



Natura 2000 in the Pannonian Region



environment

**European Commission
Environment Directorate General**

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Back cover: A typical Pannonian landscape. © Zoltán Vajda

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Puszta landscape in Hortobágy, Hungary © Ronnie Zeiller/4nature

The Pannonian Region – a flat plain surrounded by mountains

The Pannonian Region is dominated by a large flat alluvial basin that is transected from north to south by two major rivers – the Danube and Tisza. Once an ancient inland sea, the basin is almost completely enclosed on all sides by low-lying hills and mountains. To the north and east lie the Carpathians, to the west the Alps and, to the south, the Dinarics.

All of Hungary is included in the Pannonian Region as are peripheral areas of Slovakia, the Czech Republic and Romania within the EU, as well as Serbia, Croatia and the Ukraine outside the EU.

The sheltered position of the region beneath the mountains has had a significant impact on biodiversity here. It has also influenced the climate. Wet weather coming in from the west is tempered by drier warmer winds rising up from the Mediterranean and cooler temperatures coming from the Carpathians and Alps nearby.

As a result of these complex weather patterns, the Pannonian Region exhibits a mosaic vegetation structure instead of the more classic zonal arrangements that one sees in other biogeographical regions. The conflicting climatic influences also account for the dramatic thunderstorms that sometimes build up over the plains at various times of the year.

At one time the basin was covered in large tracts of oak-dominated thermophilous forests and forest steppes but, over centuries, these were gradually cut down to make way for extensive grasslands which stretch out as far as the eye can see across the flat plains. This so called

Puszta is not only one of the oldest man-made habitats in Europe, having been maintained for centuries by low-key grazing and cultivation, but also one of the largest continuous grasslands left in Europe.

The Great Hungarian Plain covers three quarters of Hungary but equally significant are the smaller Little Hungarian Plain to the west, straddling Slovakia, and the Drava Plain to the south, on the border with Croatia.

Another key feature of the Pannonian Region is – rather surprisingly – water. The surrounding hills and mountains are an important source of water for this otherwise arid. In the past, vast areas within the basin were also regularly flooded by the slow moving Tisza and Danube rivers with their intricate network of tributaries. Thanks to these rivers, water permeated across much of flat terrain, creating shallow patches of ephemeral marshes and lakes that are no more than a few centimetres deep in places.

As the water ebbed and flowed, huge deposits of sand, silt and mineral-rich loess were left behind. With time, these fine particles were eventually blown over long distances by the prevailing easterly winds to form an intricate mosaic of different habitats, such as inland sand dunes, sand steppes, loess grasslands and maple-oak loess forests.

The hills that encircle the flat plains add considerably to this already complex biodiversity. They exert a major influence on species dispersal and migration. Many have, over time, evolved into endemic species that are unique to the region. The hills also still harbour important tracts forests and dry grasslands which provide a very different range of species than is found in the Plains.

In the north, the hills merge with the Carpathians to form a typical karst landscape. Aggtelek, Slovensky Kras and Moravsky Kras are prime examples. Beneath their surface a massive subterranean labyrinth of caves, underground rivers and aquifers carves its way through the porous limestone rocks. It too harbours its own unique wildlife.

