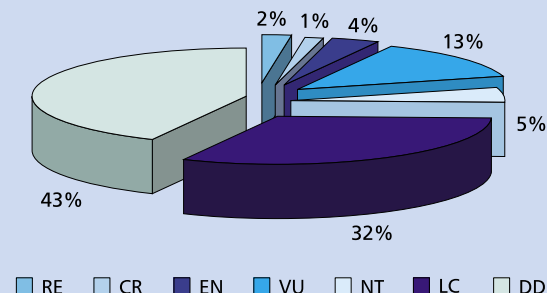
Share of individual threat categories in the total number of threatened taxa of dragonflies



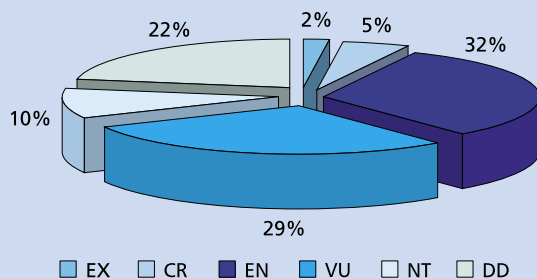
Share of individual threat categories in the total number of threatened taxa of ground beetles



Share of individual threat categories in the total number of threatened taxa of stoneflies



Share of individual threat categories in the total number of threatened taxa of underground fauna



Estimations of threats are so far made for butterflies, dragonflies, ground beetles, stoneflies and underground fauna. Red List includes 38 out of 180 butterfly species, 36 out of 71 dragonfly species, 395 out of 820 ground beetle species and 82 out of 90 stonefly species.

Red list of Cave fauna includes 41 taxa, including freshwater and terrestrial cave taxa, some Vertebrate species (fishes, bats), which are already listed on Red List of Freshwater Fishes and Red List of Mammals.

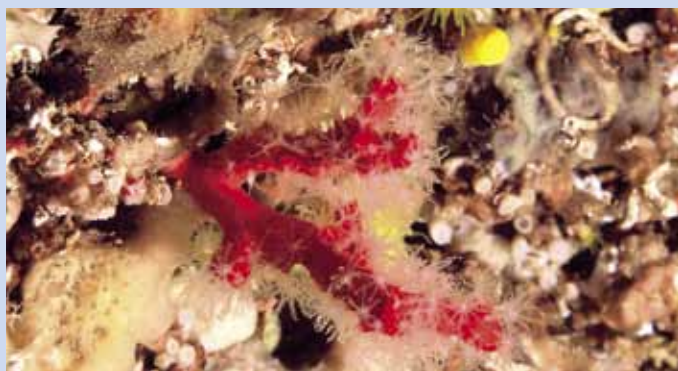
Invertebrate fauna of the Adriatic Sea is also very diverse, though poorly researched. Until now, a total of 5,655 species have been recorded. Only one species has been registered as an Adriatic endemic species – the sea squirt *Polycitor adriaticus*, but this too is doubtful due to the insufficient study of this group of species in the Mediterranean Sea.



Mountain blue (*Maculinea rebeli*) is one of threatened Croatian butterflies (photo: M. Šašić)



Stag beetle (*Lucanus cervus*) is threatened due to the lack of deadwood in managed forests (photo: SINP)



Red coral (*Corallium rubrum*) is an endangered Mediterranean species (photo: D. Frka)

All species of Adriatic invertebrates, whose habitats are exploited or destroyed to a larger extent than the natural ability of population regeneration, are considered to be threatened. The most threatened economically exploited species are the Norway lobster (*Nephrops norvegicus*) and Jacob's scallop (*Pecten jacobus*).

Despite long-term legal protection, red coral (*Corallium rubrum*) and the giant Mediterranean Pen (*Pinna nobilis*) are still classified as endangered.

Diversity of Adriatic invertebrate fauna

Phylum	No. of species
SARCOMASTIGOPHORA	676
SPOROZOA	24
MYXOZOA	25
CILIOPHORA	207
PORIFERA	221
PLATYHELMINTHES	129
GNATHOSTOMULIDA	5
CNIDARIA	339
CTENOPHORA	10
ROTIFERA	31
GASTROTRICHA	36
CEPHALORHYNCHA	13
ACANTHOCEPHALA	5
NEMATODA	312
PRIAPULIDA	3
KAMPTOZOA	6
NEMERTINA	27
MOLLUSCA	866
SIPUNCULA	18
ECHIURA	2
ANNELIDA	595
TARDIGRADA	4
ARTHROPODA	1,594
PHORONIDA	1
BRYOZOA	263
BRACHYOPODA	11
HEMICHORDATA	4
ECHINODERMATA	104
TUNICATA	123
CHORDATA	1
TOTAL	5,655



Attractive coral sea fan *Eunicella* (photo: NP Telašćica, D. Petricioli)

INVASIVE ALIEN SPECIES

Like other European countries, Croatia has many problems with invasive alien species (IAS). As late as 1910, 11 individuals of the small Indian mongoose (*Herpestes javanicus auropunctatus*) were introduced on the island of Mljet for the biological control of poisonous snakes. Over a 20 year period, the introduced animals eliminated all the snakes on the island and began attacking other small wild animals, including migratory birds and domestic animals. Although about 100 mongooses are eliminated every year, and some attempts for total eradication were made in the past, these animals still inhabit the island and have a negative impact both on wild and domestic fauna.

Allochthonous freshwater fish in Croatia

Rainbow trout	<i>Oncorhynchus mykiss</i>
Prussian carp	<i>Carrasius gibelio</i>
Pumpkinseed	<i>Lepomis gibbosus</i>
Goldfish	<i>Carassius auratus</i>
Silver carp	<i>Hypophthalmichthys molitrix</i>
Big head carp	<i>Hypophthalmichthys nobilis</i>
Grass carp	<i>Ctenopharyngodon idella</i>
False harlequin	<i>Pseudorasbora parva</i>
Brown bullhead	<i>Ameiurus nebulosus</i>
Charr	<i>Salvelinus alpinus</i>
Brook trout	<i>Salvelinus fontinalis</i>
Largemouth bass	<i>Micropterus salmoides</i>
Black bullhead	<i>Ameiurus melas</i>
Peled	<i>Coregonus peled</i>
Schelly	<i>Coregonus lavaretus</i>
Mosquito fish	<i>Gambusia affinis</i>
Monkey goby	<i>Neogobius fluviatilis</i>
Round goby	<i>Neogobius melanostomus</i>
Kessler's goby	<i>Neogobius kesslerii</i>
Amur sleeper	<i>Percottus glenii</i>



Goldfish (*Carassius auratus*) (photo: SINP, M. Povž)

Known threats to Croatian biodiversity by IAS today are numerous. The tropical green algae *Caulerpa taxifolia* and *Caulerpa racemosa* are spreading rapidly across the Adriatic Sea coastal benthic habitats.



Removing of invasive tropical green algae (*Caulerpa taxifolia*) by divers can only slow down its invasion (photo: A. Žuljević)

20 allochthonous fish species have been introduced into Croatian rivers and lakes during the past century - the Adriatic Basin, rich in endemic fish species, is extremely threatened in this regard.

The plant species false indigo (*Amorpha fruticosa*) is spreading through riverine and forest edge habitats in the Pannonian lowlands, creating significant problems for the regeneration of forest areas after the cutting. The common ragweed (*Ambrosia artemisifolia*) has spread through rural habitats throughout Croatia - it is known as the greatest allergen in Europe. The clam *Dreissenia polymorpha*, known as a pest in water regulation and hydroelectric power stations, poses a great threat to autochthonous freshwater mussel populations (*Unionidae*) and other benthic organisms. The Mediterranean form of black rat (*Rattus rattus*) and the Italian lizard (*Podarcis Isicula campestris*) have had a strongly negative impact on native island fauna. The invasive allochthonous spinycheek crayfish (*Orconectes limosus*), the crayfish plague carrier, has been found in Kopački rit Na-

ture park and is spreading rapidly along the Danube River. Allochthonous game species, such as the chukar (*Alectoris chukar*), introduced deliberately to hunting grounds, both on the islands and mainland, represent a further problem.

There is a need to organize the prevention of unwanted introductions of alien species at the national level, to recognize and evaluate the level of their impacts on native biological diversity, and to define and implement actions to reduce these threats. Several actions in this regard have already been taken. The Ministry of Culture finances monitoring of *Caulerpa* species and cleaning activities with special attention given to four marine protected areas (Brijuni, Kornati, Telačica and Mljet). The State Institute for Nature Protection has initiated a project of invasive plant species inventory in cooperation with competent scientists.



