



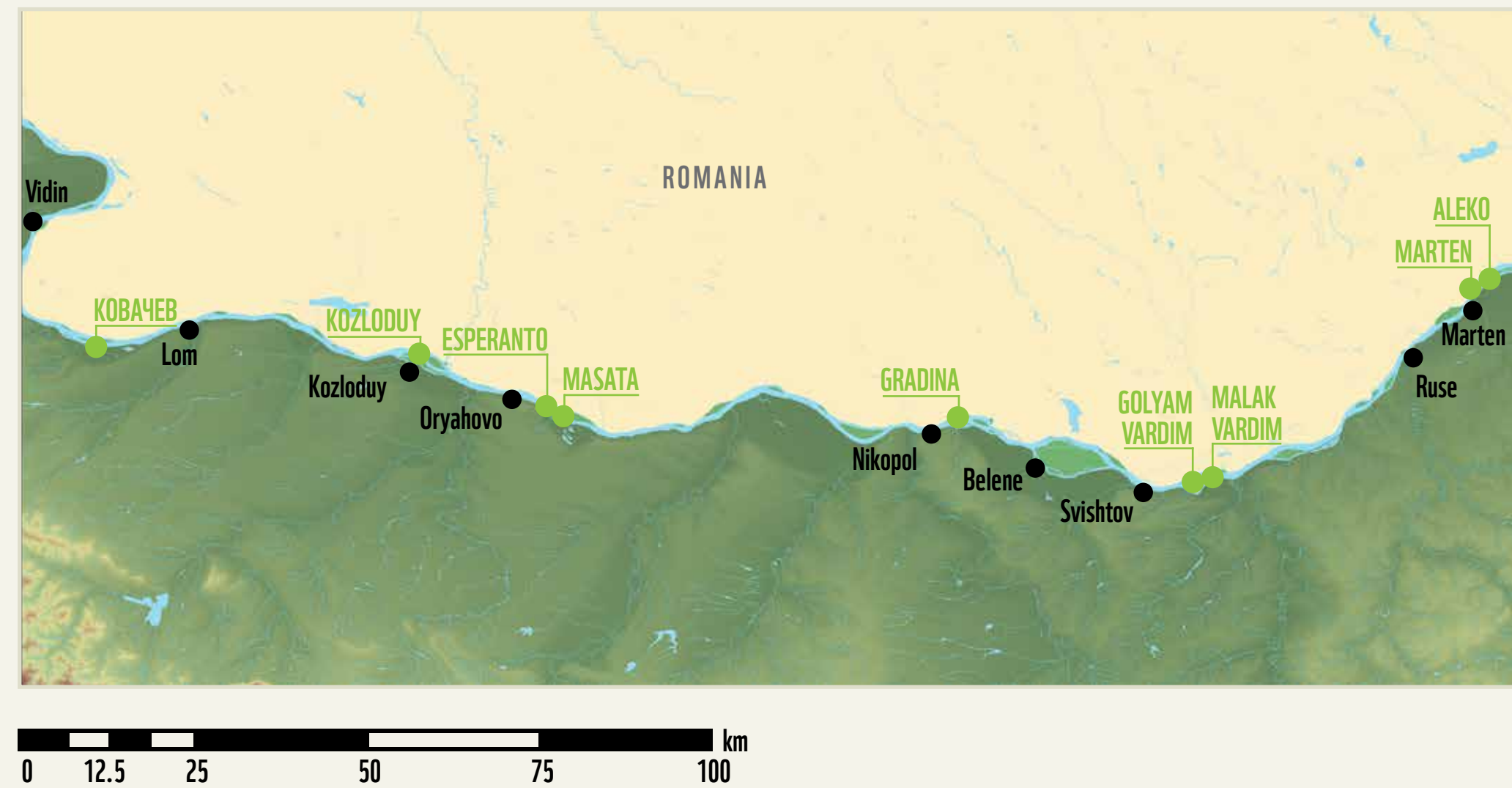
# EXPERIENCE FROM RIPARIAN FORESTS RESTORATION PROJECTS IN BULGARIA

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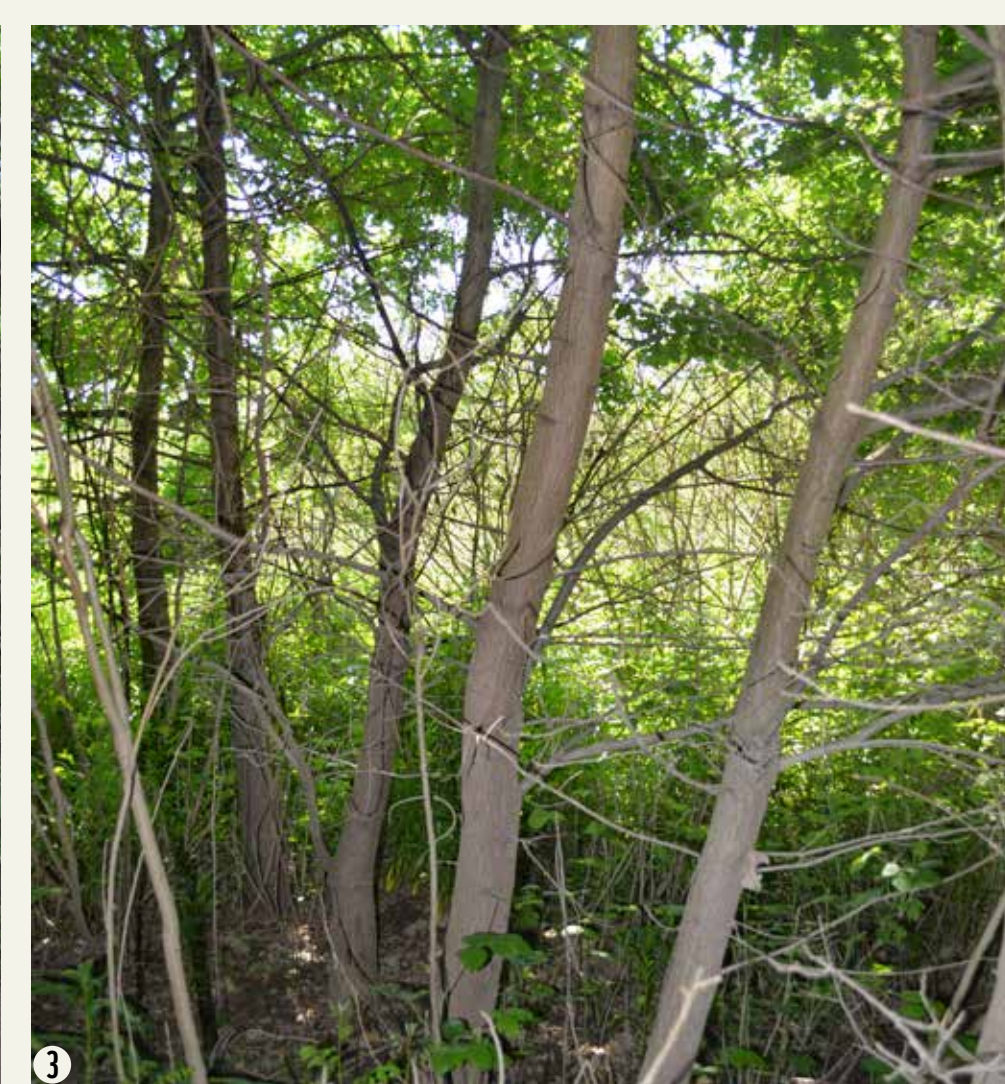
## INTRODUCTION

Riparian forests have huge ecological significance, playing an important role in both nature and human populations. Historically, riverbeds have dwindled as a result of loss of area to agriculture, intensive cultivation of hybrid poplar trees, corrections, aggregate mining, improperly conducted logging; construction of dams and hydropower stations, etc. In 2007 Bulgaria has designated important territories, with five distinct riparian forest habitats, for conservation in the Natura 2000 network of protected areas. But the riparian habitats are poorly represented within protected territories at the national level. The huge ecological importance of these forests, the damage they have already suffered, and the threats they face today call for immediate efforts for their restoration. Including the creation of new riparian forests by means of forestation activities using typical local species, and improving the structure and functions of existing forests through the removal of invasive species.