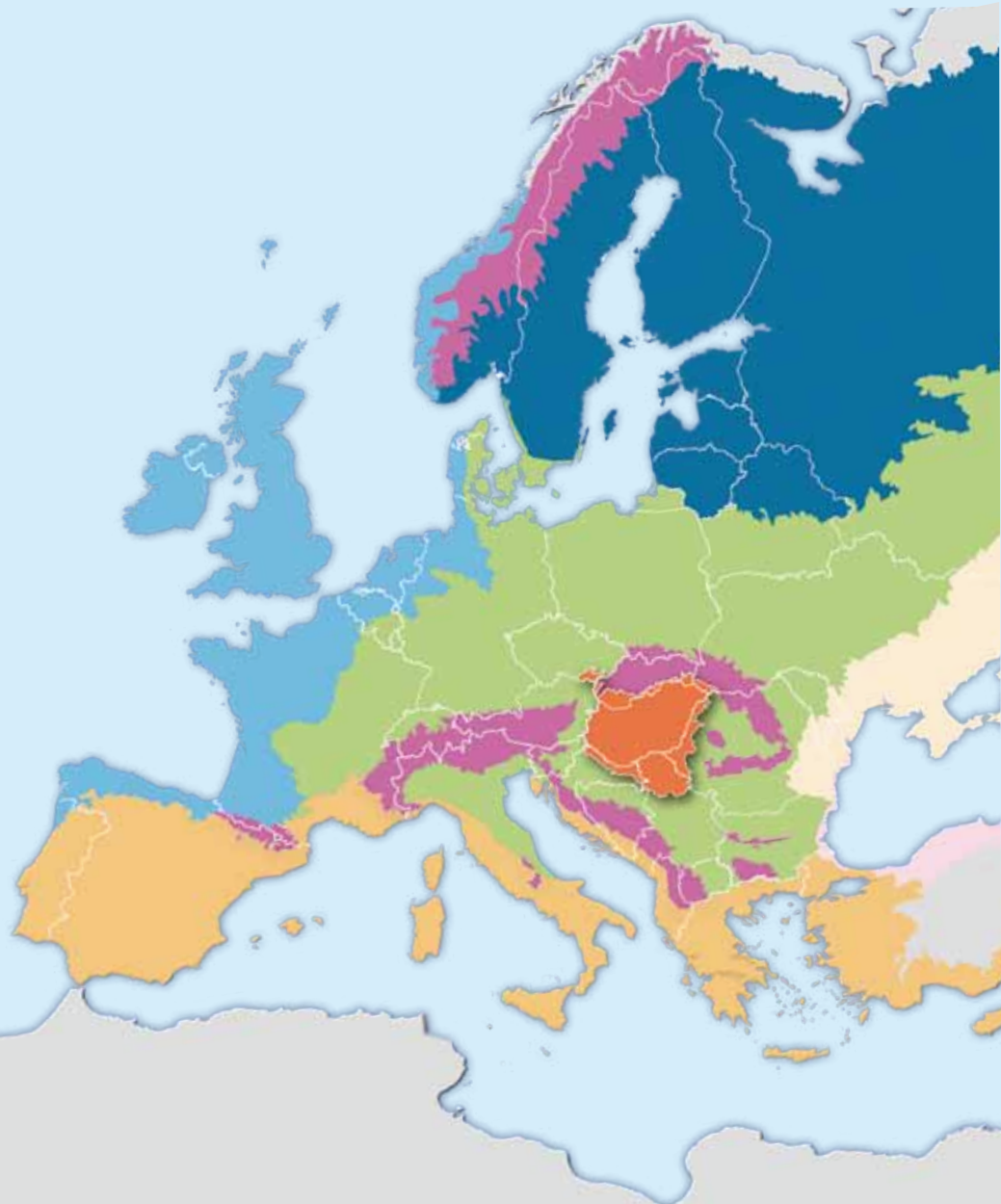
With such a wealth of diverse and contrasting habitats, it is no surprise that the Pannonian Region has a particularly high level of species diversity, with many endemics. The region is also of major importance for birds. Hundreds of thousands of geese, ducks and other waders flock to the shallow wetlands every year. Amongst them are rare species like the lesser white-fronted goose *Anser erythropus* and the spoonbill *Platalea leucorodia*.

For thousands of years, the Pannonian Region has been heavily influenced by humans. Today over 60% of the land has been converted to arable lands. At first, grazing and farming was done in a relatively sustainable way across large parts of the Puszta. But more recently, drastic changes were made which destroyed many of the semi-natural and natural habitats.

Large-scale canalization and land reclamation schemes were launched at the end of the 19th Century which resulted in substantial areas of floodplains and the Puszta being carved up and drained to make way for arable crops and fast growing alien trees like the false acacia *Robinia pseudoacacia*.

Region	Countries involved	% of EU territory
Atlantic	Belgium, Germany, Denmark, Spain, France, Ireland, Portugal, Netherlands, United Kingdom	18.4
Boreal	Estonia, Finland, Latvia, Lithuania, Sweden	18.8
Continental	Austria, Belgium, Bulgaria, Czech Republic, Germany, Denmark, France, Italy, Luxembourg, Poland, Romania, Sweden, Slovenia	29.3
Alpine	Austria, Bulgaria, Germany, Spain, Finland, France, Italy, Poland, Romania, Sweden, Slovenia, Slovakia	8.6
Pannonian	Czech Republic, Hungary, Romania, Slovakia	3.0
Steppic	Romania	0.9
Black Sea	Bulgaria, Romania	0.3
Mediterranean	Cyprus, Spain, France, Greece, Italy, Malta, Portugal	20.6
Macaronesian	Spain, Portugal	0.2