Bushes of invasive false indigo (*Amorpha fruticosa*) pose a great problem in forestry (photo: SINP)

DOMESTICATED TAXA

Throughout history, man has altered nature by adapting certain species to his needs through breeding and selecting specific properties. Such domesticated animals and plants also represent a part of our biodiversity. Over thousands of years, numerous domesticated taxa have adapted to man-made habitats, developing “local” varieties of cultivated plants and “ecotypes” of domesticated animals. The protection of biodiversity implies keeping records of indigenous sorts of cul-

tivated plants and breeds of domesticated animals in individual countries and their conservation. These sorts and breeds, adapted to the local climate, are more resistant to disease and often very well incorporated into the surrounding nature and landscape. Due to the great efforts and knowledge of numerous generations invested into their creation, they also represent national cultural heritage.



Posavina horse in Lonjsko Polje Nature Park (photo: B. Krstinić)

BREED	(*estimated No.)	STATUS	TREND
HORSES AND DONKEYS			
MEDI-MURJE HORSE	36	CRITICALLY ENDANGERED	↓
POSAVINA HORSE	3,516	POTENTIALLY ENDANGERED	→
LIPIZZANER	1,165	NOT ENDANGERED	→
CROATIAN COLD-BLOOD HORSE	4,897	POTENTIALLY ENDANGERED	↑
DONKEYS	1,348	CRITICALLY ENDANGERED	→
CATTLE			
ISTRIAN CATTLE	691	HIGHLY ENDANGERED	↑
SLAVONIAN PODOLIAN	162	CRITICALLY ENDANGERED	→
BUŠA OF LIKA	196	CRITICALLY ENDANGERED	→
SHEEPS AND GOATS			
ISTRIAN PRAMENKA	8,000*	NOT ENDANGERED	→
DUBROVNIK RUDA SHEEP	406	HIGHLY ENDANGERED	↑
PAG SHEEP	27,000*	NOT ENDANGERED	→
CRES SHEEP	20,000*	NOT ENDANGERED	→
PRAMENKA OF LIKA	15,000*	NOT ENDANGERED	→
DALMATIAN PRAMENKA	200,000*	NOT ENDANGERED	→
TSIGAI	3,000*	NOT ENDANGERED	→
KRK SHEEP	20,000*	NOT ENDANGERED	→
RAB SHEEP	7,500*	NOT ENDANGERED	→
CROATIAN WHITE GOAT	4,000*	POTENTIALLY ENDANGERED	→
CROATIAN COLORED GOAT	25,000*	NOT ENDANGERED	→
PIGS			
TUROPOLJE PIG	193	CRITICALLY ENDANGERED	↓
BLACK SLAVONIAN PIG	729	HIGHLY ENDANGERED	↑
POULTRY			
TURKEY OF ZAGORJE	-	HIGHLY ENDANGERED	↑
HRVATICA HEN	1,000*	HIGHLY ENDANGERED	→



Posavina pointer is recognized as indigenous dog of Croatia (photo: SINP)

In Croatia there are 26 indigenous domestic animal breeds. The Croatian Agricultural Agency is keeping the central register for **domestic livestock breeds** valuable for breeding and also evaluating their threat status. In line with 2008 data, the Medimurje horse, Istrian and North-Adriatic donkeys, Buša cattle of Lika, Slavonian podolian cattle, and the Turopolje pig are critically endangered, while Primorje-dinaric donkey, Istrian cattle, the Dubrovnik ruda sheep, the Croatian white sheep and the black Slavonian pig, Hrvatica hen and Zagorje turkey are highly endangered.



Slavonian podolian cattle (photo: B. Krstinić)



Tornjak sheepdog lives with the sheep herd (photo: SINP)

Dog breeds are also of special concern, with several breeds officially registered: the Dalmatian dog, Istrian shorthaired pointer, Istrian longhaired pointer, Posavina pointer and Croatian sheep dog. The registration procedure is underway for the Tornjak sheepdog breed. The Croatian Kennel Club stresses the Tornjak sheepdog and Croatian shepherd dog as very valuable national breeds.



Turopolje pig is critically endangered indigenous breed of Croatia (photo: B. Krstinić)

There is no central register system for **indigenous plant sorts**. Conservation of indigenous sorts is sporadic and most activities are based on ex-situ methods. The Faculty of Agronomy of the University of Zagreb has initiated the "Croatian gene bank" project.

The Nature Protection Act has recently introduced the category of the **protected autochthonous domestic breed** for endangered plants and/or animal breeds that have developed as a result of traditional breeding and forms a part of the natural heritage. Conservation of endangered autochthonous domestic breeds is implemented keeping the balance between nature protection and agriculture in mind, and their breeding is encouraged by paying annual premiums to breeders and giving special criteria for loans.



HABITATS

INTRODUCTION

INTRODUCTION

A great diversity of habitats is distributed throughout the lowland, mountain and coastal areas of Croatia. A variety of geomorphologic forms above and underground allow for a three-dimensional distribution of habitats, contributing to habitat richness. **It is exceptional to find such a diversity of habitats in a relatively small country like Croatia.** Many habitat types are specific to Croatia, such as the underground karst habitats or plant communities of rocks and screes.

A number of habitat types in Croatia are threatened. The aim of nature protection is to conserve all threatened and rare habitat types in a favourable conservation status. For such habitat types, a coherent and functional network of important sites containing these types must be preserved. This is possible through the system of an **ecological network**. To establish such a network, habitat types are being mapped, their conservation status analysed and necessary protection measures defined. The **EU Habitats Directive** (Council Directive 92/43/EEC) requires that a coherent and functional network of important sites be established for threatened habitat types of the EU. This network is called NATURA 2000.

In January 2006, the **Ordinance on Habitat Types, Habitat Map, Threatened and Rare Habitat Types, and on Measures to Preserve Habitat Types** was adopted. It lists all habitat types protected under the Habitats Directive, Res. 4 of the Bern Convention as well as those threatened at the national

level. General conservation measures have been prescribed while specific measures are being incorporated into physical plans, sector management plans and projects through nature protection measures and requirements issued by the Ministry of Culture.

Habitat is defined by the Nature Protection Act as follows:

"Habitat is the unique functional unit of an ecosystem, defined by geographical, abiotic and biotic features; all habitats of a type constitute a single habitat type."

Habitat types are described through the systems of **habitat classification**. There are several habitat classification systems in Europe. CORINE classification was developed by the European Community and is used in the Habitats Directive. It was extended to the whole of Europe as the Palaearctic Habitat classification and later as EUNIS classification.

Like other countries, Croatia has developed its **national habitat classification (NHC)** in order to emphasize the habitat diversity of its territory and certain specific characteristics such as habitats related to karst underground and marine environments. With the "key" for transferring one habitat typology into another, it is possible to convert national classification into any European standard.



