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EXPERIENCES IN FOREST
LANDSCAPE RESTORATION (FLR)

Lessons Learnt from 20 Years of Floodplain Forest Restoration: the Lower Danube Landscape

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WWF is one of the world's largest and most experienced independent conservation organizations, with over 5 million supporters and a global Network active in more than 100 countries.

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, and promoting the reduction of pollution and wasteful consumption.

PREFACE

The mesmerising and mighty Danube River has captured the imagination of many poets, musicians and other artists. It stamps its mark across much of Europe crossing diverse cultures and geographies from Germany to Ukraine. Home to a multitude of species, it is also an important migratory corridor for such critically endangered species as sturgeons.

Riparian and floodplain forests present along the Danube are particularly important for the broad myriad of ecosystem services they provide. Some examples include protection of human settlements from floods, securing water quality and contributing to healthy fisheries. However, decades of mismanagement, in particular within the agricultural and forestry sectors, have had devastating impacts on these forests. Monoculture plantations of hybrid poplars and exotic tree species narrowed the set of benefits for nature and communities. Dykes built to gain agricultural land have dried up multi-functional riparian habitats and decreased the water retention capacity of floodplains. The price is high: more frequent flooding, loss of soil fertility, species and habitat decline.

WWF has been working in the Danube Region since the early 1990s. Wetland and riparian forest restoration has been a priority from the outset. We have brought together diverse governmental and non-governmental stakeholders across borders and sectors to jointly plan and implement conservation projects that aim to restore natural processes. As observer to the International Commission for the Protection of the Danube River (ICPDR), a high-level platform for 14 countries and the European Union, we have successfully pushed restoration up the political agenda. We have used our excellent relations at the European Commission to increase compliance with EU nature and water legislation calling for ecosystem restoration. Simultaneously, we have collaborated closely with local stakeholders to make restoration beneficial to both nature and people.

As this report demonstrates, we have been involved in numerous small-scale restoration actions along the Lower Danube. Each on its own may not appear to bring about sufficient change, but taken together, their value is enhanced and they provide much needed knowledge. Ultimately, sharing this information with our partners will make future landscape restoration projects of this kind more effective.



Irene Lucius,
Regional Conservation Director
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EXECUTIVE SUMMARY

Lessons Learnt from 20 Years of Floodplain Forest Restoration: the Lower Danube Landscape



The last stretch of the Danube river – the Lower Danube – extends along 1000 km across Bulgaria, Romania, Moldova and Ukraine before it flows into the Black Sea. Numerous islands dot the river along this section. Decades of human modification of the natural landscape have left the islands, the river and its banks degraded. These modifications have included conversion to agriculture, to hybrid poplar mono-culture plantations, introduction of non-native invasive species, infrastructure such as dykes, and pollution.

Riparian forests, along the banks of the Danube and floodplain¹ forests are important habitats for birds, fish and other wildlife, protect the riverbanks from erosion and act

as a filter for water quality. Furthermore, natural floodplain and riparian forests protect coastal settlements from natural disasters, most notably from flooding.

In 2000, a joint declaration was signed by the Environment Ministers of Bulgaria, Romania, Ukraine and Moldova to establish a Lower Danube Green Corridor. This agreement commits the four countries to preserve a total of 935,000 ha, including enhanced protection for 775,000 ha of existing protected areas and new protection for another 160,000 ha; to restore 223,000 ha of former wetland areas; and to promote sustainable development along the Lower Danube. It provided the backbone for restoration activities to take place in the wider Lower Danube corridor or landscape. Over the course of the following two decades a series of projects have been implemented within this overarching framework, many of which have tackled alignment with EU legislation such as the 1992 Habitats Directive.

WWF's active involvement in forest landscape restoration (FLR) in the region started at the turn of the 21st century when it collaborated with the World Bank to influence the Bulgarian Danube forestry strategy which eventually led to the above declaration. Initial activities in the late 1990s and early 2000s focused on building a constituency to promote restoration of the Lower Danube corridor. State employees from both forestry agencies and protected area agencies, received training in active and passive restoration of a broad range of native species. Restoration involved policy work, training workshops, but also active removal of dykes and sources of degradation, and trials on relatively small plots to determine best methods for the restoration of forest dynamics. Activities have included numerous field-based interventions, site preparation, removal of invasive species and both passive and active restoration, even though it did not necessitate the plantation of a large number of trees. Economic studies have demonstrated that the benefits of restoration, in terms of ecosystem goods and services secured, and disaster mitigation, far outweigh the costs.

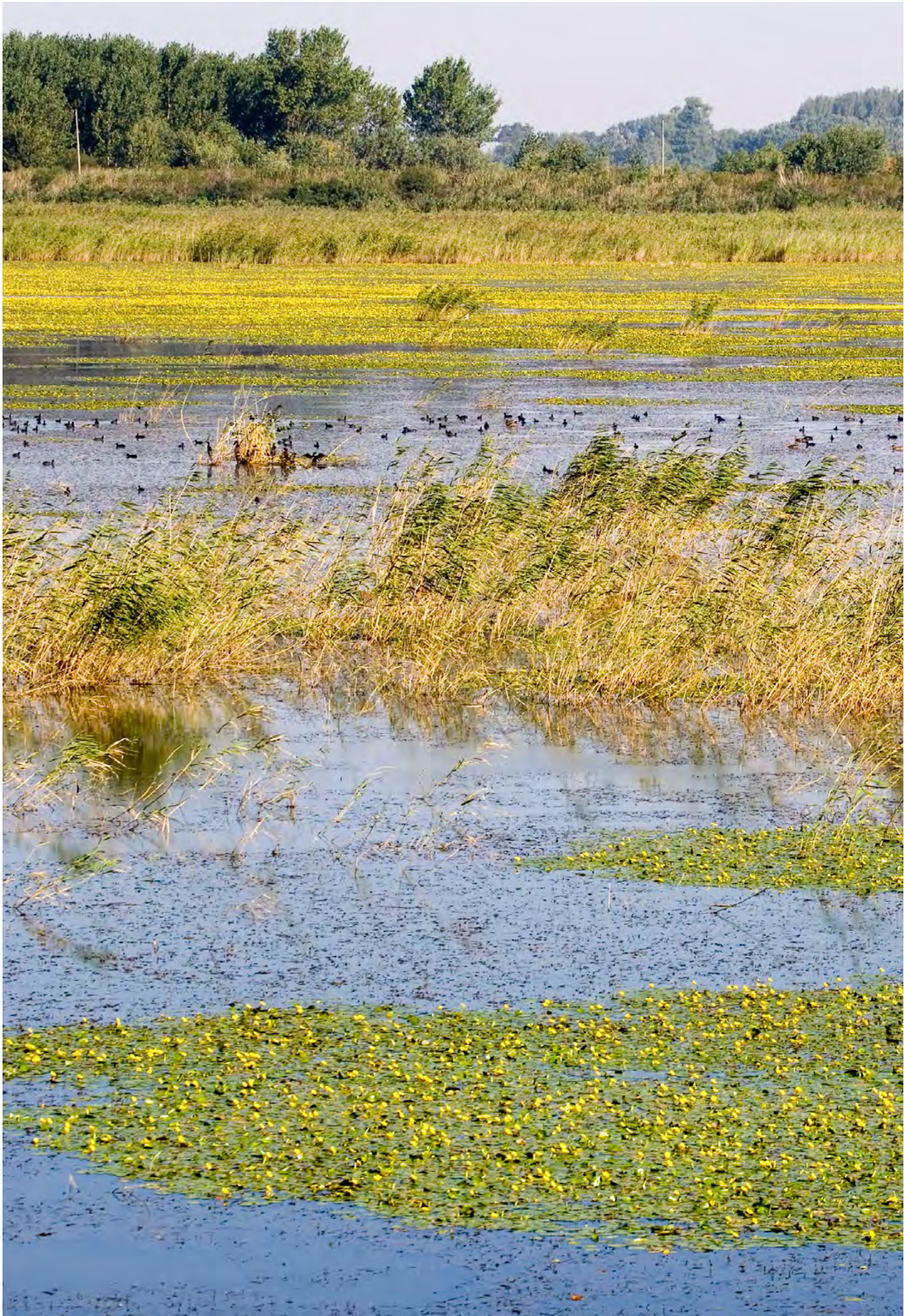
Several actors have been involved in different restoration projects, including communities and children who have engaged in tree planting, cleaning and clearing processes. However, the main actors have been public sector land managers from the forestry and the environment departments.

In this complex, multi-country context, where the fate of forests is not only dependent on humans, but also on the hydrological cycle, a number of lessons can be highlighted.

¹ Land alongside a stream which is flooded when the streamflow exceeds the water-carrying capacity of the channel (WMO, 2012). In our case, the floodplain considered is a relatively narrow strip (5 to 10 km) of floodable land lying along the 1000 km of the Lower Danube. The area (935,000 ha) includes the river bed, the islands, the banks and adjacent land.