Source: European Topic Centre on Biological Diversity (European Environment Agency) <http://biodiversity.eionet.europa.eu> October 2008



Natura 2000 species in the Pannonian Region

Despite covering just 3% of the EU territory, the Pannonian Region harbours 118 species of animals and 46 species of plants listed in the Habitats Directive, as well as around 70 birds listed in Annex I of the Birds Directive. The high number is not only a reflection of the high level of biodiversity in this small region, but also of the fragility and restricted distribution of some of the species, especially those that are endemic to the region.

They include endemic plants like the sand saffron *Colchicum arenarium*, the diminutive pink carnation *Dianthus diutinus*, the Hungarian pasqueflower *Pulsatilla pratensis* ssp. *hungarica* and the Torna goldendrop *Onosma tornensis* as well as animals like the Hungarian meadow viper *Vipera ursinii* ssp. *rakosiensis*, the snail *Sadleriana pannonica* and the translucent Aggtelek cave shrimp *Niphargus aggtelekiensis*, which, as its name suggests, is only found in the underground caves of Aggtelek and Slovensky kras on the border between Hungary and Slovakia.

The region is particularly rich in invertebrates (67 species are included in the Habitats Directive). Many inhabit the forests which still cover large parts of the low-lying hills and mountains. They include some of Europe's rarest and most colourful beetles like the striking stag beetle *Lucanus cervus* and the nocturnal *Morimus funereus* or the little red *Cucujus cinnaberinus*. Fish are also well represented (24 species in the Habitats Directive) as are bats (10 species on the Habitats Directive). The latter seek out the extensive underground caves and natural forests that are so typical for the region.

Above all, the region is of major importance for birds. Many species that are endangered in the rest of the EU still breed in significant numbers here like the great bustard, *Otis tarda*, the ferruginous duck *Aythya nyroca*, the imperial eagle *Aquila heliaca* and the saker falcon *Falco cherrug*. The raptors often feed off the small rodents that inhabit the sandy steppic plains, grasslands and thickets, like the



Photo © Hortobágy National Park Archives

Red footed falcon *Falco vespertinus*

The red footed falcon is a typical species of the steppe and forest-steppe zones. It occurs in relatively warm and open habitats, for example grasslands and meadows interspersed with copses, scattered trees and gallery forests which are used for nesting. Its main diet consists of grasshoppers, beetles, dragonflies, termites and the occasional small mammal. The birds do not build nests themselves but tend instead to occupy old or unused corvid nests, mainly in rookeries. Being a gregarious species, colonies can sometimes reach several hundred pairs.

Within the EU, the main breeding population is now in the Pannonian Region which is estimated to contain around 2,000 pairs. Here, as elsewhere, it has suffered a steady decline. This is probably linked to the combined effects of a reduction in insects through pesticide use and the collapse of local rook populations through persecution.

souslik *Spermophilus citellus* and the southern birch mouse *Sicista subtilis*, both of which are now very rare as a result of habitat loss.

As for the many shallow wetlands and alkaline lakes, they are an absolute paradise for waterfowl and migratory birds. Every spring and autumn, hundreds of thousands of birds come to the region to rest and feed during their annual migration. In Hortobágy alone there may be up to 80,000 cranes *Grus grus* during these periods. They are accompanied by large flocks of wild geese, ducks and other waders.



Photo © Daniel Petrescu www.bibis-tours.ro

Souslik *Spermophilus citellus*

The souslik is a type of ground-nesting squirrel endemic to Europe. It is easily recognised by its habit of standing on its back legs and whistling at the sight of a predator such as a bird of prey, stork, or larger carnivore. It is a typical species of grasslands and steppes, feeding mainly off seeds, flowers, insects and roots. The soft loamy and sandy soils are ideal substrates in which to build their burrows.

The species range is divided in two by the Carpathians. One part includes the Pannonian Basin, the other is to the south and east in Southern Romania, Bulgaria, Moldova and the Ukraine. In both regions, the souslik population has shown a serious decline in recent decades due to the transformation of steppic grasslands into arable land, the advance of mechanised farming and the abandonment of grazing which helped to keep the tall grasses at bay.