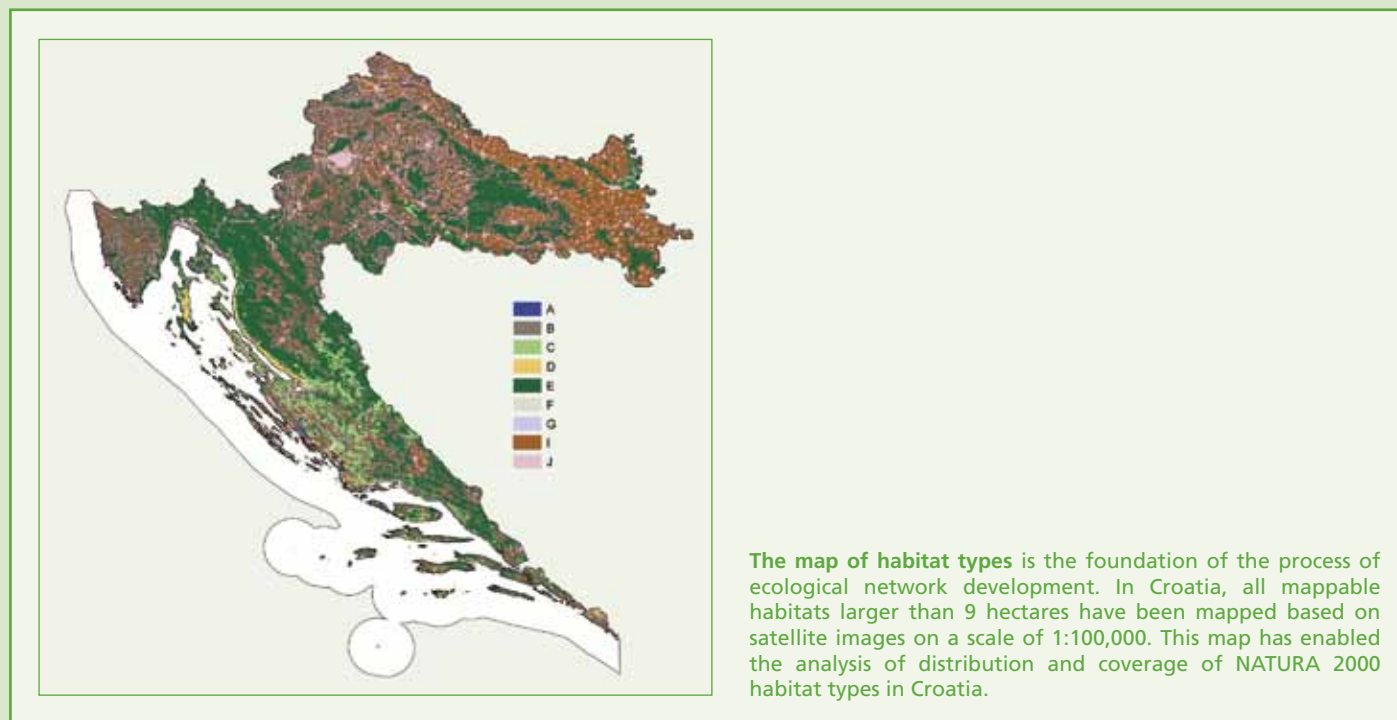
Biogeographical regions

Europe has been divided into ten biogeographical regions based on a vegetation map. According to EU legislation and the Bern Convention, each country lists its species and habitat types through these biogeographical regions. In Croatia there are four regions – the Pannonian, Continental, Alpine and Mediterranean, thus indicating the great richness and diversity of nature.

National habitat classification of Croatia defines the following main habitat classes, with each divided into four levels of habitat types:

A	inland surface water and wetland habitats
B	inland unvegetated and sparsely vegetated habitats
C	grassland, bogs, fens and tall forbs habitats
D	scrub habitats
E	forest habitats
F	coastal habitats
G	marine habitats
H	underground habitats
I	cultivated non-forested land and habitats with weeds and ruderal vegetation
J	constructed and industrial habitats
K	complexes

The first eight classes contain the majority of natural habitat types in Croatia, and these classes are presented in this booklet.



General trends and threats – Marsh and aquatic ecosystems are in general most valuable, as well as very rare habitats outside their usual areas of distribution (bogs, vegetation of sands). Anthropogenic influences also affect and thus endanger habitats of small spatial coverage (gravelly and sandy beaches, ponds on the islands, small wetlands).

Loss and degradation of habitats are one of the major reasons of endangerment of biological diversity. Habitats in Croatia are affected primarily by anthropogenic influence. Among these anthropogenic activities the following should be mentioned: construction of hydroelectric power plants and the creation

of accumulation lakes, construction of drainage channels for irrigation of agricultural land, draining marshes and other wetland habitats and different forms of pollution. The construction of tourist infrastructure causes devastation of rare coastal habitat types. Loss of habitats is not necessarily caused by anthropogenic influences. Natural vegetative succession also leads to changes in the environment and the disappearance of many species. Today's grasslands in Croatia originated almost exclusively under the influence of people, who have in this way contributed to an increase in biodiversity. Without grazing, mowing and similar activities, pastures and meadows gradually heal crossing over to shrubs and finally forests.

A. INLAND SURFACE WATER AND WETLAND HABITATS

This class includes inland surface waters with natural or semi-natural communities, with or without vegetation, regardless of whether they are of natural or artificial origin. Standing water and watercourses are included together with water-fringe vegetation. Most wetland types defined by the Ramsar Convention on Wetlands are included in this class.

Among the most **threatened habitats** from this class are river gravels, sands and muds that are particularly represented in the large lowland rivers (Drava and Mura as well as some left-overs on the Sava River). Also threatened are the tufa stream and tufa cascade habitat types specific to the Croatian karst rivers. This vegetation consists of euhydrophyte moss and algae communities of streams poor in nutrients but rich in lime, forming large tufa deposits.

Ramsar wetlands

In Croatia, 28 of the total 42 Ramsar wetland types are represented in three main groups: natural marine/coastal, natural inland as well as artificial wetland types. All areas that are in some way dependent on water are included. Additionally, the term "floodplain" is used for areas alongside large rivers that are in fact complexes of several wetland types. Ramsar habitat types belong to several classes of the Croatian NHC.

The State Institute for Nature Protection has conducted an inventory of Croatian wetlands in the framework of the project Ramsar Small Grants Fund 2003. Available data on wetlands has been collected and a relevant database established as the basis for follow-up activities of collecting new data. Results of the inventory are shown in following table.

	Ramsar wetland type	Sites	Length (km)	Area (ha)
	Complex sites	11		800,365
A/B	Shallow marine waters and marine beds			26,028
D	Rocky shores*		5,599	
E	Sand/shingle shores*		354	
F	Estuarine waters	8		7,523
G	Tidal flats	18		666
H	Salt marshes	83		
J	Coastal brackish/saline lagoons	6		4,058
Zk(a)	Karst and other subterranean hydrological systems, coastal - vruljas	9		
M	Permanent rivers/streams/creeks		14,338	30,127 (large rivers)
N	Seasonal/intermittent rivers/streams/creeks		15,109	
O	Permanent freshwater lakes	441		8,916
P	Seasonal/intermittent freshwater lakes (including flooded karst fields)	15		29,405
Q	Permanent saline/brackish/alkaline lakes	6		361
Tp/p	Permanent freshwater marshes/pools - ponds	343		1,929
Tp/r	Permanent freshwater marshes/pools - reedbeds			6,290
Ts/p	Seasonal/intermittent freshwater marshes - ponds	994		
Ts/m	Seasonal/intermittent freshwater marshes - flooded meadows			72,486
U	Non-forested peatlands - bogs	29		
W	Shrub-dominated wetlands			4,784
Xf	Freshwater, tree-dominated wetlands			178,262
Y	Freshwater springs	1,027		
Zg	Geothermal wetlands - springs	75		
Zk(b)	Karst and other subterranean hydrological systems, inland	161		
1	Fish ponds	31		12,730
2	Man-made ponds	562		
5	Salt pans, salines	3		495
6	Reservoirs, barrages, dams	24		5,966
7	Gravel/brick/claypits	47		859
8	Wastewater treatment areas	1		
9	Canals and drainage channels		21,069	
	TOTAL	3,883	56,469	390,885 (6.9%)

* Coastline does not include harbour areas (76.1 km)

Wetland complexes

Large wetland areas that are extremely important for biodiversity conservation consist of different wetland habitats. In Croatia, these are mostly represented in the floodplains of large rivers. Among them are three Ramsar sites: Kopački Rit on the confluence of the Drava and Danube Rivers, Lonjsko Polje along the Sava River as well as the Neretva Delta on the coast.



Nature Park Kopački Rit - Ramsar site (photo: SINP)

Carp fishponds

Along the watercourses in the northern part of Croatia there are a dozen large carp fishponds that are important sites for breeding and migrating waterfowl. Rich in food and suitable vegetation such as reeds and surrounded by alluvial forest, they represent artificial wetlands of international ornithological value for some of the most threatened European bird species. The Crna Mlaka fishpond near Zagreb is one of four Croatian Ramsar sites.



Pakračka poljana carp fishpond (photo: SINP)



Zeleni vir in Gorski kotar (photo: SINP)



The Cetina River in its upper part (photo: SINP)

B. INLAND UNVEGETATED AND SPARSELY VEGETATED HABITATS

The most interesting habitats of this class are the screes, cliffs and exposed limestone rocks. A number of endemic and relic plants and plant communities are represented, distributed mostly on the mountains and coastal areas.

Screes develop where stones, rock fragments and pebbles accumulate at the bottom of slopes. Specially adapted plants grow here, the most significant among them is the endemic species *Velebit degenia* (*Degenia velebitica*) of the specific community of *Bunio-Iberetum pruitii* which has developed on Velebit mountain screes exposed to stormy winds.

Cliffs and exposed limestone rocks are inhabited with rock-crevice vegetation that often contains endemic taxa. These communities belong to the Tyrrheno-Adriatic or Alpine-Carpathian-Balcanic group of habitat types. One of the most important communities is *Phagnalo-Centaureetum ragusinae* with the Croatian endemic Dubrovnik knapweed (*Centaurea ragusina*).



