An Atlas for the Lower Danube Green Corridor
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Preface to the first edition

On June 5th, 2000 the four riparian states of the Lower Danube – Romania, Bulgaria, Moldavia and Ukraine – signed an agreement on the classification of a „Lower Danube Green Corridor”, committing themselves to conduct large-scale nature conservation and restoration measures.

This agreement was supported by WWF and was based among others on the restoration successes obtained in cooperation with Romanian partners (DDNI – Danube Delta National Institute, Tulcea/Romania) in the Danube Delta Biosphere Reserve as well as in studies carried out by WWF on the ecological significance and the restoration potential of river floodplains in the whole Danube catchment area.

To back up the planning and implementation of the intended nature conservation and restoration measures the atlas has been elaborated by WWF-Auen-Institut (WWF Institute for Floodplain Ecology, Rastatt/Germany). The atlas depicts historical maps and most recent satellite images with floodplain-specific data. In so doing the dramatic changes that took place in the floodplain areas of the Lower Danube during the second half of the 20th century may be concretely visualized and documented. These data provide the basis for both the future nature reserves and the potential restoration areas.

The first edition of this atlas mainly provides fundamental data. On the basis thus established and with additional, more detailed data further information will be gathered on specific areas of the Lower Danube Green Corridor. These are meant to complement the atlas’ spatial data base and will be visualized in a new edition. In doing so the atlas may be used as a means to support decision making within the frame of the measures to be taken in the Lower Danube Green Corridor.

(March 1st, 2004)

Preface to the second edition

The atlas of the Lower Danube Green Corridor, for the establishment of which the riparian countries of the Lower Danube signed an agreement on June 5th, 2000, was meant to provide fundamental data. On their basis further, more detailed data obtained in the different Danube sections were to be elaborated and to be published in a second edition. Meanwhile, five years have passed since the first edition has been released. Throughout this time quite a number of things have changed on the Lower Danube as from the point of view of nature conservation but also from an economical planning and political point of view. New protected areas have been classified and evaluations have been conducted on the ecological significance of individual areas (2004). The latter served as a basis for the nomination and classification of Natura 2000 areas according to the European Council Directives on the conservation of wild birds, the conservation of natural habitats and of wild fauna and flora subsequent to Romania’s and Bulgaria’s accession to the European Union on 1.01.2007.

On the Lower Danube the SPA-proposals according to the European Council Directive on the conservation of wild birds and SCI’s have meanwhile assembled in a veritable network of proposed Natura 2000 areas. The European Water Framework Directive also sets a new course. The most recent floods on the Lower Danube, most of all the year 2006 flood, provided an impetus for a rethink on the matter, considering that flood protection could be obtained by a reconnection of cut-off flood areas. The data gathered in this atlas serve as a basis for further protected sites to be established, for the elaboration of management plans and the choice of potential restoration areas that came even more in the public eye lately. In doing so the atlas may be used furthermore as a means to support decision making within the frame of measures planned in the Lower Danube Green Corridor, including those for improvement of navigation and for flood protection.

(March 10th 2009)
Objectives of the LDGC Atlas

To back the further implementation of the Lower Danube Green Corridor, i.e. a complex network of nature protection and restoration areas, WWF set itself the target to give a detailed representation of the Green Corridor in cartography. The river section concerned is that of the whole Lower Danube up to the Danube Delta, the latter being in the focus of numerous studies and cartographic maps for itself, which is why it has merely been included in the atlas in the form of a survey map.

The cartographical maps showing individual sections of the Lower Danube Green Corridor depict the area’s actual condition, with its splitting in recent and former floodplain as a result of dam constructions. At the same time they contain references to both floodplain transformation and loss of natural structures. The maps also call attention to those floodplain forests that are sheltering the poor remains of near-natural hardwood floodplain forests, comprising references as for the stand sizes of oak, ash, elm as well as black and white poplar. Besides information on floodplain forests, data on wetland areas, grasslands, waters, settlements, harbors and industrial areas are to illustrate the diversity of uses in the floodplain. Already designated nature protection areas as well as the Natura 2000 SPA areas (Special Protection Area) accordant to the Bird Directive and SCI (Sites of Community Interest) responding to the Flora Fauna Habitat Directive are supposed to enhance the nature protection value of the Green Corridor.

A juxtaposition of historical maps with recent illustrations is to exemplify the extent of all changes that occurred in the Lower Danube floodplains. Special attention is drawn here to the loss in natural, morphological structures, in water courses and in broader floodplain lake surfaces.

The objective of the atlas is to provide a basis for statements on the biological-ecological significance of floodplain habitats in the Lower Danube Green Corridor LDGC and to reveal those areas that present a high natural potential. The Lower Danube Green Corridor started as a large transboundary nature protection initiative with the support of the Danube-Carpathian Programme of WWF International. On June 6th 2000, Romania, Bulgaria, Moldavia and Ukraine signed an agreement on the declaration of a “Lower Danube Green Corridor” as a network of protected areas, areas that are still to be protected and floodplain areas to be rehabilitated (Fig. 1). The network of natural landscapes shown in the map sheets serves as a starting point for further nature conservation strategies and as decision making support and argument for solutions to be found in connection with waterway programs. Moreover, the maps shall be the basis for restoration measure strategies and for modern flood protection concepts through floodplain restoration. They thus make a contribution to the reestablishment of a near-natural landscape where the people living on the Lower Danube may pursue a sustainable economic activity.

Fig. 1: The Lower Danube Green Corridor

Fig. 2: The Lower Danube upstream Russe with the Bulgarian Island Luljak (Photo Karl Gutzweiler)
The Danube from the springs to the Black Sea

Introductory part

The Danube sections – general description

From its spring area in the Black Forest to its mouth in the Black Sea the Danube River extends over a considerable length of more than 2840 km and crosses various natural areas and unspoiled nature. Along its way a great variety of morphological forms become apparent that, in combination with varying climatic conditions, to the formation of extremely different natural landscapes. Characteristic elements are on the one hand varying basin landscapes, marginal depressions and broad lowlands. On the other hand the landscape is characterized by the highland breach of the Swabian and Franconian Alb, Austrian Alpine foothills and crystalline mountains (older layer complexes mainly composed of magma or metamorphic rocks) along the Upper Danube River, the breach between Alps/Carpathian Mountains near Bratislava, the breach of the Hungarian highlands (Visegrad Gate) on the Central Danube River as well as the immense Danube gorges breaking through the Carpathian Mountains at the Iron Gate, on the lower end of which the river becomes the Lower Danube.

The river attending lowlands, i.e. the morphological floodplain, is of varying width and distinctly stands out against the surrounding landscape. On the Upper Danube comprising the section up to the Devin Gate or Porta Hungarica upstream Bratislava, the extension of the morphological floodplain is relatively small as compared to the following sections (Fig.3). The Central Danube reaching from the Devin Gate up to the Danube gorges at the Iron Gate, disposes of a very broad morphological floodplain. The Lower Danube’s broad morphological floodplain areas together with those of the Danube Delta point up the dimensions of the whole Lower Danube’s former flood prone area (see WWF/PCU 1999, Fig.3).

If we compare the morphological floodplain’s area size to that of the recent floodplain which is also subject to water level fluctuations such as flooding and drying out, the loss of floodplain areas becomes clearly apparent and so does the extent of human interventions and alterations that occurred on this river and in its floodplains (Fig.3). On the whole Upper Danube, slightly more than 95 km² of the former floodplain area have been preserved and this mainly on the Austrian Danube east of Vienna in the Donau-Auen National Park. As for the German Danube, in Bade-Wurttemberg the section between Sigmaringen and Ulm merely comprises twelve 1-km stretches that have not been trained (see KONOLD & SCHÜTZ 1996). On the Bavarian Danube as well only few areas of the recent floodplain have persisted along the last natural 70-km river section between Straubing and Vilshofen (see WEIGER 1994). The Central Danube only comprises 2002 km² of recent floodplains, the Lower Danube 2200 km² and the Danube Delta 3799 km². It has to be noted here, that all numbers mentioned also comprise the river itself (see also WWF/PCU 1999). With exclusion of the river itself, four fifth of the floodplain, i.e. on the Lower Danube upstream the Delta, more than 4500 km² (of a total of 5407 km²) are cut off from the river (see BOTZAN 1984, SCHNEIDER 1991, Fig.4).