Herds of traditional grey cattle help maintain the natural vegetation of the puszta. Photo © László Lisztes

Map of Natura 2000 sites in the Pannonian Region

The list of Natura 2000 sites in the Pannonian Region was first adopted in November 2007 and further updated in December 2008. Altogether, within the Pannonian Region there are 756 Sites of Community Importance (SCIs) under the Habitats Directive and 100 Special Protection Areas (SPAs) under the Birds Directive. There is often considerable overlap between SCIs and SPAs which means that the figures are not cumulative. Nevertheless, it is estimated that together they cover around 15% of the total land area in this region.

Number of habitat types in Annex I and species or sub-species in Annex II of the Habitats Directive.

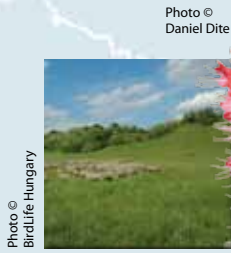
Region	Habitat types	Animals	Plants
Atlantic	117	80	52
Boreal	88	70	61
Continental	159	184	102
Alpine	119	161	107
Pannonian	56	118	46
Steppic	25	25	14
Black Sea	58	79	6
Mediterranean	146	158	270
Macaronesian	38	22	159

Source: European Topic Centre on Biological Diversity (European Environment Agency) <http://biodiversity.eionet.europa.eu>
 – the figures are not cumulative since many habitats and species occur in two or more biogeographical regions
 – Birds from Annex I of the Birds Directive are not listed as they are not categorized according to biogeographical region

Region	N° SCI	Total area covered (km ²)	Terrestrial area covered (km ²)	% of total terrestrial area	N° SPA	Total area covered (km ²)	Terrestrial area covered (km ²)	% of total terrestrial area
Atlantic	2,747	109,684	68,794	8.7	882	76,572	50,572	6.4
Boreal	6,266	111,278	96,549	12.0	1,165	70,341	54,904	6.8
Continental	7,475	150,014	135,120	10.8	1,478	147,559	128,432	12.4
Alpine	1,496	145,643	145,643	39.7	365	93,397	93,397	31.1
Pannonian	756	15,858	15,858	12.3	100	19,965	19,965	17.5
Steppic	34	7,210	7,210	19.4	40	8,628*	8,628	24.4
Black Sea	40	10,243	8,298	71.8	27	4,100	3,561	30.8
Mediterranean	2,928	188,580	174,930	19.8	999	147,358	142,350	16.0
Macaronesian	211	5,385	3,516	33.5	65	3,448	3,388	32.3
TOTAL	21,612	655,968	568,463	13.3	5,004	486,571	429,615	10.5

Source: European Topic Centre on Biological Diversity (European Environment Agency) <http://biodiversity.eionet.europa.eu> October 2008

- SPAs and SCIs are not cumulative as there is considerable overlap between them
- Some sites are on the border between two regions, the database does not allow for the possibility to split sites between regions, therefore some sites may be counted twice
- Percentage of marine areas not available
- SPAs are not selected according to biogeographical region
- SPA area for the Steppic Region are calculated according to available GIS data



8 Moravský Kras

Photo © Daniel Dite



1 Slovenský Kras



Photo © Josef Hlasek

Photo © Balint Halpern



Photo © Balint Halpern



7 Hanság grasslands

Photo © Josef Hlasek



Photo © Laszlo Molnar



6 Bakony forest

Photo © Daniel Dite



Photo © Zoltán Várda



4 Kiskunság

Photo © László Lisztes



2 Hortobágy

Photo © Mike Read



Photo © Red Footed Falcon LIFE project



3 Campia Careiului



Photo © Duna-Dráva NP



5 Duna River

Photo © bufo.do.apus.ru



- SCIs
- SPAs
- SPA and SCI

Map based on site coordinates supplied by the European Commission through the University of Leuven, Division SADL, October 2008





Alkaline lakes in Hortobágy National Park, inset Spoonbill. Photos © Hortobágy National Park Archives

Natura 2000 habitat types in the Pannonian Region

Originally, much of the region was clad in forests. Extensive willow-poplar woods and other riverine forests dominated the floodplains whilst oak-hornbeam forests and thermophilous oak woods took over in the drier hilly area. Because of the contrasting climatic influences which separate humid from semi-arid areas, the Pannonian Region is in fact at the meeting point of two major vegetation zones – broadleaved forests and forest-steppes.