Konavoske Stijene (Konavle Rocks) in Southern Dalmatia are rich with endemic plants (photo: SINP)



Karst area of Bijele and Samarske Stijene is protected as the strict reserve (photo: SINP)



A detail from the Bijele Stijene strict reserve (photo: S. Posavec)



A scree on the Biokovo mountain (photo: A. Alegro)

C. GRASSLANDS, BOGS, FENS AND TALL FORB HABITATS

BOGS AND FENS

Bogs and fens are wetlands with small sedge and moss communities developed on permanently waterlogged soils with nutrient poor water supply and a water table that is below or slightly above the surface.

In Croatia, these habitats are threatened with extinction. They are relics from after-glacial periods and are represented at small sites, mostly smaller than 1 ha and are highly dependent on microclimatic conditions. Many highly specialised and extremely threatened species are dependent on these habitats, such as the bog mosses (*Sphagnum sp.*), sundew (*Drosera rotundifolia*), common butterwort (*Pinguicula vulgaris*), bog arum (*Calla palustris*) and several fungi and spiders.

Most of the Croatian bogs and fens have disappeared during recent decades. About twenty remain and only a handful could be preserved through the application of active conservation measures, like maintaining a favourable water regime and removing overgrowing vegetation.

GRASSLANDS

From the conservation perspective, the most important grasslands are the wet and Mediterranean dry grasslands. These

The Dubravica bog is one of few protected bogs where activities of removing overgrowing vegetation have been implemented for several years. This has resulted in a recovery of the sundew that has almost become extinct from this site.



Photo: SINP

The Blatuša bog is one of the largest preserved bogs in Croatia. It is protected for its specific vegetation, including the downy birch (*Betula pubescens*), a critically endangered and extremely rare species in Croatia.



Photo: SINP

habitats are highly threatened. While hydromelioration activities are a specific cause of threat to wet grasslands, the neglect of meadows and pastures due to the abandonment of villages and extensive agriculture is a common threat to all grasslands.

Wet grasslands are well represented in northern Croatia where they form parts of large wetland complexes along the lowland rivers, especially along the Sava River. The Lonjsko Polje Nature Park is a Ramsar site with large temporarily flooded pastures where hundreds of horses, pigs and cattle roam free-



Wet pastures of the Lonjsko Polje Nature Park (photo: SINP)



Wet meadows in Northern Croatia are habitats with threatened fritillaria (*Fritillaria meleagris*) (photo: SINP)

ly year round, except for the period when flood water covers this retention area. One threatened species highly dependent on the wet grassland is the fritillaria (*Fritillaria meleagris*).



Colorful mountain meadows (photo: A. Alegro)

In central Croatia which is mainly mountainous, wet meadows are very specific. They occur along the watercourses that are mostly intermittent in this karst area – sometimes they disappear or “sink” below ground and sometimes they flood large karst fields that become temporary lakes. In these areas, special vegetation of the *Scillo litardierei-Deschampsietum mediae* community develops, with the squill (*Scilla litardieri*), species strictly protected under the Habitats Directive.

Wet grasslands are represented even in coastal Croatia, especially in the Neretva Delta area as well as along the Cetina River.

Dry Mediterranean grasslands cover large coastal and inner coastal areas. A large proportion belongs to the East sub-Mediterranean dry grasslands *Scorzoneratalia visillosae* that are protected under the Habitats Directive.

Grassland vegetation of the inland sands is represented only on two very small sites near the Drava River. The Jurjevac sands and Kloštar sands are famous for the endemic *Corynephorofestucetum vaginatae* community. A complete degradation of the original community took place over a part of the sands as the result of spread of bushes and other plants, which makes it necessary to take active protection measures by removing the overgrown vegetation. These two sites are the only remnants of the former area of sand dunes, called the “Croatian Sahara”, which was earlier several kilometres long and wide.



Kloštar sands in Podravina (photo: SINP)



Picturesque dry grasslands under the Dinaric Mountain (photo: SINP)



Meadows with threatened Siberian iris (*Iris sibirica*) (photo: A. Alegro)

D. SCRUB HABITATS

D. SCRUB HABITATS

This class consists of scrub vegetation that is floristically clearly distinguished from forest vegetation, while forest scrub vegetation is included in the Forests class of habitat types. Among the threatened and rare scrub habitats are some types of willow scrub along rivers and oleander galleries in Southern Dalmatia. Illyrian garrigues represent the characteristic evergreen vegetation of small bushes in coastal areas that often disappear due to development of forest vegetation.



Stands of wild oleander (*Nerium oleander*) near Slano in Southern Dalmatia (photo: SINP)



Scrub vegetation overgrowing Drava river gravels (photo: SINP)

The oleander galleries habitat type is rare and protected at the European level by the Habitats Directive. It appears along the temporary watercourses in the Mediterranean area. In Croatia, it has been registered only in 2004 and 2005 on two small sites in the southernmost part of Croatia. Natural oleander stands are situated in gullies along temporary watercourses that end into the sea. Along with the species *Nerium oleander* and *Arundo donax* that characterise this habitat type, vegetation is represented with elements of the holm oak (*Quercus ilex*) macchia.



Oleo-Euphorbietum dendroidis is a rare plant association present on distant islands of Sušac and Palagruža (photo: SINP)

E. FOREST HABITATS

E. FOREST HABITATS

There are around one hundred forest communities in Croatia. The total area of woodland is about 2,688,000 hectares, covering 47.5% of Croatian territory. Dense forests occupy 37% of the territory while the rest belongs to various forest degradation stages. Only 19% of forests are privately owned with the majority state-owned.



Distribution of forests in Croatia



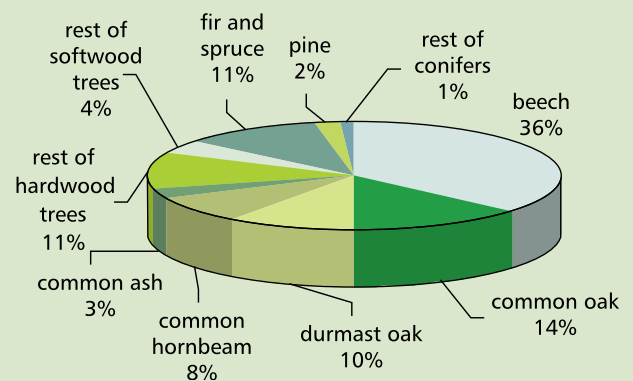
Old pubescent oak forest of Tramuntana on the Cres Island (photo: SINP)



Holm oak forests in Glavotok on the island of Krk (photo: SINP)

The forests in Croatia belong to the first or the second generation after the natural renewal of vast virgin forests in the area between the Sava and Drava Rivers, as well as in the karst region to the south of the Kupa River. According to the composition of trees, they are natural or very similar to the virgin forests from which they originated. The conservation status of Croatian forests is very good compared to the European level. As high as 95% of forest components show a natural composition, this is rare and highly valuable in global proportions.

Trees of Croatian forests





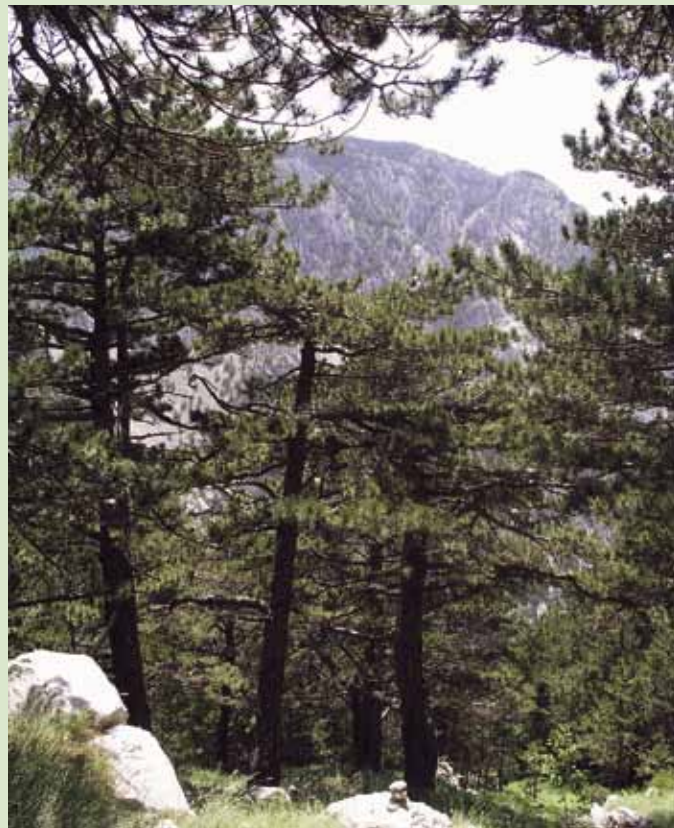
Dinaric beech and fir forests (*Omphalodo-Fagetum*) are distributed in mountain parts of Croatia (photo: SINP)

The largest forest complexes can be found in the western Dinaric Alps (Gorski Kotar, Velebit Mountain) where the beech and fir forests predominate, as well as in the Sava River region with the alluvial basins of Spačva and Lonjsko Polje. In the Mediterranean region, most forest vegetation is in macchia form, though there are also areas with nicely preserved holm oak as well as black pine forests.