Key lessons learnt over the course of this project are:

- 1 **Variable perceptions make the ‘landscape’ definition challenging:** A landscape is not necessarily well defined by its size in ha or km². As social constructs, landscapes do not have widely-accepted boundaries and the framing of these boundaries in FLR may be perceived differently.
- 2 **Site-based interventions within the landscape can help to initiate FLR:** Even if a more detailed and jointly agreed planning and prioritisation exercise is not yet complete, site-based restoration interventions can contribute to demonstrating and testing approaches, as well as providing capacity building opportunities.
- 3 **Site-based activities can provide an important connectivity function in the restoration of river systems:** Prioritising the restoration of riparian zones in a river system may provide multiple benefits (such as new habitats for species, flood control, improved water quality, migratory routes for biodiversity) and enhance ecological connectivity.
- 4 **Juggling multiple parameters is central to floodplain forest restoration:** The specificity of floodplain forests and associated ecosystems (water, wetlands) signify that there is a need to adapt to the complexity of feedback loops across the ecosystems.
- 5 **Valuable insights into locally-viable techniques can be gained by testing and monitoring innovative restoration approaches:** Small scale pilot restoration efforts allow the testing of different restoration approaches prior to scaling up.
- 6 **Restoration often requires first stopping or reversing degradation:** Restoring a habitat may first signify the removal of infrastructure or other causes of ecological degradation.
- 7 **Transboundary collaboration can be achieved through institutional mechanisms at various levels:** Due to their strategic nature, intervening in transboundary areas can be sensitive and the support of internationally-accepted institutional mechanisms is required to accelerate implementation.
- 8 **A formal plan or strategy can be an effective facilitator for field-based restoration:** Even a relatively broad or general plan or strategy for FLR at the landscape level contributes to field-based restoration progress.
- 9 **Conflicting policies across sectors are more likely in complex landscapes that embrace multiple ecosystems:** The conflict across sectoral priorities can prevent effective floodplain restoration and even compromise the effectiveness of restoration actions.
- 10 **Natural regeneration is a cost-effective tool for restoration:** Lessons to date have shown that natural regeneration is viable but only under certain conditions.
- 11 **Restoring forest dynamics does not always mean more trees and tree cover:** In ecosystems where water and wetlands are intertwined with riparian and floodplain forests, recovering functions could mean leaving space for other ecosystems.
- 12 **Anticipating an exit strategy:** For the key proponents in an FLR intervention, exiting from the landscape is a necessity at some point and needs to be well planned to safeguard achievements and secure continuity.
- 13 **Forest landscape restoration is a challenging long-term effort that requires attentive planning, implementation and monitoring:** Engaging stakeholders in decision-making at different levels is essential to secure success in FLR.



INTRODUCTION

The mighty Danube river snakes across Europe along 2,850 km from Germany in the west right to its vast delta on the Black Sea in the east – a UNESCO biosphere reserve – in Romania and Ukraine. Overall the Danube River Basin crosses 19 countries and covers about 80,000,000 ha – 10% of continental Europe (ICPDR, 2015). This vital waterway is important for wildlife, but also for people. As many as 80 million people live within the Danube basin, many of whom depend on the Danube for drinking water, energy production, agriculture and transport.

Riparian forests, along the banks of the Danube, and floodplain² forests present also on the Danube islands, are important habitats for birds, fish and other wildlife, protect the water from erosion and act as a filter for water quality more generally. It is difficult to place a value on the services that floodplain forests provide, but for example, the carbon sequestration value alone of the entire Danube basin was recently estimated at EUR 29 million per year (Tucker *et al.*, 2010).

Numerous islands covered in forests lie dotted along the river. A recent inventory of these Danube islands (WILDisland map) has mapped a total of over 900 islands along the Danube River covering an area of more than 138,000 hectares. These floodplain habitats represent a home and a vital nursery for fish, and in turn for fish-eating birds (Kavrakova, 2003). Yet, as economic interests have prevailed, agriculture, forestry and transport, have removed natural forests along the river banks and on the islands, altered the river's natural geomorphology, hydrology, chemistry, vegetation and overall ecosystems. As a result, over a period of approximately 100 years, the extent of floodplains has been reduced by 68% (Hein *et al.*, 2016), and floodplain and riparian forests have become scarce. Invasive species are also a major and growing threat to the delicate floodplain ecosystems, caused in large part by the natural water flow transporting their seeds and by transport vessels along the river inadvertently carrying these species and dispersing them along the river.

Three distinct sections of the Danube River Basin have been described based on geologic and geographic conditions: the Upper Danube from the source in the Black Forest in Germany to the confluence with the Morava River near Bratislava ('Porta Hungarica'); the Middle Danube which extends from Bratislava to the border between Romania and

The extent of natural habitat in floodplains, especially riparian forests, has been drastically reduced.

² Land alongside a stream which is flooded when the streamflow exceeds the water-carrying capacity of the channel (WMO, 2012). In our case, the floodplain considered is a relatively narrow strip (5 to 10 km) of floodable land lying along the 1000 km of the Lower Danube. The area (935,000 ha) includes the river bed, the islands, the banks and adjacent land.



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**FURTHER TO
TRANSNATIONAL
AGREEMENTS, SITE-
BASED RESTORATION
PROJECTS HAVE
CONTRIBUTED TO
RESTORING THE LOWER
DANUBE LANDSCAPE**

Serbia; and finally, the Lower Danube stretching from the Romanian floodplains downstream of Călărași -Siliștriu (border between Romania and Bulgaria) onto the delta in the Black Sea (Mölder and Schneider, 2011). While connected, each section can be viewed as a distinct ecoregion or several functional landscapes.

Starting in 1998, in recognition of the poor conservation status of the Lower Danube's forests, the Bulgarian National Forestry Board (NFB), the Ministry of Environment and Water (MoEW), Green Balkans and WWF came together under a Wetlands Working Group with the aim to coordinate and support floodplain and wetland conservation and restoration in the Bulgarian part of the Danube basin. It led to the drafting of a joint declaration signed by the NFB, MoEW and the Ministry of Rural Development and Public Works (MRDPW), on the importance of Danube wetlands and the need for their conservation, restoration and sustainable management which was signed by over 130 environmental NGOs. By 2000, thanks to this momentum, another declaration was signed by the Environment Ministers of Bulgaria, Romania, Ukraine and Moldova to establish a 'Lower Danube Green Corridor'. This agreement commits the four countries to preserve a total of 935,000 ha, including enhanced protection for 775,000 ha of existing protected areas and new protection for another 160,000 ha; to restore 223,000 ha of former wetland areas; and to promote sustainable development along the Lower Danube (WWF website and ICPDR website)

Further to this agreement, a number of site-based restoration projects have contributed to the overall effort to restore the Lower Danube corridor or landscape. Planning at the scale of the Lower Danube corridor has provided the political and strategic context within which individual restoration actions could integrate into one coherent landscape.

Forest landscape restoration (FLR) was initiated in Bulgaria in 1999 with attempts to create the right policy environment to support large scale restoration and connectivity in the context of the Lower Danube. The term 'forest landscape restoration' was defined in 2000 by a group of experts brought together by WWF and IUCN as "a planned process that aims to regain ecological integrity and enhance human wellbeing in deforested or degraded landscapes" (WWF and IUCN, 2000).

The emphasis in this report is on Bulgaria where most of WWF's FLR work was initiated. However, some information on the three other Lower Danube Green Corridor countries (Moldova, Romania and Ukraine) is also included.

FLR in WWF's Global Forest Programme

WWF's 'Forests for Life' programme during the period 2001-2006 centred around three global targets: protected areas, sustainable forest management and FLR. The FLR target was "to undertake at least twenty FLR initiatives in the world's threatened, deforested or degraded forest regions to enhance ecological integrity and human well-being by 2005". WWF contributed specific steps along the way to this global target, including leading the implementation of 10 long-term FLR initiatives.

Outside the WWF network, much has been achieved at an international level to raise the political profile of FLR and to advance technical understanding through implementation in key landscapes (Mansourian and Vallauri, 2014).

Today, WWF's global forest strategy includes as one of its ambitions to contribute to the international effort to restore '350 million hectares of forest landscapes' by 2030 (New York Declaration on Forests and Bonn Challenge on FLR). These global efforts aim to reverse the trend of forest loss and degradation by putting an emphasis on restoring the ecological functions of degraded forest landscapes.

PRESENTATION OF THE LANDSCAPE

The Lower Danube stretches for approximately 1000 km primarily across Bulgaria and Romania (forming the political border), but also through Moldova and Ukraine (Figure 1). Overlapping landscape designations exist in the area, reflecting the diversity of stakeholder views (both politically, but also between scientists focusing on the freshwater resource, and those focusing on the forest resource):

- From a hydrological perspective, the freshwater ecoregion entitled the 'Dniester-Lower Danube' encompasses the basins of this stretch of the Danube as well as that of the Dniester and extends across 13 countries. This ecoregion contains a number of functional landscapes. For WWF (Schneider *et al.*, 2009), the Lower Danube floodplain, while once representing 817,300 ha (and the delta another 540,200 ha), now extends only 599,200 ha – including the delta – as a result of human activities;
- In turn, for the governments which signed the Lower Danube Green Corridor Declaration, no specific area is given, but the Lower Danube Green Corridor is understood as being a mixture of: a) areas under strict protection; b) buffer zones in which human activities could be permitted and degraded areas restored; and c) areas where sustainable economic activities could be developed. The Declaration further commits to maintaining 773,166 ha of existing protected areas, adding a further 160,626 ha of new protected areas, and 223,608 ha of proposed areas for restoration – making up a total of 1,157,400 ha;
- Numerous islands covered in forests lie dotted along the river. A recent inventory of these Danube islands (WILDisland map) has mapped a total of over 900 islands along the Danube River covering an area of more than 138,000 hectares. The fact that none of the Danube islands are inhabited (except for the notorious Belene island which hosts a prison) and that land is mainly state-owned, somewhat simplifies the social definition of the landscape.