Today, only around one-sixth of the region is still forested. What is left is mostly located on the low hills and slopes of the surrounding mountains. Areas like the Bükk or Zemplén Mountains in the northeast and the Bakony Mountains further west still harbour large continuous tracts of forests which extend over hundreds of kilometres.

The typical Pannonian woods with hornbeam *Carpinus betulus*, sessile oak *Quercus petraea* or downy oak *Quercus pubescens* are particularly rich in wildlife. Their relatively open canopy and low growing habit of these trees means that the forest floor is often much more species diverse than in other forests with a more closed canopy cover.

This enables the growth of a whole range of flowering plants which, in turn, attract an abundance of insects and ultimately also a wide variety of birds like the collared flycatcher *Ficedula albicollis*.

Equally important for wildlife are the characteristic Pannonic wooded steppes and inland sand dune thickets with their scattered junipers and white poplar trees. These represent an important transition zone between the woodlands and the steppic grasslands.

On the relentlessly flat plains precipitation becomes too low for the growth of forests and instead vast areas are taken over by steppic grasslands. These take on a variety of forms depending on local conditions and underlying soil conditions.

Photo: © Daniel Dite



Pannonic sand steppes

Pannonic sand steppes are endemic habitats of the Pannonian Region. They occur on the large deposits of sand left behind by the Danube and Tisza rivers that once flooded large areas of the plains. Every year, the sand would drift across the flat landscape in the direction of the prevailing winds, eventually accumulating to form high inland dunes sometimes 30–40 m high in places.

Whilst the unstable dunes remain largely devoid of vegetation, the sheltered hollows have, over time, been anchored down by feathery grasses and other deep-rooted plants. This in turn has created a unique mosaic of sandy habitats in varying stages of succession which is exceptionally rich in plants and insects. Typical plant species include the dyer's alkanet *Alkanna tinctoria*, the sand saffron *Colchicum arenarium* and the rare *Dianthus diutinus*. Typical animal species include the Hungarian grasshopper *Acrida ungarica*, the sand lizard *Lacerta agilis* and the ubiquitous souslik *Spermophilus citellus*.



Limestone karst mountain clad in forests, Slovenský Kras . Photo © Daniel Dite, inset *Echium russicum* © Daniel Dite

Habitat types included in the Habitats Directive range from Pannonic sand steppes with their characteristic tussock forming grasses like *Festuca vaginata* and *Stipa borysthenica* to the denser Pannonic loess steppic grasslands rich in species like *Astragalus vesicarius* and the extremely rare *Crambe tataria*.

Because parts of the plains have high levels of salinity in the soil, a number of salt tolerant habitat types are also curiously present in this region. They include salt steppes and salt marshes which are more usually found along the seashore.

Shallow alkaline lakes have also formed in depressions. Unlike many other salt lakes of the world, those in the Carpathian Basin are highly alkaline. They are amongst the most important lakes in Europe for migrating and breeding waterfowl.

The vast Lake Fertő wetland complex on the border with Austria is a typical example of a large fluctuating salt steppe lake. It is a remnant of the Pannon Sea that once covered the basin some 20,000 years ago.

Much of the Pannonian Region is also heavily influenced by the Danube and Tisza rivers and their many tributaries. In the surrounding mountains the river courses are fast flowing and precipitous offering ideal habitats for a wide range of rare freshwater fish and other water dependant species.

As the rivers reach the flat plains they slow down considerably. An altogether different range of wetland habitats emerge as a result. Some are permanently waterlogged, whilst others are of a more ephemeral nature having been created through a complex ritual of annual flooding and a gradual drying out during the relentlessly hot summer months.

As for the rivers themselves, although both the Tisza and Danube have suffered considerable alteration over the centuries, they still harbour large areas of natural floodplain forests and meadows which provide a vital refuge and green corridor for a whole variety of wetland species. The Duna-Drava complex in Southern Hungary is a typical example. It continues across the border into Croatia and Serbia where it becomes known as Kopacki Rit – a vast area of sunken forests, marshes and hidden lakes.