Fig. 3: Comparison of the extension of morphological and recent floodplains along the Danube River (WWF-DCP & WWF-AUEN-INSTITUT 1999, completed and corrected for the Lower Danube Green Corridor, 2008)

<table>
<thead>
<tr>
<th>River section</th>
<th>Morphological floodplain (km²)</th>
<th>Recent floodplain (km²)</th>
<th>Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Danube</td>
<td>1762</td>
<td>95</td>
<td>95%</td>
</tr>
<tr>
<td>Central Danube</td>
<td>8161</td>
<td>2002</td>
<td>75%</td>
</tr>
<tr>
<td>Lower Danube</td>
<td>8173</td>
<td>2193</td>
<td>73%</td>
</tr>
<tr>
<td>Danube Delta</td>
<td>5402</td>
<td>3799</td>
<td>30%</td>
</tr>
</tbody>
</table>

Purple loosestrife (Lythrum salicaria)
Basic ecological conditions

Hydrological characteristics

Over its considerable length the Danube River shows varying hydrological characteristics in some sections that are affected by the regime of its tributaries. The very Upper Danube up to the Iller mouth is a highland river and shows a correspondingly characteristic hydrological regime with winter maxima. Conditioned by its right-bank tributaries it transforms into an alpine river, the maxima shifting into summer. From the Inn mouth the alpine character of the hydrological regime is predominant and controls the latter up to the pannonian area (LÁSZLOFFY in LIEPOLT 1967, REG. ZUS. DONAULÄNDER 1985, see also DISTER 1985). The highest values are found downstream the Drava as a result of an early snowmelt already in March. Under the influence of Mediterranean precipitations a second maximum can however be registered in November. The flow regime changes only downstream the Tisza and the more Mediterranean Sava, maximum values occurring mainly in May. On the Lower Danube these characteristics remain largely unchanged given that its tributaries do not carry enough water to have a great influence.

The total flow of the Danube amounts to a long-time mean value of about 6500 m³/s (see LÁSZLOFFY in LIEPOLT 1967, JOINT DANUBE SURVEY 2001). The Danube’s mean annual runoff data show a distinct classification in three sections that do also point up the influence of the tributaries on the Danube River’s flow regime. The upper section extends up to the Isar mouth. The second section...
between Isar and Drava mouths distinctly shows the dominating influence of the Inn river (760 m$^3$/s) as the Danube’s mean runoff doubles downstream its mouth. The third and lowest section reveals the definite influence of Tisza (920 m$^3$/s) and Sava (1800 m$^3$/s) rivers (Fig. 5).

The lower section of the Danube River shows a completely different discharge behavior compared to the river’s more alpine regime in Austria and Hungary, which is due to its above mentioned large tributaries such as Drava, Tisza and Sava. Whereas at the Hainburg gauge (between Vienna and Bratislava) the highest average water levels are obtained in June (DISTER 1994, 2007), they may already be observed in April at the gauge of Giurgiu (Romania). The same is true for the low water levels in September, they are much more pronounced at the Giurgiu gauge compared to that of Hainburg (Fig. 6 and 7).

Despite of the huge reaches constructed at the Iron Gate, today the Lower Danube shows very considerable water level fluctuations as a result of dramatic losses in floodplains. These have been dyked in the course of the 1960ies and 70ies and could thus no longer assume their function as flood retention areas. The extreme water levels measured at gauge Giurgiu are of 144 cm (on 8.9.2003) and 822 cm (on 24.4.2006) and do thus show an amplitude exceeding 9.5 m (DISTER 2007).
Morphological dynamics

The Danube also shows a pronounced morphological dynamics which is closely related to its hydrological dynamics. On the upper Danube a considerable bedload supply originating from its alpine tributaries could thus be registered. As a result of this bedload supply, in its broad alluvial basin the Danube developed a widely ramified river bed which was modified on the occasion of many flood events. Huge talus cones had formed in the estuaries of the alpine rivers where characteristic pioneer species settled dependent upon the substrate's grain size. Caused by the Danube's development until upstream Vienna and in parts also of its tributaries, bedload transport and supply have been widely stopped (SCHWARZ 2008). Downstream Bratislava the Danube changes from an alpine river that is mainly characterized by its hydrological and morphological dynamics to a lowland river with high suspended loads and a small gradient. Sava and Tisza notably contribute to the Lower Danube's high bedload and most of all to its high suspended load. On the Lower Danube the effects of bedload and suspended load reflect in an average slope of 0.05 per mill in the numerous ramifications and islands ('ostrov') that mainly consist of fine sand and silt sediments. This counts as well in the natural separation/damming up of tributaries with a lower transport capacity by evolution of natural levees through sedimentation towards the riparian lakes called fluvial limans (see REG. ZUS. DONAULÄNDER 1985, SCHNEIDER 1991, 2002, Fig. 8).

In consequence of barrage constructions on the Danube River a deepening of the river bed had to be observed downstream the Iron Gate. This again entailed aggravated erosion, less stable banks, increased aggradation and the formation of islands. Morphological alterations on the Lower Danube River are also closely knit to the barrages and weirs on its tributaries and, as a result, a lower bedload supply from the tributaries (SCHWARZ 2008).

The construction of barrages at the Iron Gate also implied a dramatic reduction of suspended sediments in the Danube River. The trapping-efficiency of the Iron Gate barrage amounts to between 66% for flood-abundant years and 85% in dry years, with an 80% average (SCHWARZ 2008). The amount of suspended sediments in the Danube is reduced to merely 30% as compared to the numbers measured previous to the construction of the barrage. According to Bondar et al. (1999 a, b) the total suspended sediment load carried thus now amounts to only 18 million tons/year in the Delta area as compared to the previous 53 million tons/year (also cf. Schwarz 2008). The deepening of the river bed also implies a lowering of the river's water level. Frequently related to this is the disconnection of lateral branches and floodplain areas, shorter flood durations in the remaining recent floodplains and a drawdown of the groundwater level. In some sections the latter becomes apparent by the fact that the biocoenoses' species composition in the floodplain adjusts to that of arid areas.

Climate gradients in the Danube River basin

Hydrological and morphological dynamics are decisive for the succession and spatial spreading of life communities and define the characteristics of the floodplain vegetation occurring along the Danube River. The Danube shows a considerable West-Southeast extension and thus its vegetation composition is not only affected by these ecologically determining factors but also by the continentality gradients of the climate.

This becomes obvious from the comparison of the floodplain vegetation occurring along the varying sections of the Danube River. Whereas the influence of the subcontinental-central European climate prevails on the Upper Danube (abundant summer precipitations and moderately cold winters), the Pannonian lowlands already show a continental influence (moderately poor winter precipitations and relatively frequent years with dry late summers). In the southern regions the central European-submediterranean climate affects the vegetation of this area. In the easternmost Danube region, i. e. in the large “Balta” (Romanian) “Blato” (Bulgarian) (=floodplain wetlands) areas of the Lower Danube as well as in the Danube Delta, the impact of a typically continental climate becomes apparent (summer aridity, frequent frosty winters with little snow) (see also WALTER & LIETH 1964, HORVAT, GLAVAC & ELLENBERG 1974, INST. DE GEOL. SI GEOGRAFIE 1969).
Climatic-biogeographical differentiation of the Danube sections

The influence of these factors on the azonal floodplain vegetation results in a very concise classification of the Danube floodplains. This classification differentiates, with a growing continentality in the eastward direction, by the occurrence of section-specific species. These influences reflect increasingly in the species composition of hardwood floodplain forests and may be anticipated from the occurrence of geographic differential species. The sometimes still gallery-like softwood floodplain stands, however, are more azonal.

The alpine-prealpine Upper Danube (in Baden-Wurttemberg) is characterized by the occurrence of alpine species in the river-attending vegetation that is frequently reduced to a small fringe. The importance of calcareous beech forests is made out by the occurrence of alpine species such as Carex alba and Lunaria rediviva. In some rare places Salix elaeagnos willow and grey alder (Alnus incana), characteristic of dynamic, alpine floodplains, occur as well.