Mediterranean beech forest (photo: A. Alegro)

Almost all Croatian forest habitat types belong to one of the classes of NATURA 2000 habitats protected under the Habitats Directive. Some cover large areas like beech forests, durmast oak forests and common oak forests. The others have restricted distribution like relic forests of lime and yew, relic forests of black pine and chestnut woods.



Relic forests of the black pine (*Pinus nigra*) on the Biokovo mountain (photo: A. Alegro)

The main causes of threats to forests in Croatia include: pollution of air, soil and water (fir is the most affected species), change in water regimes due to water management activities in lowland forests (common oak forests are threatened) as well as construction of roads through large forest complexes.



Willow and poplar forests are distributed mostly along the Mura, Drava and Danube rivers (photo: SINP)

F. COASTAL HABITATS

This class consists of habitats above the high tide line that are under maritime influence. They are grouped into habitats of mud, sand, shingle and rocky shores. Among the most threatened are the rare mudflats of Northern Dalmatia, glasswort swards and tall rush saltmarshes found at a few small localities, mixed delta habitats of the Neretva River as well as sand and shingle beaches.

Intertidal mudflats are rare on the Croatian coast and are best preserved in the Neretva Delta area and Northern Dalmatia with nice sea inlets where mudflats border the glasswort (*Salicornia*) swards and wet grassland vegetation. These habitats are important for wintering waders, sea ducks and other waterfowl.

Sand and shingle beaches are represented on only 5.4% of Croatian coastline. These are extremely threatened habitats under the pressure of tourism, construction and waste disposal. Their specialised flora and fauna has all but disappeared at many sites. Some of the largest sand beaches are situated



Rich stands of the glasswort (*Salicornia fruticosa*) like this one on the Cres island are rare on the Croatian coast (photo: SINP)



The biggest part of the Croatian coast is formed of the rocky shore (photo: SINP)

on the island of Rab and in the Neretva Delta. Sand vegetation is still preserved at certain small localities like Saplnara beach on the island of Mljet.

Coastal habitats forming parts of **estuaries** are in fact complex habitats classified under the class K in the NHC, together with **lagoons**. They consist of mixture of coastal and marine habitats. Both are threatened and rare areas on the Croatian coast, exposed to great pressures of development projects. Besides the Neretva Delta, the estuaries of the Krka and Zrmanja Rivers, which in fact submerged karst river canyons, are also interesting. Lagoons are isolated brackish waters connected to the sea by a narrow connection. Only a few such sites have been preserved on the Croatian coast, like the small lagoon in the Pantan wetland near Trogir and two large lagoons in the Neretva Delta.



Protected sand beach on the Mljet island with rare and critically endangered sea daffodil (*Pancretium maritimum*) (photo: A. Alegro)

G. MARINE HABITATS

G. MARINE HABITATS

These are habitats below the high tide limit, including pelagial and benthos communities. There are several marine habitat types that are quite specific for Croatia.

Karst marine lakes are a rare phenomenon of the Croatian coast. These are sea water bodies enclosed in limestone, which are in contact with surrounding coastal sea through fissures in karst rocks or very narrow and shallow channels, so tides are reduced. Their communities in marine lakes significantly differ from those found in the surrounding coastal sea. Typical examples and regions are Zmajevo Oko (Rogoznica) and Mir (Telašćica, Dugi otok). In the broader sense, the Mljet marine lakes can be also included in this category.



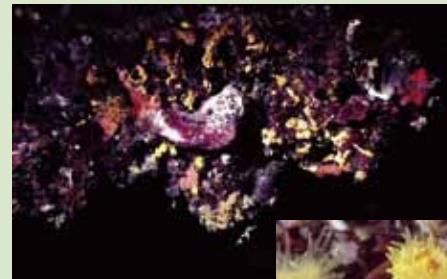
Posidonia beds are threatened in the whole Mediterranean (photo: SINP)

Submerged caves and pits where cold winter water can reside for the whole year contain deep sea organisms even in shallow areas in the littoral zone. Examples are finds of the carnivorous sponge *Asbestopluma hypogea* (submarine pit on Dugi otok) and the hexactinellid sponge *Oopsacas minuta* (in a cave on the southern part of the island of Hvar) at depths of less than 30 m.



Greater forkbeard (*Phycis blennioides*) from the coralligenous biocenosis (photo: NP Telašćica, D. Petricioli)

Submerged karst is characteristic for the Croatian Adriatic and is important at the Mediterranean level. Submerged river canyons of the Croatian karst rivers, the Zrmanja and Krka, with remains of submerged calcium tufa barriers can be traced on today's seabed.



Biocenosis of half-dark marine caves (photo: NP Telašćica, D. Petricioli)



Leptopsammia pruvoti from half-dark marine cave of the Nature Park Telašćica (photo: NP Telašćica, D. Petricioli)

The Adriatic is a shallow sea, with the greatest depth of 1,330 m. The depths of up to 200 m occupy as much as 73.9% of the Adriatic sea bottom while bigger depths may be found in the depression of the island of Jabuka and of the south Adriatic. The Adriatic stands out in the Mediterranean by its number of flora and fauna endemics. The sea-grass meadows are significant habitats because lot of species feed, breed and hide there. **Posidonia beds** are threatened in the whole Mediterranean. In Croatia they cover rather large areas of coastal waters up to 50 meters of depth. This belt with Posidonia beds is internationally important area for growing stages of the loggerhead turtle (*Caretta caretta*).



Sea urchin (photo: NP Telašćica, D. Petricioli)

H. UNDERGROUND HABITATS

Karst geology represents 46% of the land area of Croatia. Approximately 7000 caves and pits are known, however this number is expected to increase considerably with new discoveries.

Between the largest is Lukina jama – Trojama pit system on the northern part of the Velebit Mountain with a surveyed depth of 1392 meters. The largest underground system is \ ulin ponor – Medvedica cave system that is more than 16 kilometers long.

The diversified geomorphology, hydrology and climate have resulted in remarkable range of underground terrestrial, aquatic and interstitial habitats. Some of them, such as deep,



The cave Višičina jama in the karst surrounding the Neretva Delta area (photo: SINP)



Bats are among the most significant inhabitants of underground caves (photo: SINP)



Specific karst phenomenon is the “vrulja” - the spring under the sea level (photo: SINP)