- Forest Restoration sites
- Towns near Danube
- Water bodies

Project names/ activities	1 Riparian Forests – Restoration and conservation of riparian forests of habitat type *91E0 in Natura 2000 sites and model areas in Bulgaria	2 Conservation And Reforestation Of 11 Natura 2000 Riparian and Wetland Habitats In 10 Bulgarian Forests	3 Riparian Forests Reforestation Activities Along The Danube River On Kozloduy, Esperanto And Masata Islands	4 Oak Forests Reforestation Activities Along The Danube River – Kovachev (Skomen) Island, Bulgaria	5 Riparian Forests Reforestation Activities Along The Danube River – Golyam Vardim Island, Bulgaria	6 Creating A 'Vardim Oak' Variety Plantation On Malak Vardim Island, Bulgaria
Implementation period	2014 – 2019	2010 – 2014	2006 – 2007	2004 – 2006	1996	The middle of 20th century
Restoration target	Improving the conservation status of the priority habitat 91E0* – alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> by directly restoring and improving the quality of the habitat in SCI (Natura 2000 site) Marten – Ryahovo.	Restoration Of Natural Habitat 91E0* On Gradina Island On Areas, Previously Occupied By Hybrid Poplar Plantations	Restoration of semi-natural alluvial forests on the islands	Restoration of natural riparian forests, habitat types 91F0 and 91E0, on Kovachev (Skomen) Island	Restoration of natural forests on Vardim Island	The plantation was created about 60 years ago and has been used as a seed base for pedunculate oak with Vardim origin for 15-20 years.
Restoration methodology used	Large sized saplings of black poplar ( <i>Populus nigra</i> ) and white willow ( <i>Salix alba</i> ) from local origin were planted, after full soil preparation in Aleko and Marten Islands on Danube river. Planting scheme 3x3 m. Soil preparation completed in the autumn of 2015, as well as the planting. Tending (by machines and manually) – 3 time per year. Fertilizing of soils, treatment against pests and diseases.	Full Soil Preparation, planting of saplings of pedunculate oak ( <i>Quercus robur</i> ), black polar ( <i>Populus nigra</i> ), white willow ( <i>Salix alba</i> ) and white elm ( <i>Ulmus laevis</i> ). Tending for 3 years. The soil between rows has not been processed during tending.	Kozloduy and Esperanto Islands Planting took place in 2006 and in Masata Island in 2007 with year-old oak ( <i>Quercus robur</i> ) seedlings of local provenance. The selected area for planting was on poplar clear-cuts, with full soil preparation on Kozloduy and Esperanto islands and with no soil preparation on Masata island. The plantation scheme was 4x1 m to allow disking. In all three sites tending for 3 years was applied, with no subsequent activities. Supplementary planting was carried out in the first three years.	Plot R: planted in 2004 with pedunculate oak ( <i>Quercus robur</i> – Vardim origin) saplings on a scheme 4x1 m. The existing natural undergrowth of false indigo-bush had a positive influence. Plot K: sowing of oak acorns, in holes. The acorns were dug out by badgers or rats and they had to be substituted by sapling planting. Reforested area: 0.2 ha Plot S: after full soil preparation, planting of small-sized pedunculate oak saplings on 3 ha on a scheme 2x1 m. Small-sized saplings are thought to sprout more successfully. Reforested area: 1.5 ha.	Initially acorns from pedunculate oak ("Vardim" origin of <i>Quercus robur</i> ) were sowed in holes on a 3 x 1 m scheme in 1996. However, the young plantation was destroyed by wild animals and required planting of small sized saplings on a dense scheme of 2x1 m. Vardim origin is very rare and also considered exceptionally valuable. This sort is resistant to long period floods (>3 months), straight-stemmed and relatively fast growing.	The plantation was created with pedunculate oak ( <i>Quercus robur</i> ) seed materials from selected individual trees from the island's <i>Stariyat Dab</i> (the old oak) protected area. The reforestation was made by applying an exceptionally dense scheme of 1 x 1 m. The aim was to allow natural self-thinning, resulting in the survival of individuals with the best qualities (including resilience, self-pruning etc.).
Results	Two locations on a total area of 9.8 ha – planted.	Plantation of 27 ha.	Total area planted: 3.5 ha • Kozloduy Island – 1.2 ha; • Esperanto Island – 1.2 ha; • Masata Island – 1.1 ha.	Total area planted: 1.8 ha In plot R a substantial annual growth rate of 60-80 cm was registered.	Total area planted: About 2 ha	At present the average diameter of the trees is 45 cm, and the maximum – 80 cm. Self-pruning is at a good level.