The central European moderately continental upper Danube area is mainly characterized by European respectively central European species of the colline level. Very characteristic of the whole Upper Danube’s pre-alpine area are also numerous alpine plants that have been washed ashore in the lowlands by the Danube’s tributaries. These are partly species of dynamic pioneer stands with large grain sized sediments, among others Salix elaeagnos, German Tamarisk (Myricaria germanica) and grey alder (Alnus incana). Moreover, the hardwood floodplain forests comprise a number of alpine calcareous beech forest species such as Carex alba, the spring pea (Lathyrus vernus), in some places the uncommon Yellow Lady’s Slipper (Cypripedium calceolus), the mezereon (Daphne mezereum), Pleuropspermum austriacum, blue aconite (Aconitum napellus), great masterwort (Astrantia major), yellow aconite (Aconitum napellus), muskroot (Adoxa moschatellina) (see also JANSSEN & SEIBERT 1986, BIRKEL & MAIER 1992, MARGL 1971).

The Pannonian section is much more continental and is characterized by the occurrence of pontic-Pannonian and continental but also submediterranean, thermophilic species. These do already occur partly in the Danube floodplains east of Vienna (see also MARGL 1971). Besides woods such as e.g. the pannonian narrow-leaf ash Fraxinus angustifolia ssp. pannonica, Hungarian Hawthorn (Crataegus nigra), Cornelian cherry (Cornus mas) and bladder nut (Staphylea pinnata), one may also observe Summer Snowflake (Leucojum aestivum), Polygonatum latifolium, Wilde Wine (Vitis sylvestris) and Upright Virgin’s Bower (Clematis recta) (SOÓ 1964-1980, PÓCS 1991, SCHNEIDER 2003). In the Southern area of the Pannonian lowlands thermophilic species such as Black bryonia (Tamus communis), Butcher’s broom (Ruscus aculeatus) and Carpesium abrotanoides point out a submediterranean-illyric influence (see PÓCS 1991). This influence also proceeds in the breach valley area of the Iron Gate (Clisura Dunării), where a submediterranean-illyric characterized rock vegetation occurs with the occurrence of geographic differential species. The sometimes still gallery-like softwood floodplain stands, however, are more azonal.

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Fig. 9: The Danube gorges breaking through the Carpathian Mountains at the Iron Gate (Photo Eckbert Schneider)

Fig. 10: Lilac (Syringa vulgaris) and Flowering ash (Fraxinus ornus), on rocky cliffs of the Rusenski Lom river valley, tributary of the Danube, Natura 2000 priority habitat type: 40A0 (Photo Milko Belbarov)
The transition to the Pontic-Danubian section is smooth and characterized by the occurrence of species such as Moraine Ash (Fraxinus holotricha), Silk Vine (Periploca graeca), Wild Asparagus (Asparagus tenuifolius, A. pseudoscaber), Cynanchum acutum, Liquorice root (Glycyrrhiza echinata). On pioneer stands one may find the Tamarisk (Tamarix ramosissima) that escorts the Danube up to its mouth in the Black Sea (SIMON & DIHORU 1963, SCHNEIDER 1992) and also occurs frequently on the lower courses of its tributaries such as e.g. in the Olt mouth, Ialomita, Buzau and Siret (SCHNEIDER 1991, 2004, DIHORU 2004). Further pontic species may be found in the Danube-Delta, but Irano-Turanian and eastern Mediterranean elements do occur all the same (Fig. 11 and 12).

The Lower Danube

Subdivisions of the Lower Danube

From downstream the Iron Gate to the Delta, the Lower Danube is bordered by initially large floodplain areas that constantly broaden downstream. The floodplain comprises numerous floodplain lakes, water courses, wetlands, gallery forests, levees and sand dune areas, altogether forming a complex called „Balta” in Romanian, and „blato” in Bulgarian (786.000 ha) as well as multitudinous islands in the river. The complexity of the Lower Danube’s flood areas which also determines the natural habitat diversity along this river section is easily perceptible on historical maps. As compared to recent maps they impressively illustrate the extent of the alterations that took place in the course of the 20th century (INSTITUTUL DE GEOLOGIE SI GEOGRAFIE AL ACADEMIEI REPUBLICII SOCIALISTE ROMÂNIA 1969).

Downstream the rocky section of the Iron Gate ensues the section reaching from Gura Văii to the Olt mouth (Izlaz). As compared to the next section it is characterized by low terraces along the floodplain borders. Between Turnu Severin and Calafat the Danube river course shows small meanders before reaching the Danube bend near Calafat. It comprises the broad dune area near Ciuperchi-Desa which is subject to constant changes as a consequence of mobile sands. The structures found here are characteristic of large dune areas offering a broad diversity of habitats in a complex of dune ridges and dune valleys with varying directions and moisture. Characteristic dune areas of the Gura Văii to Olt mouth section are those near Balta Luminosa/ Bechet and Dăbuleni. This section is also characterized by floodplain lakes, so e.g. the Bistret lake in the “Balta” area of the same name and the Potelu lake situated in the so-called “Balta Potelu” wetland area (BÂLTEANU & DUMITRAŞCU 2008, INSTITUTUL DE GEOLOGIE SI GEOGRAFIE AL ACADEMIEI REPUBLICII SOCIALISTE ROMÂNIA 1969).

The next section reaching from Izlaz on the Olt mouth to Călărași is straighter and is characterized by the fact that dunes are almost completely lacking. On this Danube section numerous smaller and larger islands become apparent and the floodplains are already broader. From Giurgiu they are considerably broader as compared to the Olt section on the right side of the Olt river in the Oltenia area. The floodplains were criss-crossed by numerous smaller and larger water courses and comprised numerous floodplain lakes of various sizes so as e.g. Balta Suaia, Balta Mahâru, Balta Gereaca and Izezerul Călărași.

The section of the Balta Borcei (Ialomitei) and Balta Brălei areas are very broad and comprise a distinct morpho-hydrological variety as a result of the Danube bifurcation in two main arms, numerous islands, small water courses “Gârla”, flood channels as well as larger and smaller floodplain lakes. As for their surface, these were the broadest floodplain areas of the Lower Danube that were dyked and transformed into agricultural land.

The section downstream between Brăila and Tulcea, i. e. the so-called Isaccea floodplain, comprises numerous limans situated left of the main branch. The last river section comprises the Danube Delta with its three main branches, levees, depressions, lakes, smaller and larger water courses as well as the dune complexes adjacent to the Black Sea.

Characteristics of the floodplain habitat types on the Lower Danube

In the floodplain transect reaching from the lowest vegetation levels around mean water level to the highest levels, the vegetation distribution corresponds to the hydrological dynamics and the dynamics of sediments with varying grain sizes. Flood depth, duration, moment and frequency play an important role at this. Even though man-induced changes occurred and near-natural floodplain forests have been transformed into hybrid poplar cultures, a vegetation distribution along ecological gradients becomes distinctly apparent.

When considering the historical situation, i. e. the time when the broad Lower Danube floodplains...
had not yet been cut off from the river, drained and transformed for agricultural use, it becomes apparent that given the former floodplain extension and the small gradient, larger swamp areas with extended rush and reed stands must have existed in coexistence with forest areas.

The broad diversity of the varying floodplain waters with their long and straight watercourses, flood channels, lakes of various sizes and depths that dry out partly during summer time, is reflected by habitats that show a comparably large diversity as for their aquatic vegetation. Softwood floodplain forests were prevalent along the water courses and the main stream whereas hardwood floodplain forests merely occurred and still occur on the higher natural levees („grinduri de măl”) or on other more elevated floodplain spots. Given that even at the present time floodplain forests occupy large areas in the recent floodplain and particularly on the islands, they will be described in further detail below. In the maps as well particular attention is drawn to them which is visualized by a number of detailed maps (Fig. 13 a–e).
Besides reeds, rushes and floodplain forests, grassland areas with alluvial meadows of couch grass (*Agropyron repens*) and creeping bent grass (*Agrostis stolonifera*) existed in the natural, dynamic floodplain all the same. Extended grassland areas emerged along with the alluvial meadows as a result of floodplain forest clearings and also extended subsequent to the floodplains’ cut-off and drainage. At the present time this applies rather to grasslands used as pastures than to alluvial meadows that were subject to regular mowing. As noted in ancient documents there were real hay meadows in former times. This is witnessed by the one or the other hayrick (characteristic hay barns) in a number of villages along the Danube River.