In conclusion, the boundaries of the Lower Danube landscape prioritised for restoration activities are flexible. Policy, strategy, awareness and communication activities have focused on the landscape of the Lower Danube Green Corridor Declaration. Field interventions in turn have focused along the banks of the river and the floodplain forest on the islands (Figure 2). The wider landscape which reaches further inland from the river is however, important for planning purposes and for understanding historical changes as well as secondary drivers of forest and wetland loss.

**BOUNDARIES OF THE
LOWER DANUBE
LANDSCAPE ARE
FLEXIBLE, DEPENDING
ON THE ACTIVITY
CONSIDERED**

How is a landscape interpreted?

Landscape ecology and large-scale environmental management have gained momentum in the last two decades. However, defining what is a landscape can still be tricky, as no single definition exists. A landscape is not necessarily defined by its size in ha or km², and the term 'landscape' has ecological, political and socio-cultural dimensions.

In this document, following Chatterton *et al.* (2016), we define a landscape as “a socio-ecological system that consists of natural and/or human-modified ecosystems, and which is influenced by distinct ecological, historical, economic and socio-cultural processes and activities”. Thus, a landscape contains heterogeneous characteristics and land-uses but the main drivers influencing its overall functioning contribute to its practical delineation.

This landscape approach creates a “framework whereby stakeholders in a landscape aim to reconcile competing social, economic and environmental objectives” (Chatterton *et al.*, 2016) to reverse the identified degradation of ecological integrity and human well-being.

Unique characteristics distinguish this part of the Danube from the more Alpine Upper Danube. The floodplain is made up of diverse lakes, water courses, wetlands, gallery forests, levees and sand dunes. Forests represent important migration corridors crucial for the dispersal of many species. A total of 5,137 species have been identified along the lower stretch of the river, including 42 different species of mammals, such as the near threatened Eurasian otter (*Lutra lutra*), the critically endangered European mink (*Mustela lutreola*) and the steppe polecat (*Mustella eversmanni*) and 85 species of fish, including five different sturgeons (Sommerwerk *et al.*, 2009; ICPDR website). The Danube Delta alone harbours about 1800 plant species and about 3500 animal species (Nichersu, 2006 in Hein *et al.*, 2016). About 30 million people live in the Lower Danube region, and are heavily reliant on the ecosystem goods and services provided by the river. Many local villagers rely on agriculture and fishing for their livelihoods.

The floodplain is made up of diverse lakes, water courses, wetlands, gallery forests, levees and sand dunes.



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Migrating birds, like the European roller after its wintering in Africa, use the Danube corridor, nesting in tree trunks.

Typical forest formations include white willow (*Salix alba*), white and grey poplar (*Populus alba*, *Populus canescens*), as well as some small leaved ash (*Fraxinus angustifolia*) and some black poplar (*Populus nigra*). Some scattered patches of near natural hardwood forests (*Quercus-Ulmetum*) still remain in the Lower Danube, notably on the Romanian side in the floodplains of Balta Greaca and Balta Calarasi, on the Bulgarian Vardim Island, and in the dune areas of Letea and Caraorman in the Danube Delta. On the Romanian stretches of the Lower Danube, hardwood forests include stands dominated by Balkan oak (*Quercus pedunculiflora*) and small-leaved ash, while the common oak (*Quercus robur*) plays a sub-dominant role. The hairy ash (*Fraxinus pallissae*) can also be found in these forests (Schneider *et al.*, 2009).

Here, the forest is shaped by the natural flooding regime and is extremely sensitive to changes in water levels. In turn, floodplain forests create unique conditions that control and influence the transfers of energy, nutrients and sediments between the aquatic and terrestrial ecosystems. They play an important role in maintaining water quality and

in soil protection. Because they are boundary ecosystems, they positively influence the water ecosystems through regulation of temperature and creation of new habitats. The recreational and cultural functions of these forests also merit consideration.

Agriculture, forestry and transport have taken their toll on the naturalness of the Lower Danube. During the second half of the 20th century, close to three-quarters of the Lower Danube's floodplains were cut off from the main river by dykes and were transformed into agricultural areas, with subsequent impacts on flooding regimes and ultimately on the ability of these delicate forest ecosystems to regenerate (Schneider *et al.*, 2009).

Eutrophication resulting from anthropogenic pollution has severely affected the Danube, and in particular the lower stretches of the river. In the early 2000s, estimates suggested that nutrient emissions into the Danube river system were about 70% higher than in the 1950s (Mölder and Schneider, 2011). Conversion of floodplain forest to agriculture and monoculture hybrid poplar plantations has led to more extreme flood events. These events are also expected to increase in intensity with climate change. Already in the year 2010 alone, the severity of floods in the Danube River Basin led to 35 casualties and damages valued at EUR 2 billion (ICPDR, 2012).

Floodplain ecosystems are cut off from the main river dynamics by the construction of dykes.



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**PRESSURES ON
FLOODPLAIN
ECOSYSTEMS ARE
NUMEROUS: HABITAT
DESTRUCTION,
INVASIVE SPECIES,
EUTROPHICATION,
MONOCULTURE
TREE PLANTATIONS,
CLIMATE CHANGE...**

Another major problem is the proliferation of non-native invasive tree and shrub species such as false indigo bush (*Amorpha fruticosa*), the tree of heaven (*Ailanthus altissima*), ashleaved maple (*Acer negundo*) and green ash (*Fraxinus pensylvanica*), which leads to negative changes in the natural species composition and structure of riparian forest habitats. False indigo bush is a particularly aggressive invader with individuals occupying large areas of forest, leading to a change in the conditions of habitat, as well as hindering natural regeneration of native trees. Poplar plantations and open areas are particularly vulnerable to invasion. Another highly invasive species is the green ash which, because of its adaptivity, replaces the native species of ash. Due to its good regeneration potential, the tree of heaven used for road side stabilisation is also spreading out of control. Climate change is exacerbating already vulnerable plant communities in the Lower Danube which may also have a negative effect on efforts to promote natural regeneration.

Along this stretch of river several hundreds of islands can also be found (Table 1) that are home to numerous species. Fourteen groups of habitats (including 53 distinct habitat types) have been described on the Bulgarian islands alone and they harbour about 300 higher plant species (Kavrakova, 2003). The biological importance of these islands is confirmed by the fact that seven of Bulgaria's islands and island groups are classified as Important Bird Areas (IBA), three are transboundary Ramsar sites and almost all of the islands are included in the EU ecological network of NATURA 2000.

Table 1. Key figures about the lower Danube Islands (Source: WILDIsland)

	Bulgaria	Romania	Ukraine
Number of islands	58	167	30
Area	10,492 ha	75,954 ha	31,251 ha

**MOST OF THE
DANUBE ISLANDS ARE
UNINHABITED AND
THEY ARE PUBLICLY
OWNED WHICH
FACILITATES DECISIONS
FOR RESTORATION**

In Bulgaria, for several decades, forestry management on the Danube islands has consisted largely in the conversion of floodplain forests – dominated by willow (*Salix alba*), black and white poplar (*Populus nigra* and *Populus alba*), elms (*Ulmus minor* and *Ulmus laevis*), pedunculate oak (*Quercus robur* subsp. *pedunculiflora*) and ashes (*Fraxinus excelsior* and *Fraxinus angustifolia*) communities – to large-scale hybrid poplar monocultures. By 2000, the area covered by native tree species represented about 30% and plans to further convert those would have reduced this amount to 7% within 5 years. The decision taken by the government in 2000 halted these plans for further conversion. In recent years, numerous interventions have taken place in diverse Danube islands and along the river banks to try to restore some of these natural habitats.

While past forestry practices have failed to consider maintenance of ecosystem services or key elements of the biodiversity of riparian forests – such as deadwood, hollow trees, nurse trees, and especially preservation of old growth forests – more recently, important ecosystem functions of forests have been recognised, with attempts to value and map the ecosystem services provided by forests and some relevant legislation enacted.

A number of significant issues triggered interest in floodplain restoration at the turn of the century. Firstly, there was the recognition of the role of floodplains as a natural buffer against climate-related extreme events such as flooding. Secondly, water quality levels were considered alarming and restoration was identified as a necessary process to enable the whole ecosystem to regain acceptable levels of water quality. Thirdly, EU policy instruments such as the Habitats Directive (1992), created an important framework for countries wishing to accede to the European Union (such as Romania and Bulgaria which joined in 2007) to integrate and upgrade their environmental standards. The fact that none of the Danube islands are inhabited has signified that once the political decision to restore was made, the restoration process was a purely technical one, with few social challenges.

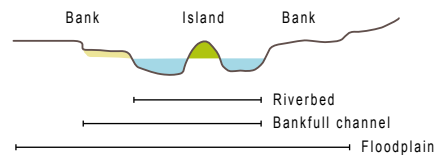
The landscape

Figure 1.
Location of the Lower Danube river:
a green infrastructure in Europe.