Pannonic salt steppes and marshes

Pannonic salt steppes, salt pans, salt marshes and shallow salt lakes all have one thing in common: the presence of salt which is found in higher than normal concentrations in the soil here, even though the Pannonian Region is nowhere near the sea. This unusual phenomenon is the result of a unique combination of continental climate, flat topography and flooding from the surrounding Tisza River. The flatness of the land causes floodwater to spread far and wide across the terrain creating hundreds of kilometres of shallow ephemeral wetlands, sometimes no more than a few centimetres deep. The intense heat during the summer months causes the water to evaporate rapidly which in turn encourages the formation of salt crystals. Consequently only salt tolerant plants are able to grow here such as *Artemisia santonicum*, *Suaeda pannonica*, *Salicornia prostrata* and various species of *Puccinellia* spp. Together, they create a complex vegetation structure that varies according to subtle changes in micro-topography and salinity levels.



Photo: © Daniel Dite



Photo © LIFE project Pannonian Grasslands, BirdLife Hungary

Management issues in the Pannonian Region

A significant proportion of the natural vegetation in the Pannonian Region has been converted to productive agricultural land. Today, cultivated habitats cover almost two-thirds of the region. At first, this was done in a way that was largely compatible with the natural environment.

Farmers carved out a living in these harsh conditions by grazing large livestock herds on the relentlessly flat plains. Ancient breeds were used such as the Hungarian grey cattle, Mangalica pig or Racka sheep because they were well adapted to the Puszta.

Herdsmen moved their livestock over great distances in order to avoid the vast floodplains created by the flooding of the Danube and Tisza Rivers during spring and winter, and to seek out precious watering holes during the hot, dry summers. Nowadays, an occasional wooden sweep pole is often all that remains of this ancient farming tradition that goes back over millenia.

Arable farming was also popular. The loess-rich soils provided ideal conditions for cereal production but were few and far between. So, in order to meet the growing demand for arable land, massive land reclamation and river regulation projects were launched in 19th Century to drain the wetlands, create new agricultural land and control floods.

The two major rivers that transect the plains were also heavily regulated to prevent flooding. The Tisza River alone was shortened by 134 km during that period. A vast network of dykes and drainage channels were constructed across the puszta which cut off much of the water supply and caused a dramatic transformation of the vegetation. It is estimated that over the last 150 years as much as 93% of Hungary's floodplain had been lost as a result of these activities.

Further transformations of the plains were initiated after World War II. Under the Communist Regime, large state or collective farms, averaging 3,500 ha to 7,000 ha each, were created taking agricultural activities to a new industrial scale. Even poor or remote areas were cultivated because of guaranteed prices for crops.

Attempts were also made to artificially irrigate the puszta for cereal production or even to create rice paddies. Needless to say the schemes ultimately failed but not without

Photo © Hortobágy National Park Archives



Wildlife-friendly agri-environmental schemes

In Hungary, EU agri-environmental schemes have been developed under the new Rural Development Programme for 2007–2013 in order to help maintain suitable habitats for steppic birds like the great bustard and red footed falcon. These either focus on pre-defined 'environmentally sensitive areas' or on specific species and habitat types.

Farmers are for instance paid to apply bustard-friendly farming, like leaving 6 m-wide buffer zones or growing alfalfa strips, cutting after 15 June and using game-detering chains when cutting. The voluntary schemes provide farmers with annual compensation payments for the loss of yield and other income due to the restrictions laid down in the contract. The schemes have proven to be surprisingly popular. For instance, in Kiskunság which hosts some of the Natura 2000 sites with the largest population of great bustard in Hungary, 50% of the land is included in agri-environment. A further scheme has also recently been introduced which encourages the conversion of arable land to grassland. This could also help the species to expand into new areas in due course.



Photo © LIFE project Pannonian Grasslands, BirdLife Hungary

causing even more damage to what remained of the fragile steppic grasslands. In the end only those habitats on the poorest of soils were spared.

Following the collapse of Communism, agricultural production slowed down at first as the large state farms were broken up and the land returned to their rightful owners. The consumption of artificial fertilisers also dropped significantly. But it was not long before modern production systems started to take over.

Further intensification of steppes in Hungary was partly averted in 2002 with the introduction of the EU's Environmentally Sensitive Areas (ESA) scheme. The reform of the Common Agricultural Policy also decoupled single area payments from production and introduced possibilities for encouraging wildlife-friendly farming through agri-environment schemes, which Hungary is now applying.