Real alluvial meadows underlying the rhythm of being flooded and then falling dry again, as is the case on the Central Danube respectively on the Lower Morava River, occur very rarely. On the whole one may assume that these meadows never covered broad areas on a hardwood floodplain forest level and neither did the hardwood floodplain forests themselves. On the Lower Danube the alluvial meadows belonged to the *Alopecurus pratensis*-alluvial meadow type, respectively to a type comparable to that of Cnidion alluvial meadows. These never covered broad areas given the flood duration on the Lower Danube (Fig. 14).

A specific tall herbaceous vegetation is also closely knit to alluvial meadows. It occurs as fringes of hardwood floodplain forests or proliferates in abandoned, uncut alluvial meadows. This tall herbaceous vegetation is edified of the spurge (*Euphorbia lucida*), of *Veronica spicata*, European birthwort (*Aristolochia clematitis*) or liquorice (*Glycyrrhiza echinata*).

Something worth to be mentioned are still the pioneer communities of ephemeral species developing on sand or mud banks that temporarily lay bare at low water levels. They may complete their life cycle within 2-3 months. Depending on the water levels, the so-called vegetation of muddy areas (*Nanocyperion*) may occur yearly or in larger intervals. They comprise many rare species and are also listed as a habitat type of pioneer stands in Appendix I of the Directive on the conservation of natural habitats and of wild fauna and flora. Among the pioneer vegetation species are equally the characteristic macroarthropodes of the respective protosols.

The floodplain forests on the Lower Danube

Large areas of softwood stands with a predominance of White willow (*Salix alba*) are characteristic of the Lower Danube with its extended floodplains, low slopes and fine-grained sediments. They usually develop in the form of simply structured gallery forests along the river and on the islands. Intermediary stages between softwood and hardwood floodplain forests do mainly occur on the islands.

White willow softwood forests occur in two different variants, the flood duration being clearly visible in the species composition of the herbaceous layer. In those places where the flood duration is of about six months the softwood forest is poor in species and structure, with a tree-layer composed only by White willow (*Salix alba*) and presenting a very poor shrub layer. The herbaceous layer is mainly composed of moisture indicators that are well adapted to fluctuating water levels, e. g. *Rorippa amphibia*, *Polygonum hydropiper*, *P. lapathifolium* and *Senecio paludosus*. In places where the flood duration does not exceed four months the structure of the softwood forest is different. In these places one may observe the White willow but also Black poplar (*Populus nigra*), White poplar (*Populus alba*) and locally Grey poplar (*Populus canescens*) on alluvial soils with a high proportion of sand. *Aristolochia clematitis*, a characteristic indicator of sandy soils occurs very frequently in the herbaceous layer.

Here and there along the Lower Danube one may also find gallery-like forests that are characterized by Black Poplar (*Populus nigra*) and White poplar (*Populus alba*) in varying proportions, the Black Poplar (*Populus nigra*) representing smaller ratios (see also Zanov 1992). On sandier floodplain soils the White poplar also forms pure stands rather comparable to the Mediterranean *Salix alba* and *Populus alba* gallery forests as for their forest structure. The latter are listed in Appendix I of the Directive on the conservation of natural habitats and of wild fauna and flora under 92A 0 *Salix alba* and *Populus alba* galleries (Fig. 15).
In willow-poplar and pure poplar stands small-leaved ash (Fraxinus angustifolia) and elm (Ulmus minor) settle in some places and do thus show the transition characteristics from softwood to hardwood floodplain forests. In these forests the herbaceous layer is characterized by Summer Snowflake (Leucojum aestivum).

Due to their lowland river conditions with extensive reed-abundant wetlands, natural hardwood floodplain forests merely occur on high natural river levees, the so called ‘grinduri’, and are thus less expanded as compared to softwood forests (Fig. 16). Moreover, with only few exceptions the hardwood floodplain forests disappeared as a consequence of man-induced changes in the course of the centuries or decades. Only few patches of near-natural hardwood floodplain forests (Querco-Ulmetum) have been left over. In some areas one may merely find single trees or groups of trees, mainly oaks, that give evidence (“martori”) of the former hardwood floodplain forests. They may be found for instance downstream the mouth of Sâiu (Oltu Mic), along the Danube near the village of Năvodari (Teaca), in the Cama-Dinu area, on the river bank between km 510-521, near Greaca, etc. and on the Bulgarian Vardim island. The famous hardwood floodplain forests in the dune areas of Letea and Caraorman in the Danube Delta are very similar to the hardwood floodplain forests of the Lower Danube but nevertheless they present very specific characteristics.

Along the Romanian river stretches of the Lower Danube, hardwood floodplain forests composed of Balkan oak (Quercus pedunculiflora), elm (Ulmus carpinifolia) and locally small-leaved ash (Fraxinus angustifolia) form stands in which the Common oak (Quercus robur) merely plays a subordinated role. In these forests one may also find the Hairy ash (Fraxinus pallisae), the Greek liane (Periploca graeca), the Swallow wort (Cynanchum acutum) as well as the Wilde wine (Vitis sylvestris) which locally forms thick curtains adding a tropical character to the Lower Danube forests. Depending on the microrelief, the herbaceous layer is composed of species with various ecological needs as for humidity, ranging from more or less wet to dry. These hardwood oak-ash-elm forests locally shelter old relict Black poplars, i.e. remnants of the natural Lower Danube floodplain forests, and therefore require special attention from a nature conservation point of view (Fig. 17 and 18).

Due to its hydrological and morphological dynamics and the formation of new sediment banks on the Lower Danube - in particular the growth of already existing islands and the formation of new ones - one may observe many processes on the Danube islands: all evolution processes of pioneer stages in willow stands, the natural regeneration of White and Black Poplar, the formation of gallery-forests like softwood forests and first settlements of hardwood forests, particularly with elm species, in more elevated places. The White willow and Black poplar forests on some small Romanian and Bulgarian islands that emerged on natural habitats without human interference are actual pristine forests, that, together with the pioneer vegetation of ephemeral species in the river bed at low water levels (below the mean water level) reach the highest degree of naturalness. Their development and survival depend on the water level dynamics, on erosion and accretion. They stand at the beginning of a whole series of developments and are the prerequisite for a natural development of floodplain forests. As they have considerably decreased all over Europe, they deserve special attention from the point of view of nature conservation (Fig. 19).
Habitats of community interest

Among the habitat types occurring along the Lower Danube, the following are listed in Appendix I of the Directive on the conservation of natural habitats and of wild fauna and flora. The list comprises all floodplain-specific habitat types plus a number of further habitat types occurring outside the floodplain on the terrace slopes and rocks along the Bulgarian Danube (DONIŢĂ ET AL. 2005, SCHNEIDER & DRĂGULESCU 2005).

1340 Inland salt meadows
Small patches of this habitat type occur in the Danube floodplain, for example near the mouth of the Jiu river into the Danube and near Ghigera. This habitat type may however also be found in some spots of the Danube floodplain. The alterations of the Danube floodplain as a result of interferences in the hydrological regime of the dyked floodplain and a high evaporation as a result of the continental climate effected an extension of the saline spots along the Lower Danube.

2340 * Pannonic inland dunes
The habitat type which includes dunes of the Pannonic plain and neighbouring basins is represented on the Lower Danube in the large dune area of Ciuperenci-Desa downstream of Calafat, near Balta Luminosă/ Bechet and in the area of Dăbuleni.

3150 Natural eutrophic lakes with Magnopotamion- or Hydrocharition-type vegetation
This habitat type that includes old Danube branches and oxbow lakes occurs in different areas of the former and the recent floodplain on the Lower Danube (Fig. 20).

3260 Watercourses of plain to mountain levels with Ranunculion fluitantis and Callitricho-Batrachion vegetation
This habitat type occurs more rarely in the floodplains of the Lower Danube, it is however characteristic of smaller water courses and has been observed in the surroundings of Corabia (Fig. 21). Along small groundwater streams that may be observed in the form of hillslope seepage along the floodplain borders one may also find a habitat type that shelters the watercress (Nasturtium officinale).