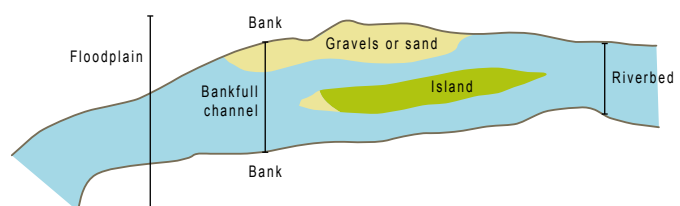


Figure 2.
Schematic presentation of the
components of the Lower Danube
landscape, as defined by hydrology:
a) cross section; b) map of a section.

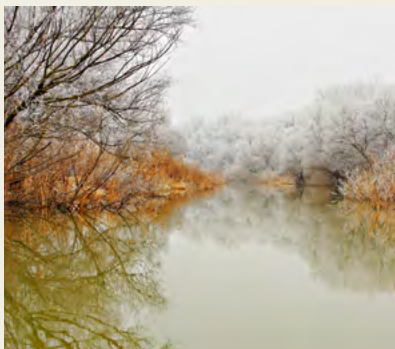
Cross section



Map of a section



↓ Water and wetlands



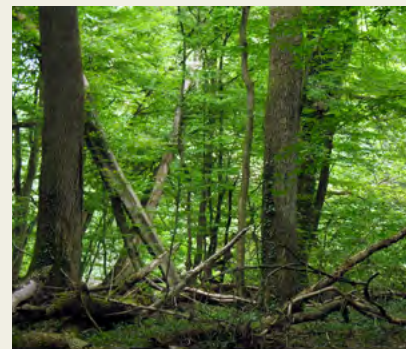
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↓ Riparian forest



© JB6

↓ Floodplain ecosystems



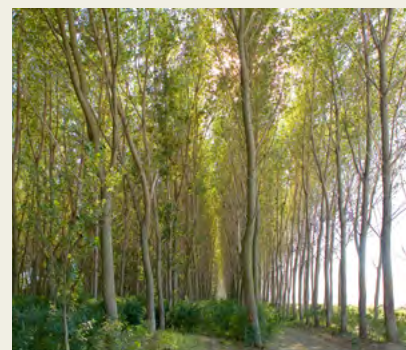
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Figure 3. The landscape in a few images: capturing naturalness and human footprint.

PROJECT PHASES

WWF'S ACTIVE INVOLVEMENT IN RESTORATION STARTED AT THE TURN OF THE 21ST CENTURY

Mirroring the islands scattered along the Danube, a number of separate projects have taken place in the Lower Danube landscape, building on each other over the years. First efforts at restoration in the Lower Danube started in 1994 when uneconomically viable agricultural polders and fish ponds, were restored by opening the surrounding dams (e.g. Babina islet and Cernovca islet, located in the northern Danube Delta near the Ukraine border) (Hein *et al.*, 2016). Twenty years later, the return of spawning fish such as the common carp (*Cyprinus carpio*), Crucian carp (*Carassius carassius*) or the Tench (*Tinca tinca*) is a testimony to the success of these efforts (Hein *et al.*, 2016).

WWF's active involvement in restoration started at the turn of the 21st century with collaboration with the World Bank to influence the Bulgarian Danube forestry strategy. Based on a cost-benefit analysis in 1999, WWF and the World Bank were able to demonstrate that restoring the ecosystem to native floodplain forests rather than converting it to further hybrid poplar monoculture plantations for pulp and paper, was cost effective (Danchev, 1999). Following intense lobbying by WWF and other NGOs, the government of Bulgaria developed a new strategy in 2001 for its Danube forests which involved conserving existing natural forest communities and restoring native floodplain forests. The strategy acknowledges the importance of preventing further conversion of floodplain forests into poplar plantations, and determined to set aside 30% of plantations slated for logging within the following five years for floodplain forest restoration (Bulgarian Ministry of Agriculture and Forests *et al.*, 2001). WWF, through its Danube-Carpathian Programme Office supported the government to implement this strategy for the conservation and restoration of the Danube islands floodplain forests, together with the World Bank, UNDP, FAO as well as the government and a local NGO: Green Balkans. A five-year action plan for the protection and restoration of floodplain forests on the Bulgarian Danube islands was drawn up jointly by the Bulgarian Ministry of Agriculture and Forests, the Bulgarian Ministry of Environment and Water, WWF, Bulgarian experts and other NGOs (Kavrakova, 2003). Furthermore, in an effort to bring in Romania which has a larger number of Danube Islands, a meeting between the Bulgarian and Romanian government counterparts was organised on 10 December 2000.

Another significant milestone occurred in 2000 when a declaration was signed between Bulgaria, Romania, Ukraine and Moldova, to create the Lower Danube Green Corridor of 935,000 ha of existing and newly established protected areas, as well as restored wetland habitats.

During the following 20 years, and to this date, a number of projects have been implemented in support of these various commitments (see Table 2). They have focused on the removal of dykes and alien invasive species such as *Amorpha fruticosa*. Active soil preparation followed by seed and sapling plantation have been the cornerstones of restoration activities as of Phase I. Pilot projects have thus taken place across several sites in all countries, but primarily in Bulgaria and Romania; they all contribute to the wider vision and objectives committed by the four governments in 2000.

Table 2. Phases and projects contributing to the restoration of the Lower Danube Green Corridor.

Date	Phases	Projects in the landscape	Related event
Before 1996			Creating a 'Vardim Oak' variety plantation on Malak Vardim Island, Bulgaria - beginning – middle of the 20th century
1996-2006	Phase I Policy, strategy and pilot sites	<p>Development of the 'Strategy for the conservation and restoration of the Lower Bulgarian Danube islands' - Supported by WWF's Forests for Life Programme (contribution to target 3 on forest landscape restoration) and WWF's Danube Carpathian programme (2000-2005)</p> <p>WWF project on Tataru island to remove dykes and re-introduce Ukrainian cattle to control invasive species, Ukraine (2003-2005)</p> <p>Oak forests restoration activities along the Danube river – Kovachev island (Bulgaria) by WWF with the local forest management unit (2004-2006)</p> <p>Riparian forest restoration activities along the Danube river on Kozloduy, Esperanto and Masata islands (Bulgaria) (2006-2007).</p>	Riparian forest restoration activities by the Bulgarian forest authorities along the Danube river – Golyam Vardim island, Bulgaria (1996-2000)
2007-2019	Phase II Up-scaling	<p>Conservation and integrated management on the Danube islands, Romania (project LIFE06NAT/RO/000177) led by the Environmental Protection Agency with support from WWF (2006-2010)</p> <p>Project 'Green borders - cross-border conservation of <i>Phalacrocorax pygmeus</i> and <i>Aythya nyroca</i> in key sites in Romania and Bulgaria' (project LIFE07/NAT/RO/000681) - led by WWF (2009-2013)</p> <p>Project 'Conservation and restoration of 11 Natura 2000 riparian and wetland habitats in 10 Sites of Community Importance (SCIs) in Bulgarian forests' (LIFE08 NAT/ BG/000281) on Persina Nature Park – Gradina Island – led by the Forest Agency with support from WWF (2010-2014)</p> <p>Project 'New life on Prut River – opportunities for local people and nature' led by WWF (2012-2018)</p> <p>Project 'Restoration and conservation of riparian forests of habitat type *91E0 in Natura 2000 sites and model areas in Bulgaria' (LIFE13 NAT/BG/000801) - The project is co-funded by the LIFE+ instrument of the European Commission, and led by the Forest Agency with support from WWF (2014-2019)</p> <p>Living Danube Partnership - a 7-year partnership between WWF, the Coca-Cola Foundation, the Coca-Cola company and its bottling partners, as well as the International Commission for the Protection of the Danube River (ICPDR) to promote the conservation and restoration of wetlands in the Danube Basin (2014-2021).</p>	<p>Entry of Romania and Bulgaria in the EU (2007)</p> <p>Public agency Moldosilva (Moldova) reforested an area of 32,600 ha and promoted natural regeneration on another 12,800 ha (Botnari <i>et al.</i>, 2011 ; 2006-2010)</p> <p>Endangered Landscapes fund project by Rewilding Europe to restore 10,000 ha of wetlands per year. Local partners are Rewilding Ukraine, Danube Delta Biosphere Reserve Authority (Romania), Danube Biosphere Reserve (Ukraine) and Verde e Moldova (2019-2024)</p>

IMPLEMENTATION: ACTIVITIES & RESULTS

Several activities have contributed over the years to the overall vision for the Lower Danube. Activities and associated results could be categorised according to the following typology:

- Policy, governance and lobbying;
- Science and knowledge;
- Awareness raising and training;
- Control of degradation and related pressures;
- Active or passive restoration;
- Monitoring and evaluation.

Some of the projects in which WWF was involved are described here. They by no means represent all of the different restoration activities that have taken place over the years in this region.

Initial efforts in the late 1990s and early 2000s focused on building a constituency to promote restoration of the Lower Danube corridor. This involved raising awareness, and brought a number of NGOs together. It provided a solid political foundation for the following phase which consisted in restoration field activities across diverse parts of the Lower Danube. To avoid repetition with following chapter, we will limit here the presentation to field activities.