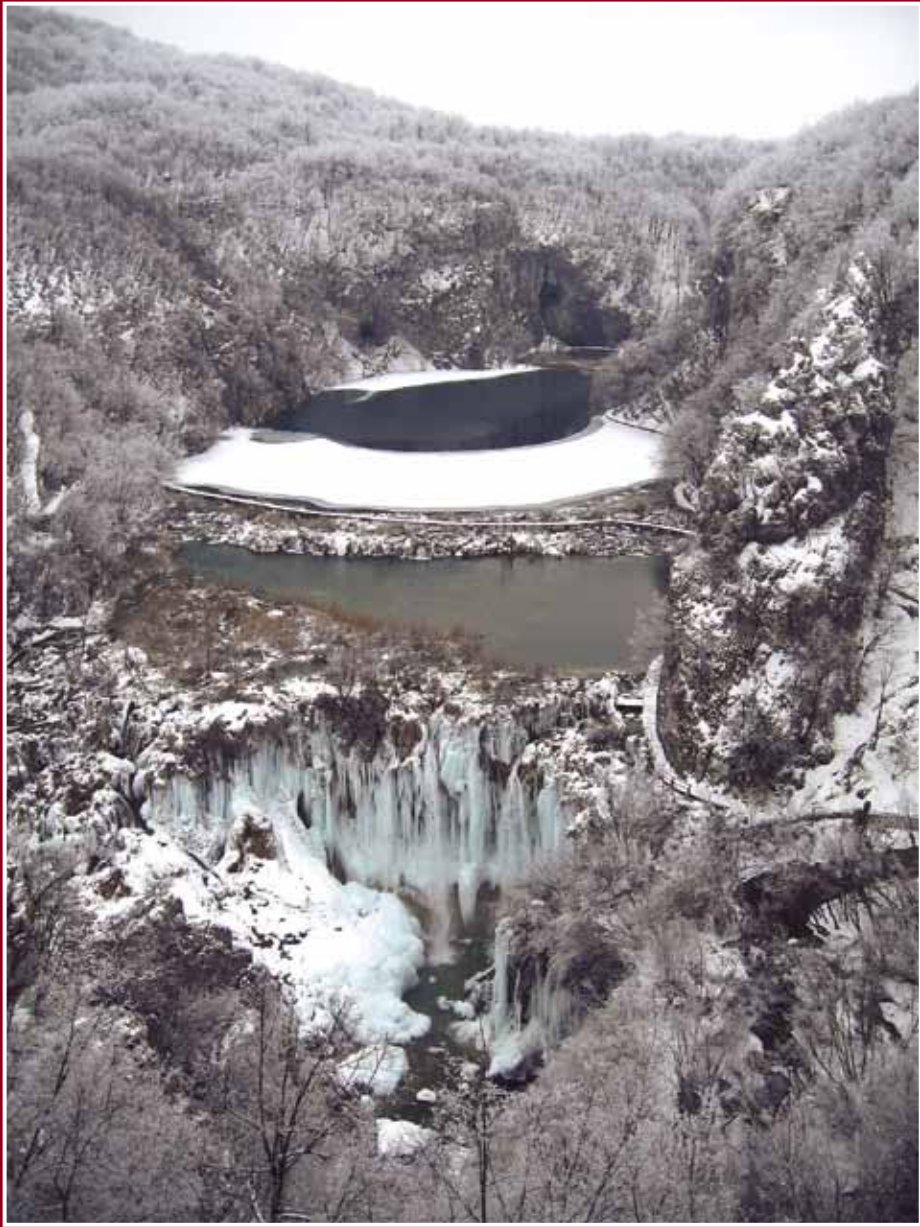
wet sinkholes and limestone glades, and certain alluvial deposits, are home to numerous relict organisms. A high degree of endemism occurs in animal species in the limestone glades of the Dinarides. Some 70% of almost 500 recorded terrestrial and aquatic cave invertebrates are endemic to Croatia. The largest animal groups with troglobites (terrestrial cave-dwellers) are beetles, false scorpions, spiders, snails and millipedes. Crustaceans predominate between stygobites (aquatic cave-dwellers). Other important groups include sponges, hydrozoa, planarians, snails, the only known aquatic cave clam (*Congerina kusceri*) and the only aquatic cave vertebrate – the olm (*Proteus anguinus*).



Marine cave Ropa medvjedina (Monk-seal Cave) on the Lastovo island was in previous times inhabited by the monk-seal (*Monachus monachus*) (photo: \. Huber)

Caves and pits are important habitats for many species of bats whose winter or summer colonies inhabit them, creating rich layers of guano that is food base for many group of invertebrates.

Underground habitats and species are extremely vulnerable and threatened by external influence. Quarrying and road building, pollution of ground waters, disturbance of animals by lighting in caves open for public and overcollecting of underground fauna by amateurs are among the main causes of threat.



IMPORTANT SITES

PROTECTED AREAS

According to the Croatian Nature Protection Act, protected areas are classified in 9 categories.

Currently, there are 449 protected nature areas designated in various categories, covering a total area of 5,499.13 km². 13 more areas are under the preventive protection on additional 1,988.34 km². The procedure for their permanent protection is ongoing. The areas under permanent and preventive protection cover 8.54 % of Croatian territory. The largest portion of the territory is protected in the nature park category. There are 2 strict reserves, 8 national parks and 11 nature parks already protected. Two regional parks (Moslavačka gora and Mura - Drava) are under the preventive protection.

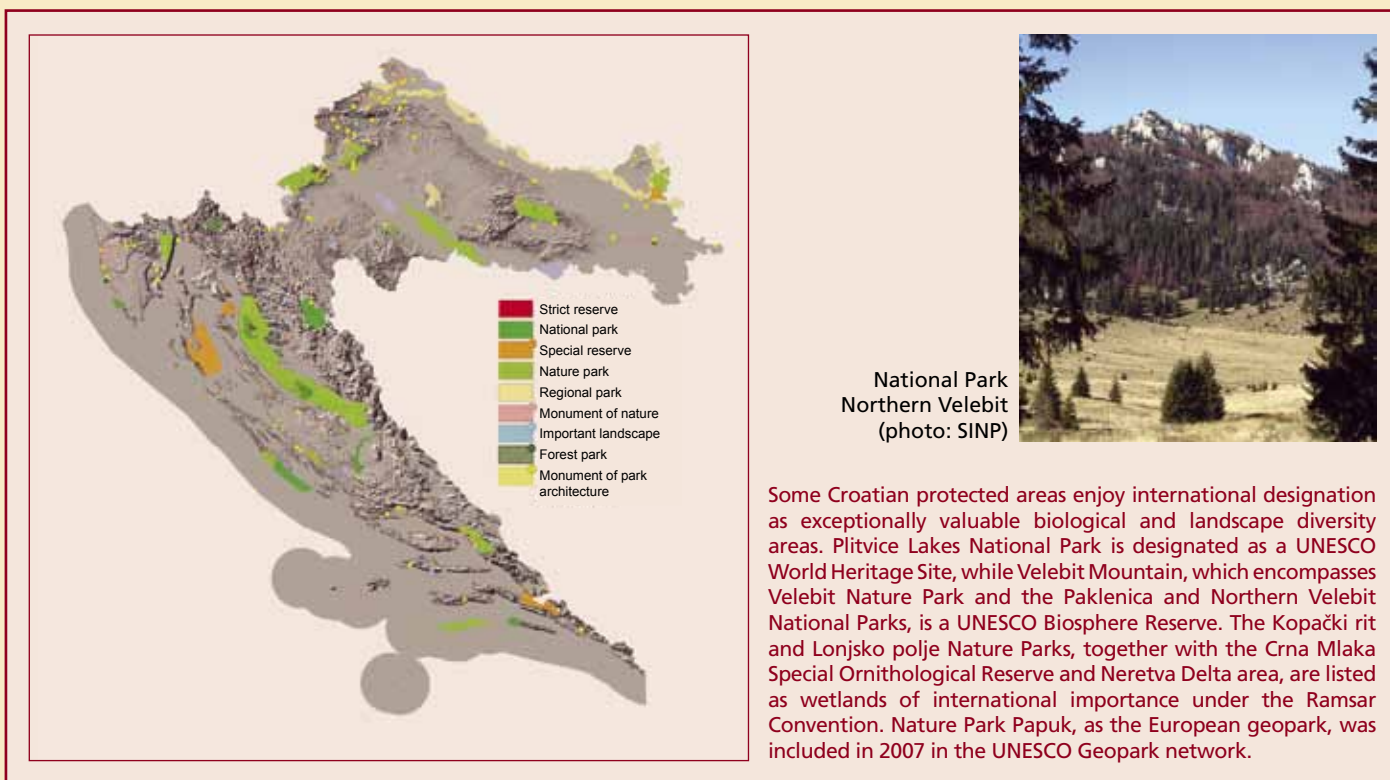
The oldest area under continuous protection in Croatia is Arboretum Opeka in Varaždinska county, protected since 1947 in the category horticultural monument. This year, our oldest national parks - Plitvička jezera and Paklenica celebrate their 60th anniversary of protection.

The work on the protection of few other areas in different categories is ongoing, the most significant being the future regional parks Dinara and Hrvatsko zagorje.

Three of the eight national parks (Kornati, Brijuni and Mljet) are insular and characterised by rich marine life. The Northern Velebit, Risnjak and Paklenica national parks are mountainous areas characterised by particular relief features with numerous limestone rocks and scree, high-mountain



Vransko Lake Nature Park on the Croatian coast near Zadar (photo: NP Vransko Lake)



meadows and vast forest complexes. Habitat diversity in addition to geographical isolation has led to the development of specific vegetation and numerous endemics. Plitvice Lakes, Croatia's oldest national park, and Krka National Park are characterised by unique karst morphology and hydrology, travertine barriers, lakes and cascades.

Six of eleven Croatian nature parks cover mountain areas (Medvednica, Žumberak-Samoborsko gorje, Učka, Biokovo, Velebit and Papuk).