3270 Rivers with muddy banks showing Chegiodon rubri pp. and Bidention pp. vegetation
This habitat type occurs more rarely in the floodplains of the Lower Danube, it is however characteristic of smaller water courses and has been observed in the surroundings of Corabia (Fig. 21). Along small groundwater streams that may be observed in the form of hillslope seepage along the floodplain borders one may also find a habitat type that shelters the watercress (Nasturtium officinale).

6120 * Xeric sand calcareous grasslands (in association with non-coastal dune complexes)
This habitat type comprises open stands of grasses and herbs which, as pioneer associations, are bound to xeric and calcareous sands. Along the Lower Danube it may be observed in the river’s dune areas of Ciuperenci-Desa, near Balta Luminosă / Bechet and Dăbuleni.

6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco Brometalia)
This habitat type comprises grassland associations of arid and semi-arid stands which are classified with Festuco-Brometalia. It occurs along the floodplain borders on the slopes of the loess terraces.

6430 Hydrophilous tall herbaceous fringe communities of the plains and montane to alpine levels
This habitat type comprises moist tall herbaceous fringes, mainly composed of nitrophilous species that occur along the borders of the area’s floodplains. Most frequent are fringes of Glechometalia and Convolvuletalia where the spurge Euphorbia lucida occurs as well.
single oak logs are extremely valuable as from a nature conservation point of view and deserve closer attention. To name only a few exemplary spots one has to mention the remainders next to the Sâiu (Oltu Mic)-mouth, along the Danube near the village of Năvodari (Tecă), next to the Vedea river mouth (km 540), in the Cama Dinu area, on the river bank between km 510 and 524, near Greaca downstream Giurgiu, near the Argeş river mouth, on the Bulgarian islands of Belene and most of all Vardim (Fig. 26).

6440 River valley alluvial meadows of the Cnidion dubii

Temporarily inundated floodplain meadows of this type are very rare on the Lower Danube and do only occur in very small areas along hardwood floodplain forests (e.g. in the nature reserve Cama-Dinu upstream Giurgiu, river km 510-520). Even though they rather show transition characteristics of Cnidion meadows to lowland alluvial meadows (habitat type 6510), they may count among the Cnidion meadows given that they shelter characteristic species such as Clematis integrifolia, Galium rubioides, Carex praecox, common skullcap Scutellaria galericulata, Veronica spicata and others (Fig. 23, 24 and 25).

6510 Lowland hay meadows/meadows of low altitude (Allopecurus pratensis, Sanquisorba officinalis)

Lowland meadows of this type occur rarely on the Lower Danube and usually show transition characteristics towards actual alluvial meadows of the Cnidion type.

91F0 Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia along the great rivers (Ulmion minoris) 

On the Lower Danube one may only find remains of hardwood floodplain forests that are composed of oak, elm and ash. Even though they were never really prevalent, fact is however that oak-elm forests existed in some sections but have unfortunately been cleared. The last remains of this type of forest which frequently is merely documented by a few new sand areas do constantly emerge. From the Olt mouth one may find these shrubs that regenerate naturally in small areas. Tamarisk bushes may be found along the lower reaches of the tributaries, e.g. along lalomita, Siret and other smaller rivers of the Danube River catchment area.

92A0 Salix alba and Populus alba galleries

Even though this habitat type is classified as floodplain forest with Mediterranean characteristics in the Mediterranean deciduous forests group, it may be considered as a characteristic habitat type of the Lower Danube.

On the Lower Danube this habitat type shows a transition character between the typical Mediterranean gallery-like riparian forest and those of the Lower Danube and its tributaries. On sandy spots along the Danube River this habitat type has well developed in parts (Fig. 27).

91M0 Pannonian-Balkanic turkey oak-sessile oak forests

This habitat type is not characteristic of the Danube floodplain but occurs along the slopes of the Bulgarian Danube valley.

92D0 Southern riparian galleries and tickets (Nerio-Tamaricetea and Securinegion tinctoriae)

Tamarisk shrubs (Tamarix ramosissima) occur along the Lower Danube and its tributaries, especially in places with a great dynamics where
Remarks on fauna

The diversity of habitats and their spatial structures are the basis for a broad variety of plants and animal species. This is true both for the aquatic and semi-aquatic and also for the terrestrial fields. And this is the case even though the Danube River and its floodplains have to be considered as two different units that are yet closely interwoven.

The Danube’s invertebrate fauna occurring downstream the Iron Gate offers a number of fauna elements that are characteristic of this section. For instance among the amphipode crustaceans a number of pontic-caspian elements (CÂLINESCU 1969) have to be pointed out. The fauna inventory of both the invertebrates in the waters and the floodplain (Fig. 28) as also of the vertebrates is very comprehensive and has been elaborated in various manners and qualities.

In the fish zone map showing the Romanian waters the Danube River emerges as a characteristic Cyprinid region (CÂLINESCU 1969, BĂNĂRESCU 1976). Cypriniformes are semimigratory fish that regularly visit the shallow, inundated floodland areas, the so-called „Intinsuri” for spawning purposes. In the early 20th century Antipa emphasized the floodplains’ importance for Cyprinids and pointed out that the fish production depends on the extent of the floods, of the inundation height and duration (ANTIPA 1910). Besides the Cyprinids with semi-migratory species such as Carp (Cyprinus carpio), Bream (Abramis brama), Roach (Rutilus rutilus carpatho-rossicus), White bream (Blicca bjornii), Pîkperch (Sizostedion luciperca), Asp (Aspius aspius) and others that are also significant as from an economical point of view, a number of further fish species occurs in the Danube River as well. Among the species that have to be mentioned are most of all anadromous species that migrate from the Black Sea into the Danube and up to their spawning grounds which for some species are hard, rocky substrates upstream. These species occur rarely in the Balta areas of the Lower Danube. Special attention has to be drawn to the dramatically threatened sturgeon species such as the Stor sturgeon (Acipenser stellatus), Black Sea sturgeon (Acipenser gueldenstaedtii) and Beluga sturgeon (Huso huso). Moreover there is a fourth species, the Sterlet (Acipenser ruthenus), it lives as pure freshwater fish in the Danube and merely undertakes short-distance migrations for spawning. Further anadromous species are Sea trout (Salmo trutta trutta) and Danube herring (Alosa pontica). According to a listing compiled by the Antipa Museum (in: SCHNEIDER, KNOBEN, KOPPELMAN, NICHERSU, CHENDEŞ, TATOLE, KEUKELAAR/edit 2004) 31 fish species have been recorded compared to 51 species recorded in the first half of the 20th century. The cutting-off of the floodplains from the river dynamics of the Danube implied a dramatic decrease in fish populations and a decline of river fishery.

Recent data collections gathered in the Danube section between Timoc mouth and Cârlăraşi (SCHNEIDER, KNOBEN, KOPPELMAN, NICHERSU, CHENDEŞ, TATOLE, KEUKELAAR/edit 2004) showed 10 amphibian species, 7 reptile species as well as 160 bird species, the latter being surely even higher. Among them are numerous species that occur on the Appendix lists of the European Council Directive on the conservation of wild birds and bear special importance within the frame of the NATURA 2000 network. SPAs have been proposed for these species (see maps SPA and SCI on the following pages). Among the species of Appendix I of the European Council Directive on the conservation of wild birds the following have to be mentioned: White and Dalmatian pelican (Pelecanus onocrotalus, Pelecanus crispus), Great white egret and Little egret (Egretta alba and Egretta garzetta), Squacco heron (Ardeola ralloides), Purple heron (Ardea purpurea), Glossy Ibis (Plegadis falcinellus), Spoonbill (Platalea leucorodia), White stork (Ciconia ciconia), Black stork (Ciconia nigra), White tailed eagle (Haliaetus albicilla), Circus aeruginosus, Black-winged stil (Himantopus himantopus), Avocet (Recurvirostra avosetta), Kingfisher (Alcedo atthis), European roller (Coracias garrulus) and others.