Field activities

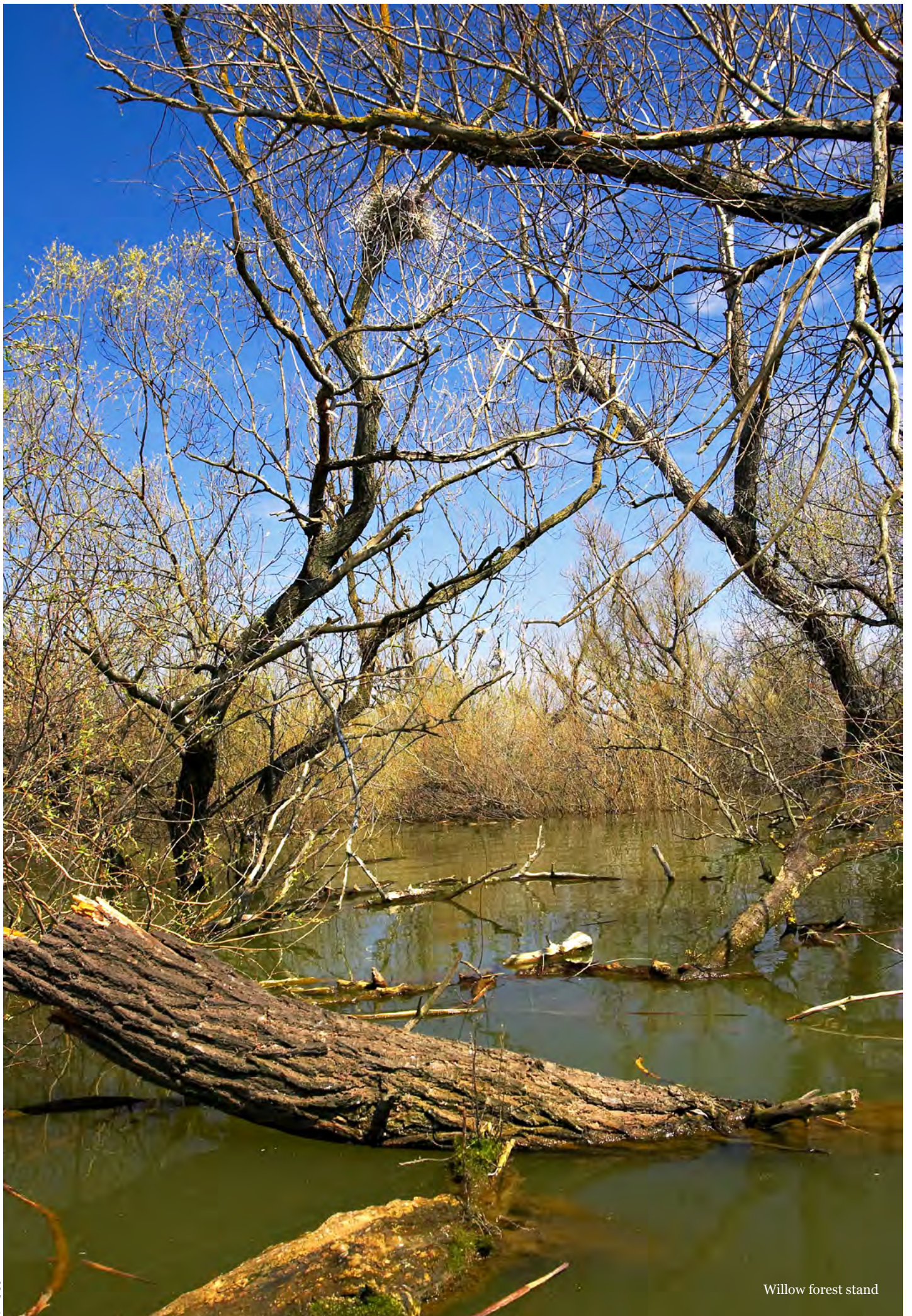
REMOVING
PRESSURES OR
SOURCES OF
DEGRADATION ARE
THE FIRST STEPS
FOR EFFECTIVE
RESTORATION

Removing dykes served to restore natural water flows. This took place for example in Ukraine, starting in 2003, when WWF and the local forestry authority removed 6 kilometres of dikes built around Tataru island to allow the restoration of natural flooding. Also on Tataru, 11 rare grey Ukrainian cattle were brought to the island in 2005 and six were introduced in the Danube delta in Izmail Gallery Forest in 2005 to manage and maintain areas open to promote competition among tree species. A similar approach has been taken on the Island of Ermakov (3,500 ha) in 2009.

Mechanical measures were used to remove the invasive species such as the false indigo bush. For example, these measures were applied in Romania's Turcescu and Fermecatu islands, from 2006 to 2010, followed by active plantation of white willow and white poplar on 26 ha (or about 16% of the island) to replace hybrid poplar plantations. Although the emphasis was on active planting, once these trees took root, black poplar also started regenerating spontaneously, thereby adding to the natural mix of indigenous species.

State employees from both the forest service and protected areas worked closely with WWF and others, to acquire new skills, knowledge and know-how related to the active and passive restoration of a broader range of native species. This involved training, but also trials on relatively small plots to determine best methods for site preparation and for active planting. For example, a small-scale pilot project in Bulgaria's Kovachev Island took place from 2004-2006 led by the local forest management unit (Lom State Forestry) and WWF Bulgaria. It focused on oak forest restoration and included experiments dividing the area into three plots and implementing different restoration pathways in each. The results from these three tests showed that while direct acorn seeding provided the strongest trees, these were also more prone to being dug up by animals such as badgers, rodents and wild boar.

Emphasising the importance of Natura 2000 sites, between 2010 and 2014, restoration was undertaken in 11 Natura 2000 Riparian and Wetland Habitats in 10 Sites of Community Importance (SCIs) in Bulgarian Forests. The project was led by the forest



**RESTORING AND
MONITORING
CONSERVATION
STATUS OF SPECIES
AND HABITATS
IS CONDUCTED IN
NATURA 2000 SITES**

agency with support from WWF Bulgaria. Although this project did not focus exclusively on Danube riparian forests, it did include the important Persina Nature Park which is situated along the Danube. Persina Nature Park was created in 2000 and covers 21,762 ha straddling 11 Danube islands. Restoration was conducted from 2010-2014 on Gradina Island. It involved removal of Indigo sage bush, full soil preparation, and planting an area of 27 ha with pedunculate oak, black poplar, white willow and white elm.

Currently, and since 2014, WWF Bulgaria is testing different silvicultural methods through a project on restoration and conservation of riparian forests of habitat type 91E0* in Natura 2000 sites and model areas in Bulgaria. Here, WWF Bulgaria is working to restore riparian forests by planting local tree species, such as black alder, white willow and black poplar, and removal of invasive and alien species. Typically, soil is first prepared, saplings planted then maintenance activities take place. Where necessary, attention is given to removal of exotic species before planting. Monitoring protocols have been designed and applied to effectively measure progress. So far 9.8 ha of the priority forest habitat type 91E0* were restored and exotic tree species were removed in 22.3 ha.

Focusing on improving habitat for the pygmy cormorant (*Phalacrocorax pygmeus*) and the ferruginous duck (*Aythya nyroca*) – both of which appear as endangered on the Bulgarian IUCN Red List of Threatened Species – WWF led a project between 2009 and 2013 to plant willow and poplar saplings on a total area of 4.5 ha at the confluence of the Olt River in the Danube and Blahnita (in Bulgaria and Romania respectively). A total of 10,750 saplings were planted for this endeavour at a cost of EUR 12,000.

In Moldova, during 2000-2010, the State forest agency Moldsilva embarked on a significant state-funded afforestation programme, partially supplemented by international funding mechanisms and projects (World Bank, Japanese grants), resulting in about 60,000 ha of newly created plantations on abandoned and/or eroded community land. Emphasising native oak forests and the need to reduce the risks of land erosion and water loss, the Naturton Foundation and WWF have jointly run a project between 2014-2018 entitled “New life for Prut river – opportunities for local people and nature” that reforested about 30 ha of publicly-owned land and rehabilitated four public wells and springs.

Ecotourism has been promoted, particularly for birdwatching and bird photography in the delta (both in Romania and Ukraine).

Results

Natural floodplain forest habitats have slowly been making a comeback in the Lower Danube. Active restoration has taken place on a number of small sites, providing the seed material for further passive restoration to take place through natural processes (Table 3). Birds and other wildlife are quick to re-establish once natural conditions improve. A key priority has been to return native tree species and to diversify forests that have been simplified in structure, age and composition. As of 2012, 60,000 ha of floodplain had been restored or was undergoing restoration (Faivre *et al.*, 2018).

WWF has been directly involved in the active restoration of several dozen hectares on various islands, such as Kozludoy, Esperanto, Masata, Gradina and Aleko Telikata in Bulgaria or Turcescu and Fermecatu in Romania.

On Kozluduy Island (Bulgaria), after 10 years, the oaks had reached five metres in height and an average diameter of 8 cm. An interesting reversal of fortune took place with the false indigo bush whereby initially the oaks benefitted from the cover provided

Table 3. Indicative list of results categorised by type. This table is not exhaustive, but aims to present the variety of key performance indicators (KPIs) used. Although data at site level is available, its compilation at landscape scale for the last 20 years was not computed.