The Kopački rit and Lonjsko polje nature parks are large flooded areas of the Pannonian lowland, and each includes a special ornithological reserve. Rivers surrounding and flooding these areas are the cause of high habitat and wildlife diversity, in particular of ornithofauna.

Vransko Lake Nature Park, on the coast near Zadar, is the largest natural lake in Croatia and is important for breeding and wintering birds. Telašćica Nature Park and our youngest nature park - Lastovo Archipelago, are insular parks with great land and marine biodiversity.

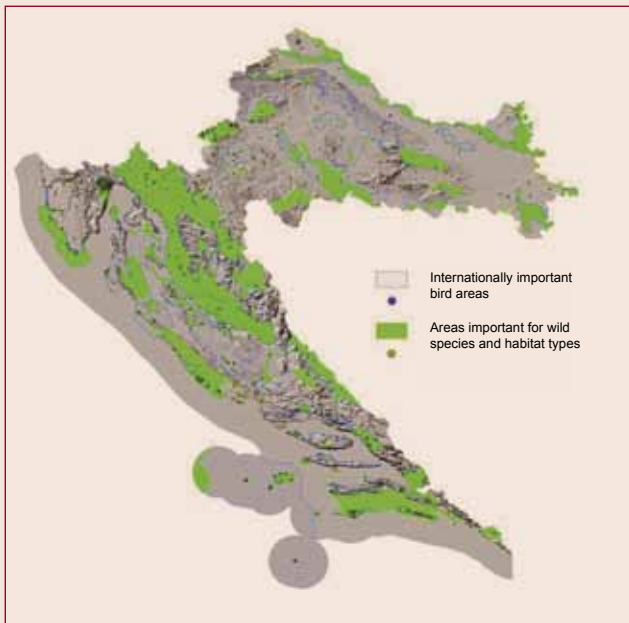
CATEGORY	No. of PAs			Total area (km2)			% of PAs in total territory		
	permanent protection	preventive protection	Total PAs	permanent protection	preventive protection	Total PAs	permanent protection	preventive protection	Total PAs
strict reserve	2	0	2	23.95	0.00	23.95	0.03	0.00	0.03
national park	8	0	8	961.35	0.00	961.35	1.10	0.00	1.10
special reserve	79	4	83	326.38	526.96	853.34	0.37	0.60	0.97
nature park	11	0	11	4,242.15	0.00	4,242.15	4.84	0.00	4.84
regional park	0	2	2	0.00	1,599.91	1,599.91	0.00	1.83	1.83
natural monument	115	1	116	2.40	1.37	3.76	0.00	0.00	0.00
important landscape	77	3	80	877.69	31.89	909.57	1.00	0.04	1.04
park forest	36	2	38	88.92	0.16	89.08	0.10	0.00	0.10
horticultural monument	121	1	122	9.56	0.00	9.56	0.01	0.00	0.01
TOTAL				6,532.40	2,038.81	8,571.21			
parts inside bigger PAs				1,033.26	171.95	1,205.21			
TOTAL	449	13	462	5,499.13	1,988.34	7,487.47	6.27	2.27	8.54

PA – protected area

CATEGORY	IUCN category	PURPOSE	LEVEL OF MANAGEMENT
strict reserve	I	protection and monitoring of overall biological diversity, scientific research, education	county
national park	II	protection of biological diversity, scientific research, tourism, recreation, education	state
special reserve	I/IV	protection of biological diversity focusing on a specific component (forests, plant communities, fauna, hydrology, etc.) , scientific research	county
nature park	V/VI	protection of biological and landscape diversity, education, tourism and recreation	state
regional park	V/VI	protection of biological and landscape diversity, education, tourism	county
natural monument	III	protection of a representative element of nature or small site, scientific research, aesthetic and educational purpose	county
important landscape	V	protection of biological and landscape diversity, sustainable development, tourism and recreation	county
park forest	V/no adequate IUCN category	tourism and recreation, protection of landscape diversity	county
horticultural monument	V/no adequate IUCN category	protection of natural and cultural heritage and landscape diversity, tourism and recreation, education	county

NATIONAL ECOLOGICAL NETWORK

An **ecological network** is a system of functionally interconnected sites important for threatened species and habitat types.



In Croatia, the Ecological Network is defined under the Nature Protection Act (Official Gazette no. 70/05 and 139/08).

In 2002 started the LIFE III funded project *Building the National Ecological Network (CRO-NEN)*. The project resulted in the preparation of the ecological network proposal as the basis for the Regulation on Proclamation of the Ecological Network (Official Gazette no. 109/07) that the Croatian Government adopted in October 2007. Furthermore, the Ordinance on Nature Impact Assessment (OG 89/07) was adopted in August 2007. In accordance with the NATURA 2000 network in the EU, the Ecological Network in Croatia consists of internationally important areas for birds, and areas important for other species and habitat types. Conservation objectives are defined for each Ecological Network site, together with the list of species and habitat types for which a certain site has been designated. The impact of the projects, plans and activities on these species and habitat types needs to be assessed in the Nature Impact Assessment. Each site has general conservation measures which have to be applied by all legal and natural persons using natural resources or conducting activities or projects that may influence the site.

The Ecological Network of the Republic of Croatia covers 47% of the land and 39% of the marine territory, and includes two corridors: the corridor for sea turtles and the corridor Palagruža-Lastovo-Pelješac (important bird migration area).

During last few decades, human influence has become so strong that it has turned into a serious threat to survival to majority of European natural heritage. Diversity of natural and semi-natural habitats is declining every day. Numerous plant and animal populations that depend on such habitats are declining in number as well as in area of distribution. Habitats are exposed to fragmentation which has as a result small islands that are not capable of surviving in a long-term, especially considering more and more intensive human influence. Plants and animals can't communicate between these fragmented habitats, so if a species disappears from one habitat, it can not be reintroduced without a human intervention. Protected areas, that approximately occupy 10% of state territory of European countries, do not fulfil the need of complete biodiversity conservation.

By realizing this threat, nature conservation in Europe has oriented in developing systems of functionally connected areas valuable for threatened species and habitats. This system is called ecological network. It is based on the network of protected areas, but with some additional parts that give the network ability to maximize protection on relatively small residual natural areas.



The Mrežnica River is one of the most beautiful karst rivers and proposed nature park (photo: SINP)

	Land (km ²)	%	Sea (km ²)	%	Total (km ²)
Ecological network area	26,689.78	47	12,140.48	39	38,830.26
Total territory	56,615	100	31,644	100	88,259



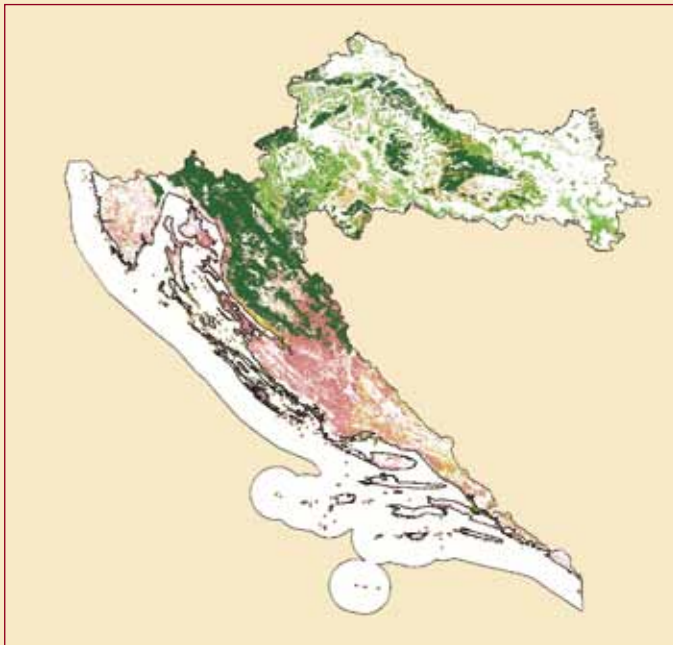
The Dvorina pond along the Sava River - protected ornithological reserve (photo: SINP)



Lonjsko Polje Nature Park - Ramsar site in alluvial wetlands of the Sava River (photo: SINP)



NATURA 2000 is the Ecological Network of the European Union that comprises sites important for the conservation of threatened species and habitat types. This program, which constitutes the foundation of nature protection in the EU, is based on the Birds and Habitats Directives (Council Directives 79/409 and 92/43 EEC). Through designation of Special Areas of Conservation (SAC) in compliance with Article 4 of the Habitats Directive, each Member State contributes to the drafting of NATURA 2000. In compliance with the Birds Directive, Special Protection Areas (SPA) are designated for protection of particular bird species. Mechanisms to protect the NATURA 2000 areas include the adoption of management plans and the impact assessment of each plan or intervention, which by itself or in combination with other plans or interventions may have a significant impact on the conservation objectives of a particular NATURA 2000 site. Qualification species and habitats in NATURA 2000 sites have to be monitored.