Among the mammals the species to be mentioned are mainly the European otter (Lutra lutra), which occurs in large populations on both sides of the Danube and some of its tributaries (on the Yantra river in Bulgaria five propagable female specimens have been found per 10 km section). In the dry areas of the former floodplain Ground squirrels (Spermophilus citellus) can be found. Bat species do also occur on the Danube, so e.g. Rhinolophus hipposideros, R. mehelyi, Myotis emarginatus, M. mystic and Miniopterus schreibersi. All these species are listed in Appendix II of the Directive on the conservation of natural habitats and of wild fauna and flora, and whose conservation requires the designation of Special Areas of Conservation (Fig. 29, 30, 31 and 32).
Natura 2000 in Romania and Bulgaria: Special Protected Areas (SPA) following Bird Directive

ID SPAs in Bulgaria
BG1 Golia ostrov
BG2 Ribarnitsi Orsoya
BG3 Zapaden Balkan
BG4 Tsibarsko blato
BG5 Ostrov Ibisha
BG6 Zlatiata
BG7 Ostrov do Gorni Tsibar
BG8 Berkovitsa
BG9 Vrachanski Balkan
BG10 Ponor
BG11 Karlukovski karst
BG12 Gorni Dabnik-Telish
BG13 Studenetz
BG14 Devetashko plato
BG15 Obnova
BG16 Nikopolsko plato
BG17 Ostrov Lakat
BG18 Complex Belenski Ostrovi
BG19 Svishtovsko-Belenska nizina
BG20 Ribarnitsi Hadzi Dimitrovo
BG21 Ostrov Vardim
BG22 Ribarnitsi Mechka
BG23 Lomovete
BG24 Ludogorie
BG25 Ovcharovo
BG26 Complex Kalimok
BG27 Ostrov Pozharevo
BG28 Blato Malak Preslavets
BG29 Garvansko blato
BG30 Srebarna
BG31 Provadiysko-Royaksko plato
BG32 Harsovska reka
BG33 Suha reka
BG34 Varnensko-Beloslavsko ezero
BG35 Galata
BG36 Batova
BG37 Chairya
BG38 Balchik
BG39 Belite Skali
BG40 Kaliakra
BG41 Shablenski ezeren complex
BG42 Durankulashko ezero

ID SPAs in Romania
RO1 Gruia - Gârla Mare
RO2 Maglavit
RO3 Valea Oltului
RO4 Valea Oltului - Livada de Jos
RO5 Suhaia
RO6 Valea Oltului - Livada de Jos
RO7 Valea Oltului - Livada de Jos
RO8 Valea Oltului - Livada de Jos
RO9 Valea Oltului - Livada de Jos
RO10 Cheile Dobrogei
RO11 Lacurile Fundata - Amara
RO12 Lacul Bugeac
RO13 Lacul Strachina
RO14 Lacul Oltina
RO15 Lacurile Fundata - Amara
RO16 Lacul Bugeac
RO17 Lacul Strachina
RO18 Lacul Oltina
RO19 Lacurile Fundata - Amara
RO20 Lacul Bugeac
RO21 Lacul Strachina
RO22 Lacul Oltina
RO23 Lacurile Fundata - Amara
RO24 Lacul Bugeac
RO25 Lacul Strachina
RO26 Lacul Oltina
RO27 Lacurile Fundata - Amara
RO28 Lacul Bugeac
RO29 Lacul Strachina
RO30 Lacul Oltina
RO31 Lacurile Fundata - Amara
RO32 Lacul Bugeac
RO33 Lacul Strachina
RO34 Lacul Oltina
RO35 Lacurile Fundata - Amara
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RO44 Lacul Bugeac
RO45 Lacul Strachina
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RO48 Lacul Bugeac
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RO52 Lacul Bugeac
RO53 Lacul Strachina
RO54 Lacul Oltina
RO55 Lacurile Fundata - Amara
RO56 Lacul Bugeac
RO57 Lacul Strachina
RO58 Lacul Oltina
RO59 Lacurile Fundata - Amara
RO60 Lacul Bugeac
RO61 Lacul Strachina
RO62 Lacul Oltina
Natura 2000 in Romania and Bulgaria: Sites of Community Importance (SCI)

- Dealul Alah Bair
- Dealurile Agighiolului
- Deniz Tepe
- Izvoarele sulfuroase marine de la Vama Veche (2 Mai)
- Mangalia
- Parâng
- Platoul Meledic
- Piatra Craiului
- Retezat
- Sfantu Gheorghe
- Siriu
- Stânca Tohani
- Tzibritza
- Vulna Mari - Conacul Balenari
- Zlatiya

- Bilernitzite
- Deleina
- Ostrov Bliznatzi
- Vidbol
- Shishentzi
- Timok

- Bilernitzite
- Deleina
- Ostrov Bliznatzi
- Vidbol
- Shishentzi
- Timok
The terraces have been used primarily for purposes of grain cultivation and viniculture, the latter covering the terrace slopes up to the floodplain border. In the early 20th century, starting from 1910 and until 1945 smaller areas of the floodplain had been delimited by summer dykes that could be overflown, allowing to use these areas as agricultural land. From 1949 parts of the floodplain were cut-off from the river by flood protection dykes. Only from 1960 and even more intensely from 1964 the floodplains were cut-off by dykes from the dynamics of the Danube River on a large scale (BOTZAN 1984, SCHNEIDER 1991) and were provided with irrigation and drainage systems to allow an agricultural use of these surfaces. New ways and structures were thus opened to agriculture. Given the separation of the broad floodplain areas from the river, the Danube kept moving farther and farther away in the perception of the people. The distance between the villages situated at the terrace borders and the Danube River itself could in some places reach up to five kilometers or even more. Some village communities that were characterized by fishery, grassland management and small-scale agriculture were transformed into a more industrial community, where traditional activities disappeared for their major part in the course of the years.

The patterns of use gathered by the Corine program are summarized in the following table:

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<td>Crop areas</td>
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<tr>
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<td>Pastures</td>
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<td>Complex cultivation patterns</td>
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The Lower Danube floodplains, important area for flood retention

During the second half of the 20th century, as has already been mentioned about three quarters of the Lower Danube’s floodplains have been cut-off from the river dynamics and were transformed into agriculturally used areas (fig. 3 and 4). This resulted in the loss of major parts of the retention areas. The most recent exceptional flood events occurred in April-May 2006 and emphasized the impact of lacking retention areas as well as the importance and necessity of a change in attitudes regarding flood control measures (WWF Danube Carpathian Programme 2006). Some dams could not withstand and broke, in other places they have been opened to provide retention areas for the water. The flooded areas are represented in the map (p. 22). Given that only few settlements are located in the Lower Danube floodplains, broad parts of the floodplain areas that are cut-off from the river could in principle be used for flood retention purposes. In the areas situated west of the Olt mouth, where terraces are lower and settlements extend beyond these terraces and up to the floodplain borders, a special protection of these settlements is required. Provided that accurate studies of all parts of the floodplain are conducted, it will be possible to create measures for both an effective flood control and the restoration of floodplain-specific habitats (Fig. 36).

In order to find solutions combining flood control measures, agricultural landuse and floodplain restoration, the Romanian government agreed on a program approved by decision HG N / 1208 of September 6th 2006 providing for the ecological and economic re-dimensioning of the Lower Danube floodplains (REELD). This program encloses the strategy for a sustainable development and comprises three levels: identification, evaluation and adequacy. It refers to:

1. The redefinition of the dykeline with the purpose to protect the localities against floods;
2. The evaluation of the area’s adequacy for economic activities in the polders that have been prepared for this purpose and its redefinition for mixed polder units serving both the purpose of agricultural use and that of controlled flood retention;
3. Restoration respectively reconnection of a number of dyked areas to the dynamics of the Danube River with the purpose to create wetlands with special conservation interest such as e.g. SCI (Sites of Community Interest) and SPA (Special Protected Area following the Bird Directive).
Based on these parameters the Danube-Delta National Institute has been entrusted with the submission of proposals regarding the adequacy of some areas in terms of the three above-mentioned aspects.

The extreme flood of April 2006 that led to quite a few dyke breaches and large-scale inundations clearly revealed the significant flood problems existing on the Lower Danube (Fig. 37). The latter have definitely been aggravated if not primarily created, by the large-scale dyking of the Romanian floodplains in the course of the 1960ies and 70ies.

These dykings have been realized even though Romania, among all those countries, complies best with the requirements for an environmentally sound, sustainable and cost-efficient solution of the flood problems. This solution could at the same time bring about considerable improvements with regard to the European Water Framework Directive and would implement the declarations of intent/assurances for a restoration of the Lower Danube on which the four riparian states agreed on June 5th, 2000. To achieve the goal it would be sufficient to break the present dykes, to let the floods flow into the former floodplain and up to the border of the lower terrace. The former floodplains still comprise broad, interrelated areas that are mainly or completely exempt from settlements (e.g. Balta Bistrița, Balta Potehu, Balta Suhaja, Balta Greaca, etc.).