Type	Key performance indicator	Results
Threat reduction	Length of dykes removed on Tataru Island in Ukraine	6 km
	Area from which the invasive indigo bush was removed in Persina Nature Park (Bulgaria) between 2010-2013	27 ha
Forest management, protection and restoration	Area planted with native species	Dozens of sites, from 1 to 32 ha in each country
	Area of floodplain restored or undergoing restoration in the Lower Danube as of 2012	60,000 ha
	In Gradina Island alone (part of Persina Nature Park, Bulgaria) number of saplings planted in 2013	Black poplar – 8,500 White Willow – 17,500 Pedunculate Oak – 18,750 White Elm – 16,000
	Area over which natural processes have taken over in the Romanian islands of Babina and Cernovca	over 3,680 ha
	Number of saplings of <i>Salix alba</i> and <i>Populus nigra</i> planted in 2015 in Aleko Telikata island (Bulgaria)	9,540
Species conservation	% increase in number of mammal species in Tataru Island (Ukraine)	38% (from 24 in 1999 to 33 in 2018)
	Increase in number of bird species in Tataru Island (Ukraine)	68% (from 124 species before 1999 to 219 in 2018)
Ecosystem services	Expected annual earnings through ecosystem benefits from restored Lower Danube floodplain	EUR 111.8 million

THE ECONOMIC BENEFITS OF RESTORATION HAVE BEEN ESTIMATED FOR SOME SITES

by this bush, but then after about eight years, oaks outgrew the bush and crowded it out, thereby naturally killing off this invasive species.

In Romania, on the islands of Babina and Cernovca where restoration started in the late 1990s, a mosaic of habitats can now be seen. Where dykes and channels had been built to make the islands favourable for agriculture, connections back to the main river were re-established and natural processes allowed to take over in an area extending over 3,680 ha. As a result, numerous bird species have come back and the economic benefits of the restoration works in terms of increased natural resources productivity (fish, reed, grasslands) and tourism, has been estimated at about EUR 140,000 per year (WWF website).

In Ukraine's Tataru Island, natural flooding conditions were re-established on 750 ha after the removal of dykes, creating rich feeding, breeding and spawning grounds for fish, flora and fauna. Rare birds such as white-tailed eagles, pygmy cormorants and ferruginous ducks, have now returned to Tataru Island and are thriving as their habitat and food sources have returned.

Water quality has improved with the nutrient inputs to the Black Sea from the Danube in 2005 showing a marked decline from the 1970s (Chapman *et al.*, 2016). While this results from a combination of factors (including improved sewage treatment and reduced fertiliser use) forest restoration is most likely a contributing factor.

Tataru Island



© N. Bazianov

Focus on Malyi Tataru Island (Ukraine)

Malyi Tataru Island is about 100 km upstream of the Danube River mouth. The island is about 716 ha and part of a regional landscape park. Izmil State Forest Enterprise manages it.



Before 2003 - Gallery forest and island under pressure

Before 2003, gallery forest, along the south bank, covered half of the natural levees of the island. The other half was poplar monoculture plantations (north and west banks). Dykes and intensive grazing changed the forest composition and structure. Part of the wetlands were drained and cultivated (south-west, yellow).

< Vegetation in 1993

- Terrestrial pioneer species and degraded land
- Tall grass helophytes (*Phragmites*)
- Gallery forest and poplar plantations
- Macrophytes

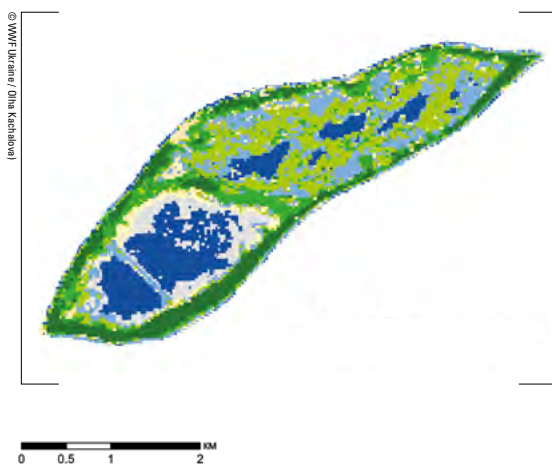


2003 - Key dykes removed to restore natural hydrology

Starting in 2003 WWF, together with the local forestry authorities, removed part of the dykes (in red) to restore the hydrological regime and increase natural forest cover in specific areas (in yellow).

Since 2007, poplar monoculture plantations started to die out (north and west banks) and forest dynamics changed.

< Background aerial photo from 2018



2015 - New hydrology means new forests

From 2003 to 2015 the area of gallery forest almost doubled. Today, floods bring sediments favourable to almond willow habitat (*Salicion triandrae*), natural grazing is less intensive and basket willow harvesting ended, thus this habitat increased fourfold since 2003.

White-tailed eagles, pygmy cormorants and ferruginous ducks are thriving on Malyi Tataru Island, while inner lakes serve as spawning grounds for Danube fish.

< Vegetation in 2015

- Terrestrial pioneer species and degraded land
- Tall grass helophytes (*Phragmites*)
- Gallery forest and poplar plantations
- Macrophytes

PARTNERS AND MAIN ACTORS

Across the Lower Danube countries several actors have intervened over the years contributing to the success of the restoration vision. At the very local level, communities and children have engaged in the tree planting, cleaning and clearing processes. Also at this level, local districts have been involved; for example, commune level authorities have been important players in Moldova.

Regionally, the International Commission for the Protection of the Danube River (ICPDR) has provided an umbrella strategic context. It has served as a platform for negotiations and has brought the four Lower Danube countries together, as well as the other 11 Parties. Due to the integrated approach of the European Union Water Framework Directive (which the ICPDR helps to implement) its analyses, for example on water quality, have provided arguments not only for treatment plants but also for floodplain forest restoration.

At the national level, forestry agencies play a key role in restoration as well as being target groups, particularly for capacity building. Park staff are involved where actions take place inside parks (e.g. Persina Nature Park). The Ministries of Environment and Waters were important early on in providing the enabling framework and policy environment to initiate the Lower Danube restoration programme. State forest agencies are particularly important in the Danube as they are responsible for the public forest estate (which is the majority of the forest in all countries). In Moldova for example, the Agency Moldsilva is the central public administration responsible for both forestry and hunting. It is in its remit to work on “Forest regeneration and afforestation of the managed forests, extension of land covered by forest and creation of forest belts for protection of fields and waters, erosion strips on a contractual basis” (Botnari *et al.*, 2011).

Other national NGOs such as Green Balkans Federation from Bulgaria or the local Birdlife partner ‘Romanian Ornithological Society’ have also played a role in restoring the floodplain forests on the Danube islands. Green Balkans in particular was instrumental in the late 1990s, together with WWF, in supporting the development of the strategy for the restoration of the Bulgarian Danube islands.

Indirect international actors include major donors such as the European Commission which has provided significant project support with over 30 LIFE projects implemented to restore the Danube river (not just in the Lower Danube) since 1992. It became an important source of funding for nature conservation since Bulgaria and Romania joined the EU (2007).

The World Bank has also been involved in funding carbon sequestration projects through reforestation and afforestation in the region. For example, it has a [contract](#)³ with the Moldovan government to buy 1.9 million tonnes of carbon through the Prototype Carbon Fund and the BioCarbon Fund over a 20-year period (2002-2022).

The private company Coca Cola has been an important partner for WWF and local governments, investing in a partnership with the organisation and the ICPDR with the aim to restore over 5,300 ha of wetland habitat by 2020 (ICPDR, 2018).

THE EU LIFE
PROGRAMME HAS
BEEN AN IMPORTANT
TOOL TO FUND
PROJECTS TO RESTORE
THE DANUBE RIVER.



³ <http://moldsilva.gov.md/pageview.php?l=en&idc=227&t=/Cooperation/Soil-conservation-project/Moldova-Soil-Conservation-Project/>

CAPACITY BUILDING

The pilot site approach taken in many of the projects has helped to improve the understanding of locally-viable restoration techniques. While many actions are small-scale, they have been used as learning sites, with the ultimate objective to scale up to a wider area, or to replicate activities elsewhere in the landscape.

Capacity building efforts started early on in the overall restoration work in Bulgaria. Training of forest service staff in Bulgaria was a priority as they were only used to working with a handful of species, in particular fast-growing hybrid poplars. WWF, in partnership with its WWF-Auen Institute in Germany (now the Department of Wetland Ecology at the Karlsruhe Institute of Technology), offered courses and exchange visits to assist the Bulgarian forest service in mastering the management of native tree species. In spring 2003, WWF sponsored the participation of 30 officers from the Bulgarian forest service at a training event at the WWF-Auen Institute. Training centred on close-to-nature forestry with an emphasis on returning natural species and ecosystems where previous monocultures of hybrid poplar plantations had been planted.

Recently, Moldova, WWF and IUCN staff were trained in the first phases of identifying priority areas within a landscape for restoration. A Restoration Opportunities Assessment Methodology (ROAM) was conducted in three communities across the country to identify priority restoration sites and species.

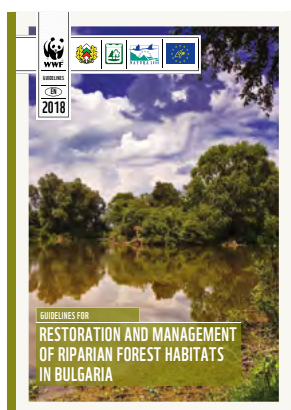
Networking and study tours have been organised more recently. For example, in 2016 both WWF and Bulgaria forest agency staff, as well as employees of two Regional Forest Directorates, went to Hungary to visit the Liberty Island restoration work. Another field visit took place within Bulgaria, focusing on the Danube islands of



In Bulgaria and Romania, training was a priority

Kovachev, Kozloduy, Goliam and Malak Vardim. Study visits from project staff (both WWF and the environmental protection agency) have also taken place in Romania in 2011 to the Danube-Olt Confluence Site and the Turcescu Island. These study tours are opportunities to exchange lessons and learn from practical experiences.