Distribution of NATURA 2000 habitat types in Croatia

Since 2006 and 2007, the State Institute for Nature Protection has been carrying out the activities to mobilise and involve the scientific and expert community, in order to meet the obligations towards the EU. A considerable part of work on the analysis of published and unpublished data on the distribution of NATURA 2000 species and habitat types in Croatia has been done, the NATURA 2000 proposal, including the GIS database, has been prepared. In 2008 and 2009, the comprehensive field work to gather new data continued, so that

the database, which is an integral part of the NATURA 2000 program, and has to be submitted by the Republic of Croatia to the European Commission at the time of Accession, would be a good basis for future obligations (monitoring, impact assessment, management plans etc.).

Through the LIFE III CRO-NEN project, the distribution and representation of NATURA 2000 species and habitat types have been analyzed. Data gathering continued afterwards in the scope of regular activities of the State Institute for Nature Protection and in cooperation with relevant scientists. A total of 222 species and 73 habitat types have been determined as well as the distribution areas of priority species such as wolf, brown bear, sea turtles, Adriatic sturgeon and olm. The most numerous are birds, with 87 bird species listed in Annex I of the Birds Directive present in Croatia. Amongst threatened habitat types in Croatia, the priority types are: posidonia beds, Pannonian inland dunes, Mediterranean temporary ponds, petrifying springs with tufa formation, alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* and others.

For each NATURA 2000 species and habitat type, the State Institute for Nature Protection has created a distribution map with all known localities. Basic input for these maps was data derived from the Red Books in combination with habitat type maps and data gathered in additional field surveys financed from the State Budget.

In 2008 and 2009, through the PHARE project Implementation of NATURA 2000 in Croatia, the State Institute for Nature Protection carried out a broad consultation process with all relevant stakeholder groups.

The participants on workshops discussed the NATURA 2000 proposal and the obligations of relevant sectors in relation to implementation of Birds and Habitats Directives. The State Institute continues to gather data in order to update the NATURA 2000 proposal, which the Republic of Croatia will submit to the EU at the time of Accession.

NATURA 2000 habitat types represented in Croatia

NATURA 2000 code	Habitat type
1110	Sandbanks, which are slightly covered by seawater all the time
*1120	Posidonia beds
1130	Estuaries
1140	Mudflats and sandflats not covered by seawater at low tide
*1150	Coastal lagoons
1160	Large shallow inlets and bays
1170	Reefs
1210	Annual vegetation of drift lines
1240	Vegetated sea cliffs of the Mediterranean coasts with endemic <i>Limonium</i> spp.
1310	<i>Salicornia</i> and other annuals colonizing mud and sand
1410	Mediterranean salt meadows (<i>Juncetalia maritimi</i>)
1420	Mediterranean and thermo-Atlantic halophilus scrubs (<i>Sarcocornetea fruticosi</i>)
*1530	Pannonic salt steppes and salt marshes
2110	Embryonic shifting dunes
*2340	Pannonic inland dunes
3130	Oligotrophic to mesotrophic standing waters with vegetation of the <i>Littorelletea uniflorae</i> and/or of the <i>Isoëto-Nanojuncetea</i>
3140	Hard oligo-mesotrophic waters with bentic vegetation of <i>Chara</i> spp.
3150	Natural eutrophic lakes with <i>Magnopotamnion</i> or <i>Hydrocharition</i> - type vegetation
*3170	Mediterranean temporary ponds
*3180	Turloughs
3230	Alpine rivers and their ligneous vegetation with <i>Myricaria germanica</i>
3260	Water courses of plain to montane levels with the <i>Ranunculion fluitantis</i> and <i>Callitricho-Batrachion</i> vegetation
3270	Rivers with muddy banks with <i>Chenopodion rubri</i> p.p. and <i>Bidention</i> p.p. vegetation
4030	European dry heaths
4060	Alpine and Boreal heaths
*4070	Bushes with <i>Pinus mugo</i> and <i>Rhododendron hirsutum</i> (<i>Mugo-Rhododendretum hirsuti</i>)
5130	<i>Juniperus communis</i> formations on heaths or calcareous grasslands
5210	Arborescent matorral with <i>Juniperus</i> spp.
5330	Thermo-Mediterranean and pre-desert scrub
*6110	Rupicolous calcareous or basophilic grasslands of the <i>Alyso-Sedion albi</i>
6170	Alpine and subalpine calcareous grasslands
6210	Semi-natural dry grasslands and scrubland facies on calcareous substrates (<i>Festuco-Brometalia</i>) (* important orchid sites)
*6220	Pseudo-steppe with grasses and annuals of the <i>Thero-Brachypodietea</i>
*6230	Species-rich <i>Nardus</i> grasslands, on silicious substrates in mountain areas (and submountain areas in Continental Europe)
*6240	Sub-Pannonic steppic grasslands
*6250	Pannonic loess steppic grasslands
*6260	Pannonic sand steppes
62A0	Eastern sub-Mediterranean dry grasslands (<i>Scorzoneratalia villosae</i>)
6410	<i>Molinia</i> meadows on calcareous, peaty or clayey-silt-laden soils (<i>Molinion caeruleae</i>)
6420	Mediterranean tall humid grasslands of the <i>Molinio-Holoschoenion</i>
6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels
6440	Alluvial meadows of river valleys of the <i>Cnidion dubii</i>

NATURA 2000 code	Habitat type
6450	Northern boreal alluvial meadows
6510	Lowland hay meadows (<i>Alopecurus pratensis</i> , <i>Sanguisorba officinalis</i>)
6520	Mountain hay meadows
7130	Blanket bogs
7140	Transition mires and quaking bogs
7150	Depressions on peat substrates of the <i>Rhynchosporion</i>
*7220	Petrifying springs with tufa formation (<i>Crotoneurion</i>)
7230	Alkaline fens
8120	Calcareous and calcshist screes of the montane to alpine levels (<i>Thlaspietea rotundifolii</i>)
8130	Western Mediterranean and thermophilous scree
8210	Calcareous rocky slopes with chasmophytic vegetation
8310	Caves not open to the public
8330	Submerged or partially submerged sea caves
9110	<i>Luzulo-Fagetum</i> beech forests
9130	<i>Asperulo-Fagetum</i> beech forests
9160	Sub-Atlantic and medio-European oak or oak-hornbeam forests of the <i>Carpinion betuli</i>
*9180	<i>Tilio-Acerion</i> forests of slopes, screes and ravines
*91E0	Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (<i>Alno-Padion</i> , <i>Alnion incanae</i> , <i>Salicion albae</i>)
91F0	Riparian mixed forests of <i>Quercus robur</i> , <i>Ulmus laevis</i> and <i>Ulmus minor</i> , <i>Fraxinus excelsior</i> or <i>Fraxinus angustifolia</i> , along the great rivers (<i>Ulmenion minoris</i>)
*91H0	Pannonian woods with <i>Quercus pubescens</i>
91K0	Illyrian <i>Fagus sylvatica</i> forests (<i>Aremonio-Fagion</i>)
91L0	Illyrian oak-hornbeam forests (<i>Erythronio-carpinion</i>)
91M0	Pannonian-Balkanic turkey oak-sessile oak forests
91R0	Dinaric dolomite Scots pine forests (<i>Genisto januensis-Pinetum</i>)
9260	<i>Castanea sativa</i> woods
92D0	Southern riparian galleries and thickets (<i>Nerio-Tamaricetea</i> and <i>Securinegion tinctoriae</i>)
9320	<i>Olea</i> and <i>Ceratonia</i> forests
9340	<i>Quercus ilex</i> and <i>Quercus rotundifolia</i> forests
9410	Acidophilous <i>Picea</i> forests of the montane to alpine levels (<i>Vaccinio-Picetea</i>)
*9530	(Sub-) Mediterranean pine forests with endemic black pines
9540	Mediterranean pine forests with endemic Mesogean pines
Croatian request for amendments of the Habitats Directive	Mediterranean wet grasslands of the order <i>Trifolio-Hordeetalia</i>
Croatian request for amendments of the Habitats Directive	Tufa cascades of the karstic rivers

* Priority habitat types for protection