The potential retention areas cover surfaces of a size so large that they would allow to considerably lower the flood peak even at very extreme floods (e.g. Balta Greaca, about 30,000 ha). They do thus also assume a strong buffer function against alterations of the hydrological regime resulting from climate changes.

Given that expensive inlet constructions would not be required at all and that dyking constructions could mainly be avoided, this solution would be very cost-efficient. The only thing required would be the transformation of the presently agriculturally used areas into areas available for grassland farming, sylvicultural and piscicultural purposes. This would to some extent bring about the re-formation of former Balta (floodplain lakes and wetlands) that would not only be interesting from a piscicultural point of view, but would as well be highly attractive as from the points of view of nature conservation and an environmentally sound tourism. Sedimentation and erosion processes would occur in the restored floodplains and would contribute to a considerable reduction of the Danube River’s pollution. Our hope is that the Romanian government recognizes this historical chance and that it does not allow contrary individual interests to impede its realization.

Fig. 39: Downstream Câlărași-Siliște, where the Danube changes its direction to flow further North and along the Dobrogea rocky foot, the constantly decreasing slope causes deposits of fine sediments. The river bed bifurcates in a meandering main channel and a lateral channel as a result of a strong lateral erosion and favorable conditions for the formation of meanders. The two arms enclose the large Balta Ialomitei with a surface of 80.125 ha. These conditions are also favorable to the formation of islands, which is why numerous smaller islands emerged in the Danube River’s main branch between Balta Ialomitei and the rocky levees of the Dobrogea. As a result, one may find here a floodplain landscape of incomparable beauty and a very abundant and site-specific biodiversity. However, the existence of the islands situated near Seimeni is threatened by the Danube River’s waterway programme (ISPA Project I) (Photo: Eckbert Schneider)
Flooded area along the Lower Danube, April-May 2006 and potential of possible retention area in Romania
**Cartography**

**General information**

The second edition of the Lower Danube Green Corridor Atlas was cartographically updated with the help of (GIS) Geographic Information System from 2005 to 2006 with further additions made in the year 2008. The most significant change compared to the first version of the LDGC Atlas was the integration of information on valuable floodplain forests in Bulgaria and Romania, on Natura 2000 areas and finally - due to the catastrophic flood event in the spring of 2006 – the issue of flood protection.

The reissue of the LDGC Atlas, however, continues to be, just like the first, a comparison between the historical and the current situation on a total of 14 maps on a scale of 1:200 000 along the whole Lower Danube starting from the Iron Gate, distributed as follows:

- **Map sheet 1:** Dobrota-Turnu Severin, river-km 940-850, including on the right river bank the settlements Kladusnica, Kladovo, Rtkovo, Grabovica, Mihaiovac, Dusanovac, Radujevac, Negotin (Serbia) and on the left side the towns Drobeta-Turnu Severin, Hinova, Crivina, Gogoșu, Craiu (Ro);

- **Map sheet 2:** Vidin, river - km 846-754 with the settlements Novo Selo, Gomotarni, Pokrajina, Vidin, Dunavci, Gajtanci, Arcar, Orsova on the right river bank (Bulgaria) and Salcia, Cetate, Calafat, Câpâreni Noi, Poiana Mare on the left river bank (Romania);

- **Map sheet 3:** Lom, river km 760-680 with the settlements Orsova, town of Lom, Kozloduj, Harlec and mouth of the Danube tributaries Lom (on river-km 743), Cibrica (on river-km 716) and Ogosta (on river-km 685) on the right river bank (Bulgaria), and Piscu Vechi, Rast, Bistrița (with lake Bistrița and large Balta Bistrița), Gighera, Ostroveni and mouth of Jiut River (km 690) on the left side of the Danube river (Romania);

- **Map sheet 4:** Corabia, river-km 681-602, with the main settlements Orjâhov, Ostrov, mouth of Iskar tributary (river-km 639), Gigen, Dabovan, Brest, Guljanci and mouth of Vit river (river-km 610) on the right river bank (Bulgaria) and on the left river bank in Romania Dăbuleni, Balta Potela, Orlea, Corabia, Izlaz and mouth of Olt river (on river-km 605);

- **Map sheet 5:** Turuțu Măgurele, river-km 606-525, with mouth of Osam river (on river-km 600), the main settlements Nikopol, Belene, Svishtov, Vardim, Krivina and mouth of Jantara-river (river-km 639) (Bulgaria) and on the left river side the town of Turuțu Măgurele, village Suhia (with lake Suhia and Balta Suhia), town of Zimnicea, mouth of Vedea river (on river-km 540) and village Pietroșani (Romania);

- **Map sheet 6:** Ruse, river-km 530-486, with town of Ruse, mouth of Rusenski Lom river (on river-km 495) on the right river bank (Bulgaria) and main settlements Pietroșani, Vedea town of Giurgiu (km (Romania);

- **Map sheet 7:** Tutrakan, river-km 485-426 with the settlements Marten, Râșnov, town of Tutrakan on the right river bank (Bulgaria) and the large Balta Greaca floodplain area on the left side of the Danube river with three small villages Oinaca, Branțiața, and Gostimu in the floodplain and the other localities Băneasa, Prundu, Greaca, Chirnogi on the terrace border, town of Oltenița and mouth of Argeș river on km 532 (Romania);

- **Map sheet 8:** Oltenița, river-km 448-368, with town of Tutrakan, villages Popina, Srebrarna and town of Silistra on the right river bank (Bulgaria) and on the left river bank mouth of Argeș river, town of Oltenița, rural localities of Ulmiș, Mănăstirea (with Mostițea lake), Dorobanțu, town of Călărași and the large floodplain area of Balta Călărași (Romania);

- **Map sheet 9:** Călărași, river- km 377- 336, with the town Silistra (Bulgaria), and localities Ostrov and Oltina, also the lakes Budea and Oltina (Romania) on the right river bank of the Danube and on the left site the town of Călărași, village Roseți, Jalgalia and Călărași-Râul island area (Romania);

- **Map sheet 10:** Cernavoda, river-km. 337-267, with the large area of Balta Ialomiței, the main localities on the right river bank Dunăreni, town of Cernavoda, Topalu and on the Borcea branch left river side Borcea, Fetești, Boroșani, Făcăieni (Romania);

- **Map sheet 11:** Hârșova (Hîrșova), river-km. 274-208, with part of the large floodplain area of Balta Ialomiței and Balta Brăeiei and the localities Topalu, Ghindărești, town of Hârșova, Cobanu, Dâncu on the Dobrogean right site of the Danube river on the Măcîn branch of the Danube and Vlădeni, Cuza Vodă on the Danube, with mouth of Ialomița river and Călmățui river (Romania);

- **Map sheet 12:** Brăila, km. 209-152, with the downstream part of the large floodplain area of Balta Brăeiei, and a part of Balta Jiului and the localities Penecagă, Caracal, town of Măcin on the Dobrogean side of the Danube on the Măcin branch, and Tulaști, Gropeni, Chișcăni, town of Brăila, town of Galați and mouth of Siret river (km 155) on the left side of the Danube (Romania);

- **Map sheet 13:** Galați, river-km 173-111, with the large floodplain area of Balta Jiului and Balta Cârpața in the so called “Cats bend”area (name from village Pisica-Cat), the town Măcin, lakes Jiulă and Luncavița, on the Dobrogean right bank of the Danube river and town Galați, large floodplain area of Brateș on the mouth of Prut river, Giurgiulești (Moldavia), Reni and floodplain lake Kulul (Ukraine);

- **Map sheet 14:** Tulcea, river-km. 110-71, including the towns Isaccea, village Somova and town of Tulcea on the right river bank of the Danube with the large floodplain area of Balta Somova, and on the left river side the large floodplain lakes area of Kulul and Kugurulă-lapihut, the settlements Nahyrene, Plavni, Ozern, Novonikrasovka, western part of the town of Izmail (Ukraine);

- **Map sheet 15:** Danube Delta, km. 71-0

The projection of all geographic data is based on topographic maps with a scale of 1:5 000 which had been made available to the WWF Floodplain Institute (WWF Auen-Institut) as a result of the study “Evaluation of Wetlands and Floodplain Areas in the Danube River Basin” (UNDP GEF 1999). The map grid of the LDGC Atlas corresponds to the basic maps and is therefore a transverse Mercator projection with bands with a latitude of six degrees and the Krassovsy ellipsoid, Pulkovo Datum. In order to facilitate orientation, geographic indications on the individual maps are made by giving longitude and latitude. A fifteenth, completely new map which shows the whole Danube Delta, scale of 1:200 000, has been added. Information was provided by the National Institute of the Danube Delta, Tulcea. Furthermore, there are maps on a scale of 1:2 mio which provide an overview of the Lower Danube focussing on Natura 2000 areas and on flood protection.
Historical Maps

The earlier layout of the area around the lower Danube, before changes as a consequence of hydraulic engineering were made in the 20th century, can be found on the map sheets 1-14. These were drawn up by using the general map of central Europe made by the Austrian-Hungarian Empire and the Royal Monarchy as well as. These maps have a scale of 1:200 000 and were created between 1889-1915. They show the situation at the beginning of the 20th century in a relatively good quality.