Training material was regularly produced. In September 2018, guidelines on the restoration and management of riparian forest habitats in Bulgaria were developed (Dimitrov *et al.*, 2018). They include an overview of the specific habitat types as well as some steps to consider in the restoration process, such as: identifying the status of the area and its management regimes, drafting a technical plan for afforestation and monitoring, determining pattern and density rates for the main species to be used. These guidelines highlight both passive and active restoration options, with for example the removal of competing species being a major tool for passive restoration in the region. Practical guidelines are offered on producing forest reproductive material of the keystone species from riparian habitats.



Riparian forest restoration guidelines for Bulgaria (Dimitrov *et al.*, 2018)

Liberty Island in Hungary

Further upstream from the Lower Danube Corridor, the 3 km long Szabadság (Liberty) Island and side channel in Béda-Karapancsa represent a model restoration effort. Teams from Bulgaria visited this site for inspiration and to learn from the experience. Although protected, Liberty island underwent significant conversion to hybrid poplar plantations and other non-native fast-growing tree species for commercial forestry. As part of the WWF-Coca Cola partnership, a significant restoration effort began in 2009, with additional funding from the EU. The aim was to provide alternative income generation through ecotourism and recreation, as well as to improve water quality. Native, alluvial soft-wood species such as white willow (*Salix alba*), brittle willow (*Salix fragilis*) and black poplar (*Populus nigra*) typical of floodplain areas were used to restore the forest on the island and its channel. Restoration also involved regular cutting back of the faster growing invasive species to allow native species to establish as well as removing part of the five-metre rock-filled dam and dredging some of the accumulated sludge in order to restore natural water flow. The five year project also secured the transfer of the island from the state to the Duna-Drava National Park Directorate as a trustee of the island.



COMMUNICATION

Over the years, communications around restoration has been limited. This may in part reflect the fact that most of the Danube islands where the restoration effort has been concentrated are uninhabited, belong to the State and are not easily accessible as they lie on a political border.



Publications, press conferences, roving exhibitions and a website help to share knowledge and raise awareness.

More recently, under the EU LIFE projects, some active communication has begun. A project website was established under the LIFE project in 2010 in both English and Bulgarian and was viewed over 11,000 times between 2010-2014. A press conference was held in 2010 targeting the national Bulgarian press and another two held in 2013 and in 2014 at the end of the larger LIFE project. A roving exhibit was organised promoting the Natura 2000 network and activities that took place in all 10 parks under the LIFE project. The exhibit in Persina Nature Park took place in Belene in September 2013. Another exhibit in four large towns in Bulgaria in 2016 was dedicated to raising awareness about the values, importance, biodiversity and threats to riparian forests. The exhibition was viewed by 5000 people.

Further, to share experiences more widely, a presentation was delivered on restoring riparian forests in the Danube in June 2018 at the international conference entitled 'Reforestation Challenges', organized in Belgrade by the University of Belgrade, the International Union of Forest Research Organizations (IUFRO) and the Reforesta Scientific and Professional Society.

Since 2016, WWF, together with local forest authorities and schools organise 'The Forests and River Day' events. The events take place near the locations of the newly created riparian forest. Children (10-14 years old) and their teachers learn facts and general information about riparian forests, their biodiversity and are involved in practical activities, such as weeding and taking care of the saplings planted. Information boards for tourists were set up in different parks, such as Persina.

Promoting Danube river conservation



Targeting youth, clean-up operations were organised by WWF in partnership with the forest department of Ruse, the Scout Club Ruse and Prista Tourist Association in June 2018. A total of 15 volunteers as well as 40 scouts were engaged to clean up Aleko Island. A lecture and game on local biodiversity was also organised targeting the scouts. Between 2010 and 2014 three large national clean up days were organised in Bulgaria, bringing together close to 10,000 volunteers! Thanks to their work, a total of 36 tonnes of waste was collected from 10 different nature parks, one of which is Persina.

Targeting a wide audience, important reports on restoration have been produced. The first is a report on lessons learnt from "Restoration of forests in 10 nature parks in

Bulgaria" produced in 2014; the second is on floodplain forest restoration experiences in the region produced in 2017 in both English and Bulgarian. This recent report highlights the importance and the benefits of riparian forests as well as providing information on several restoration activities.



Cleaning the river banks, riparian forest and wetlands during the 'Forests and River Day'

GOVERNANCE

The Lower Danube Green Corridor declaration has provided a solid political framework across the four countries to engage in restoration since 2000. It has been a major political step for restoration.

At the regional level, the International Commission for the Protection of the Danube River is an important international collaborative mechanism to bring the nations that share the Danube river together around their shared resource. It was established to help implement the Danube River Protection Convention (DRPC) which was signed in 1994 and includes 14 country contracting parties, as well as the EU. The DRPC aims to ensure that surface waters and groundwater within the Danube River Basin are managed and used sustainably and equitably. In December 2018 WWF presented a 'Gift to the Earth' to the ICPDR in recognition of its efforts to restore the river.

For the nine EU countries of the Danube Basin, the Water Framework Directive (WFD) – which came into force in 2000 – provides another important framework for restoration interventions in the Danube. It aims to protect and enhance the status of aquatic ecosystems, prevent their deterioration, and ensure the long-term, sustainable use of water resources throughout the EU.

The EU Habitats Directive of 1992 represents the most important nature conservation tool in Europe and as such frames habitat restoration issues which apply to both Bulgaria and Romania, but which aspiring countries such as Moldova will also take into consideration in their own legislation.

Flood security and water quality are high on the agenda in the EU, e.g. in the Water Framework Directive.



The Bulgarian strategy for the Danube Islands, defined in 2001, provided a clear framework to set the stage for interventions in Bulgaria in the following years. It was an important document that enabled a change in the economic development model followed until then, which had set the country on a path to significant environmental degradation. Instead, by embracing this shift in approach, the government signalled a willingness to recognise the multiple environmental values of natural floodplain for-

STATE OWNERSHIP OF THE ISLANDS FACILITATES RESTORATION WHILE ENGAGING PRIVATE OWNERS IS A SLOWER PROCESS

ests, and therefore, the need to protect and restore them. In 2003 a 4-year ‘Action plan for the protection and restoration of floodplain forests on the Bulgarian Danube islands’ was drawn up jointly by the Bulgarian Ministry of Agriculture and Forests, the Bulgarian Ministry of Environment and Water, and WWF, Bulgarian experts and other NGOs (Kavrakova, 2003). It emphasises notably, restoration of habitats of rare, threatened and economically important wild plant species, and the conservation of the genetic pool of native tree species.

Also in Bulgaria, one important governance issue relates to land ownership. All of Bulgaria’s Danube islands are owned by the State⁴. As they represent a strategic resource at the border with Romania, most are under exclusive state ownership. The islands are essentially uninhabited and therefore, a relatively easy top-down approach can be taken to restoration here. Along the river banks, the situation is significantly different with a patchwork of ownership which has resulted in significant conversion to agriculture. Engaging private owners in restoration is a slower process, and the approach to date has been to use demonstration sites on public land to first learn methods and then to be able to motivate private landowners.

A legislative amendment in Bulgaria in October 2012 raised serious concerns as it opened up the option of clear-cutting in riparian forests along the Danube river, despite the risk of negative environmental impact and the fact that some of the areas had been identified as protected areas by the EU’s Natura 2000 network. Six months of policy lobbying by WWF and other NGOs however paid off with the amendment dropped and 4,500 hectares of forest now safe from felling.

Passive restoration of wetlands removes former tree plantations.



© WWF

⁴ Across the country, the state of Bulgaria owns 74% of the forests (Stoyanov *et al.*, 2015), while in Romania, state ownership of forests is 65% (Nichiforel *et al.*, 2015)

SUSTAINABILITY AND EXIT STRATEGY

The programme has relied on national and international donor funding throughout different projects which, in the long term, is not a financially viable model. Having said that, several factors may be said to contribute to the programme's sustainability. Three aspects of sustainability are explored here:

1. Financial sustainability;
2. Institutionalisation and human capacity;
3. WWF's position toward an exit strategy.

Financial sustainability

The financial case, including the human benefits, have been a central part of the argument for restoration in the Lower Danube. Indeed, flooding with its associated human and financial costs has been a major trigger for restoration. Also, the changes in water quality caused and exacerbated notably by decades of degradation of the forest ecosystem, have raised awareness across the region about the need to improve ecological integrity.

Floodplain restoration in the Lower Danube has mostly been supported by external aid, in large part from the European Union under its LIFE programme. While efforts have been attempted to raise funds from tourism that could eventually support protection and restoration in the Danube islands, this is still not a sustainable source of income.

In terms of financial sustainability, it is important to quantify not only the amounts necessary to restore the floodplain forests, but also the benefits achieved. Thus, an analysis by WWF in Romania revealed that the cost of dyke removal would be between EUR 50,000 – 200,000 per km or a total of EUR 20 million for four polders covering 100,000 ha which would allow the capture of 1,600 million m³ of floodwater as well as generating ecosystem services valued at EUR 50 million per year (Schwarz *et al.*, 2006).