Efforts are also being made to restore the natural hydrology of parts of the plains through a series of major restoration projects co-financed through the EU's LIFE programme. Thanks to these projects, several thousands of hectares of damaged steppic habitats have already been restored, and many of the rare steppic plants and animals are slowly beginning to recover as a result.

In the surrounding hills, farming has also undergone significant changes in recent years. As a result some of the small scale farmers are finding it increasingly difficult to make a living out of their land and many are being forced to abandon their plots in favour of jobs elsewhere. As a result, many of valuable semi-natural grasslands are gradually disappearing under a layer of encroaching scrub and tall grasses. Eventually, the land will revert back to forest but this will support a completely different range of species than those found in grasslands.

The area of forest in the hills has, in fact, increased over the years precisely for this reason and significant parts remain natural with little commercial forestry. This contrasts with the large scale commercial plantation of exotics in the plains. The invasive false acacia *Robinia pseudoacacia* in

particular risks spreading uncontrollably across parts of the region, displacing what remains of the natural or semi-natural vegetation.

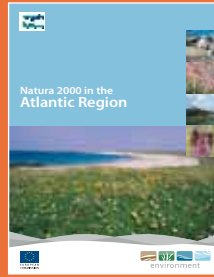
Finally, a word should be said about the many lakes and rivers that are present in the Pannonian Region. Lake Balaton is one of the largest shallow lakes in central Europe, but its intensive use by tourists, combined with the lack of sewage handling facilities and the heavy use of fertilisers in surrounding agricultural areas has caused heavy eutrophication.

The introduction of invasive alien fish species is also taking its toll on the local fauna and flora. In Lake Fertő, for instance, many indigenous fish species have disappeared completely following the introduction of eel *Anguilla anguilla* and alien grass carp *Ctenopharyngodon idella*.

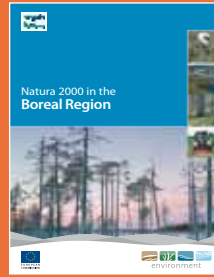
But, despite all these pressures, the Pannonian Region still hosts significant areas of high biodiversity which are now being protected and managed with conservation in mind.

Roller
Photo © Josef Hlasek

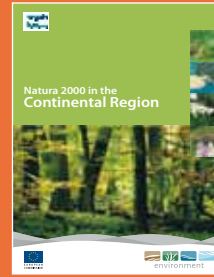
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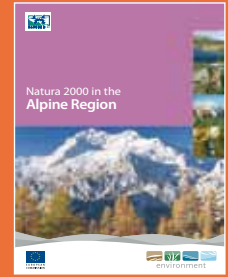
Natura 2000 in the Atlantic Region



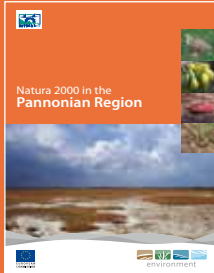
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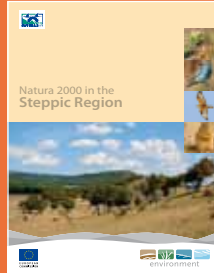
Natura 2000 in the Continental Region



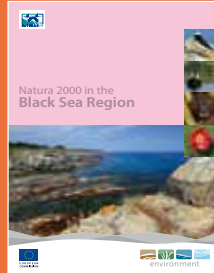
Natura 2000 in the Alpine Region



Natura 2000 in the Pannonian Region



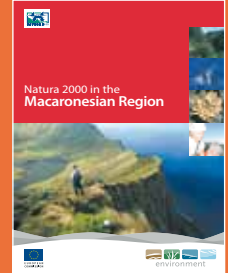
Natura 2000 in the Steppic Region



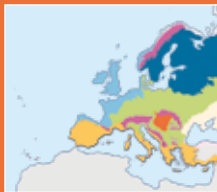
Natura 2000 in the Black Sea Region



Natura 2000 in the Mediterranean Region



Natura 2000 in the Macaronesian Region



The European Union has nine biogeographical regions, each with its own characteristic blend of vegetation, climate and geology. Sites of Community Importance are selected according to each region on the basis of national lists submitted by each Member State within that region. Working at this level makes it easier to conserve species and habitat types under similar natural conditions across a suite of countries, irrespective of political and administrative boundaries. Together with the Special Protection Areas designated under the Birds Directive, the Sites of Community Importance selected for each biogeographical region make up the ecological Natura 2000 network which spans all 27 countries of the EU.