Current maps (Satellite Images)

In order to show the current situation on the Lower Danube, Landsat 7 ETM+ and satellite images from NASA dating from 1999-2001 were used. These data are free to use and part of NASA’s contribution to the global research community and are being provided through Landsat.org and the Tropical Rain Forest Information Center, a member of NASA’s Federation of Earth Science Information Partners (ESIP, source: Landsat.org). For the purposes of the atlas, the channels 1,2 and 3 (BGR) were picked and adequate colours attributed to them. The ground resolution of the satellite images is 30m and is therefore suitable for the scale chosen. The data on the Danube itself and the kilometer indications are taken from nautical maps (“Carte de pilotage du Danube”, 1:25 000, Commission du détroit du Danube, before changes as a consequence of hydraulic engineering were made in the 20th century, can be found on the map sheets 1-14. These were drawn up by using the general map of central Europe made by the Austrian-Hungarian Empire and the Royal Monarchy as well as. These maps have a scale of 1:200 000 and were created between 1889-1915. They show the situation at the beginning of the 20th century in a relatively good quality.

Corine Landcover 2000

Corine Land Cover 2000 (CLC2000) is a pan-european project which provides a comprehensive, harmonised and thus comparable set of data on land use and vegetation. CLC2000 is produced by the European Environment Agency (EEA) and its member countries in the European environment information and observation network (EIONET). It is based on the results of IMAGE2000, a satellite imaging programme undertaken jointly by the Joint Research Centre of the European Commission and the EEA. The Corine land use was mapped on a scale of 1:100 000 and subdivided into 44 land use categories. In order to facilitate the visualisation of the land use in the atlas, these 44 classes of the level-3 Corine nomenclature were reduced to the following five land use categories:

- Settlement (111+112)
- Industrial Area, Mine, Dump, Construction Site, Port Area (121,123,131-133)
- Forest (311-313,322-323)
- Meadow, Greenland: (231,321,324)
- Swamps: (411)

Designation of the former floodplain

The designation of the river terrace was carried out with the help of different data sources and the thousand indications are taken from nautical maps (“Carte de pilotage du Danube”, 1:25 000, Commission du Danube Budapest, 1987).

Dykes and recent floodplains

Topographic maps on a scale of 1:50 000 and additional information from the Danube-Delta Institute in Tulcea, Romania were used to visualise the dykes. With the help of the contours of the dykes and the changed land use which can be made visible by using current satellite images, the recent floodplains for the Lower Danube could be identified and delineated. The major flood event in 2006 helped to verify and, in some places, even improve the recent floodplains which had been identified before. Thus, a relatively precise basis for the delineation of the floodplains had been created for the given scale. This does not imply, however, that the flooded area can also be precisely calculated like when using highly precise elevation models down to under one meter.

The area of the former and recent floodplain for each river terrace can be identified and delineated. The major flood event in 2006 helped to verify and, in some places, even improve the recent floodplains which had been identified before. Thus, a relatively precise basis for the delineation of the floodplains had been created for the given scale. This does not imply, however, that the flooded area can also be precisely calculated like when using highly precise elevation models down to under one meter.

In the following table, the summed area of the former and recent floodplain along the Lower Danube for map sheet 1-14 (Note: sum of floodplains in table 1-14 is larger than total sum in the last table, because of overlapping map sheets)
Flood event 2006

In April and May 2006 an extraordinary flood event took place along the entire Danube river. Huge areas along the lower Danube were flooded for several weeks. These floods were registered by NASA’s weather satellite MODIS (Moderate Resolution Imaging Spectroradiometer) with a resolution of 250m and published in the Internet on rapidfire.sci.gsfc.nasa.gov. The channels of the scenarios for Eastern Europe were evaluated from 05.04-09.05.2006. The WWF Floodplain Institute (WWF-Auen-Institut) calculated and identified the magnitude of the flooded area with the help of Internet publications from the Agenţia Naţională de Meteorologie (AMN) collaboration with the University of Karlsruhe, the images were analysed according to the forest vegetation and verified by using the above mentioned studies and contributions from Erika Schneider. The results are visualised on the general maps by symbols for particularly valuable floodplain forests as well as for some selected areas in a scale of 1:75 000 along the Lower Danube.

Protected areas and Natura 2000

The information on the national and international protected areas along the lower Danube was gathered in the WWF-Danube-Carpathian Programme in cooperation with the project partners in Romania and Bulgaria. The data were already digitally available in the ESRI-shape format and were incorporated without further alterations.

The areas represented in the Lower Danube Green Corridor Atlas are individual Danube River sections with their forested areas, the valuable areas being highlighted, as well as the Natura 2000 areas (SPA’s and SCI’s) on the Romanian and Bulgarian sides. The objective is to point out the geographic situation of the precious areas existing along the Danube River. They are to serve as decision making support with regard to future Danube waterway improvements and indicate sensitive areas that have to be preserved from dramatic interventions as from the point of view of nature conservation and sustainable development.

Fig. 41: Aerial view of the Lower Danube with the islands Batin and Deutzshov, river-km 630 (Photo: archive of the Nature Park Rusenski Lom Authority, Bulgaria)
References


CĂLINESCU, R. (1986): Biogeografia României.- Editura Științifică, București


Lower Danube Green Corridor Maps
**Legend**

**River Based Information**
Informația poșată în râurile

- River Terrace
  Terasea fluviată înălțată
- Terrace Edge
  Limita terasei / rupe la terasa
- Dyke
  Barieră
- Barrage
  Barraj

**585**
Kilometrage of the Danube
Răchiți kilometrări / km
- Water Body
  Corp de apă
- Flooded Area (April/May 2006)
  Arie în zâpetă / aprilie-mai 2006
- International State Border
  Grană de țară
- Port
  Port

**Protected Sites**
Zona protejată

- Protected Site < 500 ha
  Zonă protejată < 500 ha
- Protected Site
  Zona protejată
- Nature Park
  Parc Național
- National Park
  Parc Național
- Biosphere Reserve
  Reservație de biosferă

**Map Basis**
Rază cartografică

**Analysed Forest**
Analizat forestă
Pădure analizată

**Island of special Interest**
Ostrov cu interes speciﬁc

**CORINE LANDCOVER 2000 in BG and RO (Scale Level 3)**

- Settlement
  Calături
  Așezări
- Forest
  Pădure
- Swamp
  Sirena
- Meadow
  Câmpie
- Industrial Area
  Zona industrială

**Additional Information**
Informații adiționale

- Projection: Gauss-Kruger 6-Degrade, Datum: Pulkovo 1942 - România
  Centrul Meridian: 27° East
  Adițional Geographic Coordinates
  Proiecția Gauss-Kruger 6-de grade, Datum: Pulkovo 1942 - România
  Centrul meridian: 27° est

**Scale**
Scara

- 1:200 000
WWF’s mission is to stop the degradation of the planet’s natural environment and to build a future in which humans live in harmony with nature, by:
- conserving the world’s biological diversity
- ensuring that the use of renewable natural resources is sustainable
- promoting the reduction of pollution and wasteful consumption