Overall, the cost of floodplain restoration along the Lower Danube Green Corridor has been estimated at EUR 183 million (Faivre *et al.*, 2018). However, benefits in terms of ecosystem services have been estimated at about EUR 111.8 million per year. Furthermore, one can add to this the saved cost from reduced flood damage, costs which totalled EUR 400 million per year associated with the 2006 floods (Ebert *et al.*, 2009). Thus, in financial terms, benefits of restoration far outweigh costs.

Institutionalisation and human capacity

Institutionally, the overall regional agreement of 2000, the Bulgarian strategy developed in 2001 and the subsequent Bulgarian action plan developed in 2005 provided the guiding threads for a large number of diverse interventions by different actors, including WWF. These policy frameworks were key to the long-term engagement of different actors in the restoration effort.

Capacity building of relevant technical staff from the public bodies managing riparian forests has been a cornerstone of FLR activities since the start of the programme. Investing in the human capital present in the region and changing approaches and mindsets has been a long and iterative process but one that is fundamental to the long-term success of restoration efforts in the Lower Danube corridor.

IT WAS SHOWN THAT
FINANCIAL BENEFITS
OF RESTORATION FAR
OUTWEIGH COSTS

Building trust and capacity of relevant staff managing riparian forests has been a cornerstone of FLR.



Future exit strategy?

In the Lower Danube, long-term engagement through a series of projects within the landscape was necessary to raise awareness, develop the political momentum and catalyse actions from stakeholders in the different countries. So far, WWF has not planned a specific exit strategy as might have been the case in a more systematic or focused long-term FLR intervention (see for example, Mansourian *et al.* 2018 a,b; Mansourian *et al.*, 2019).

THE LOWER DANUBE STILL REMAINS HIGH ON THE CONSERVATION AGENDA

As a priority ecoregion and landscape for WWF's wildlife, freshwater and forest programmes, the Lower Danube remains high on the conservation agenda. Much still remains to be done. However, in term of FLR interventions, the lack of a detailed and participatory planning process for the whole landscape has made it more difficult to discuss long term objectives, including an exit strategy for the landscape. Moving forward in the sense of an FLR approach is not just about moving to another site to restore in the landscape. Thus, in the context of a landscape-wide restoration initiative, at some point an exit from the landscape needs to be envisaged and planned. This is not necessarily the same when considering a series of site level interventions. It will be important to determine FLR needs in the Lower Danube for the coming years, to prioritise restoration interventions, to enlist the support of non-governmental stakeholders, including private landowners, and to consider extending the scale of restoration interventions beyond the immediate river banks and floodplain. Discussing such questions with stakeholders in the Lower Danube is part of an FLR process.



OVERARCHING LESSONS LEARNT

The vast experience acquired in the restoration of the Lower Danube is a valuable resource for practitioners and policy-makers alike. Today, it is useful for other degraded landscapes worldwide to reflect on the most significant lessons learnt for the restoration of floodplain forest landscapes. Twenty years of experience of restoration in the Lower Danube raises a number of important lessons:

1 Variable perceptions make the 'landscape' definition challenging

A landscape is not necessarily well defined by its size in ha or km². As social constructs, landscapes do not have widely-accepted boundaries and the framing of these boundaries in FLR may be perceived differently.

In the Lower Danube, a political agreement was declared in a landscape covering 935,000 ha and named the Lower Danube Green Corridor. However, field interventions happened year after year on specific sites.

2 Site-based interventions within the landscape can help to initiate FLR

Even if a more detailed and jointly agreed planning and prioritisation exercise is not yet complete, site-based restoration interventions can contribute to demonstrating and testing approaches, as well as providing capacity building opportunities. Through an iterative process, these site-based interventions can inform the landscape plan.

In the Lower Danube, it was more practical to begin small-scale interventions than to wait for a participatory landscape-wide intervention plan. Field interventions took place mainly on publicly-owned islands and riparian forests.

3 Site-based activities can provide an important connectivity function in the restoration of river systems

Prioritising the restoration of riparian zones in a river system may provide multiple benefits (such as new habitats for species, flood control, improved water quality, migratory routes for biodiversity) and enhance ecological connectivity.

In the Lower Danube, some of the restoration initiatives have taken place on very small areas, notably on some of the islands, yet these areas contribute directly to ecological connectivity across the wider landscape.

4 Juggling multiple parameters is central to floodplain forest restoration

The specificity of floodplain forests and associated ecosystems (water, wetlands) signify that there is a need to adapt to the complexity of feedback loops across the ecosystems.

In the Lower Danube, it was important to allow scope for adaptive management (e.g. factor in plans for a potentially dry year) and to monitor closely these multiple dimensions and influences in the long run.

5 Valuable insights into locally-viable techniques can be gained by testing and monitoring innovative restoration approaches

Small scale pilot restoration efforts allow the testing of different restoration approaches prior to scaling up.

In the Lower Danube, such experiments provided lessons on the best techniques and the critical success parameters of forest restoration. For example, mimicking natural processes was identified as an important and cost-effective approach.

6 Restoration often requires first stopping or reversing degradation

Restoring a habitat may first signify the removal of infrastructure or other causes of ecological degradation.

In the Lower Danube, removing dykes or invasive species may enable nature to take its course through natural regeneration or natural hydrological processes taking over.

7 Transboundary collaboration can be achieved through institutional mechanisms at various levels

Due to their strategic nature, intervening in transboundary areas can be sensitive and the support of internationally-accepted institutional mechanisms is required to accelerate implementation.

In the Lower Danube, both political support at the highest level (state), and the existing transboundary platform, the ICPDR, provided an important and legitimate framing for the FLR work.

8 A formal plan or strategy can be an effective facilitator for field-based restoration

Even a relatively broad or general plan or strategy for FLR at the landscape level contributes to field-based restoration progress.

In the Lower Danube, the Danube strategy provided a framework for several otherwise apparently disjointed activities over the years which are all linked by their relationship to the wider policy context which was developed in the late 20th, early 21st century.

9 Conflicting policies across sectors are more likely in complex landscapes that embrace multiple ecosystems

The conflict across sectoral priorities can prevent effective floodplain restoration and even compromise the effectiveness of restoration actions.

The Lower Danube is primarily considered under the water and transport sectors. From their lenses, the need to clear forest from woody debris to reduce impediments to water transportation, is logical. However, from a forest and environmental perspective, it is not.

10 Natural regeneration is a cost-effective tool for restoration

Lessons to date have shown that natural regeneration is viable but only under certain conditions.

In the Lower Danube, natural regeneration was viable only if pressures were removed (invasive species, grazing) which in turn, helped to make restoration cheaper.

11 Restoring forest dynamics does not always mean more trees and tree cover

In ecosystems where water and wetlands are intertwined with riparian and floodplain forests, recovering functions could mean leaving space for other ecosystems.

In the Lower Danube, removal of dykes or rehabilitation of poplar monoculture plantations once planted on drained soils restore more water surfaces and wetlands.

12 Anticipating an exit strategy

For the key proponents in an FLR intervention, exiting from the landscape is a necessity at some point and needs to be well planned to safeguard achievements and secure continuity.

In the Lower Danube, because WWF interventions mix conservation and restoration activities, and are often site-based, logical next steps are to move to other sites within the landscape. The question of when it is sustainable to exit remains open. Part of the solution lies in the evaluation of the added value of the organization in moving toward an overarching landscape plan.

13 Forest landscape restoration is a challenging long-term effort that requires attentive planning, implementation and monitoring

Engaging stakeholders in decision-making at different levels is essential to secure success in FLR.

In the Danube, the ICPDR provides a platform to bring decision-makers together at a high level, while at the project level, actions have brought local stakeholders together. Thus, participation in restoration-related interventions has ranged from high level policymakers to local residents.

CONCLUSION AND FUTURE PROSPECTS

Twenty years of restoration in the Lower Danube is changing the landscape. Birds and fish are returning, and water quality has improved. Techniques for native forest restoration have been tested and are gradually being adopted and scaled up. The Lower Danube multi-country experience demonstrates how distinct and site-based implementation can contribute to one overarching vision, shared across borders. It also highlights the complexity of operating across such immense temporal and spatial scales and across political boundaries. Although the projects highlighted have generally been successful, climate change, population growth and related pressures on natural resources signify that much more needs to be done. At such a scale, the question of exiting is not yet relevant for WWF. Future projects are already being identified, such as the Living Landscapes project on rewilding in Ukraine. It is important for these projects to remain aligned to the common overarching vision so that choices made concerning specific areas to restore can have a larger multiplier impact through their strategic location along the corridor. Each project needs to remain aligned to the overall landscape vision but also add value to preceding projects. As this case demonstrates, at times and at certain spatial scales, a project-by-project approach that builds on previous projects in time and space may prove to be more realistic and sustainable in the long-run than one large overall programme.

Restoring hardwood forest habitats in the floodplain remains a long-term challenge in the Lower Danube



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4

The number of countries involved in one of the largest efforts in Europe for conservation and restoration.

20

the number of years over which restoration projects have taken place in the Lower Danube contributing to the four-country strategy.

183

In millions of Euros, the estimated cost of floodplain restoration (all ecosystems, all stakeholders) along the Lower Danube Green Corridor. However, benefits (112 millions of Euros per year) in terms of ecosystem services, far outweigh costs.

68%

The increase in bird species in one pilot restoration site, Tataru Island (Ukraine), 15 years after removing dykes to recover hydrological function and original forest dynamics.



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To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

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