Current Status Of Restored Area	Survival rate – 80%. Young trees are healthy and stable.	The saplings from all 4 species are in good condition, there is self-sowing of silverleaf poplar and white willow between the rows. False indigo-bush has also settled in but so far it does not compete with the saplings.	The trees in the reforestation site on Kozloduy Island are 5 metres high, with a diameter of 8 cm. As the canopy thickened, the false indigo-bush died out.	In good condition. Natural regeneration of local tree species occurs.	The stand is in very good condition, despite the floorings in the spring.	A tendency towards the formation of a mixed forest is displayed, with elms and other tree species typical of the region settling in.
Costs	€6334 per ha	Within the project frame: about €5100 per ha, including machinery transportation, soil preparation, saplings, planting and tending.	The total budget of the project is €6 900, spent for sapling production in Galovo Nursery; soil preparation; planting; supplementing and tending of 3.5 ha oak plantation.			
Experience To Share/ Lessons Learned	As a good practice can be mentioned that during the restoration activities the existing individuals of local tree species were kept. Difficulties in finding local provenances of the specified species. Climbing plants, affecting negatively the newly planted trees, have to be removed by hand during the tending operations. Potentially devastating can be ice drifts on Danube river which happen occasionally.	The plantation tolerates spring flooding which can last for up to 50 days. As a result of the low level of the ground waters and the high temperatures in August, there are greater losses in the oak plantation. The other species tolerate these changes too.	The plantations are 10 years old. There were concerns whether the newly planted saplings would survive competition of the false indigo-bush. Subsequently it was established that initially the bush provides shade for the young oaks. In 2015 the oaks outgrew the bushes. In the third year after planting there was a prolonged flooding (3 months), but the saplings survived; explained by the fact that oak saplings of the right origin were used – they were adapted to prolonged floodings. Lessons learnt from another reforestation site in Kovachev Island (2004) were applied, and considered by the foresters as a factor of success.	The risk in working with acorns is being dug out by badgers, rats and wild boar. Where the acorns survived and sprouted, the saplings are stronger and more resilient in comparison with the planted saplings. When planning acorn-sowing activities, the unpredictability of the acorn harvests for <i>Quercus robur</i> should be considered too. In case of unfruitful year, small-sized saplings are recommended instead. The fight against the false indigo-bush is successful after a dense canopy is formed, as the bush prefers open areas. Prolonged flooding also has a negative impact on the development of this alien species.	Due to the high density of the wild boar population on the island acorn sowing is risky. Small-sized sapling planting on a dense scheme is recommended.	The wet soil, the flat terrain and the ground waters are among the beneficial factors. The negative impact of the unpredictable regulation of the water levels by the Iron Gates dam should be mentioned. As a result some trees die due to changes in the humidity regime.



## LESSONS LEARNED

- » **Planting on denser rows to mimic the natural processes.** By planting on a dense scheme we recreate conditions that are close to the natural succession, allowing for the natural processes of self-thinning and selection of the most adaptable, strong and resilient individuals. In turn, this leads to better chances of recovery for this type of forest.
- » **Riparian forests restoration on Danube islands:** the planting of saplings on islands is costly; in order to achieve high efficiency, machinery and human resources should be mobilized simultaneously. Phenomena such as unpredictable droughts and flooding pose serious risks for overall success and lead to a rise in costs. The unpredictable regulation of the water regime of the Iron Gates Power Plant also causes serious – at times irreversible – changes in the water and flooding regimes, as well as in the levels of ground waters.
- » **Scale of the activities:** until sufficient experience in the restoration of alluvial forests is gained, it is risky to plan large-scale restoration activities.
- » **Invasive species:** in the initial stage of creating young plantations of shade-tolerant tree species (for example, pedunculate oak), the false indigo-bush can have a positive effect. Experience shows that in the beginning it protects the oak saplings from the sun, providing necessary shading. Subsequently the oak saplings outgrow the bush. An effective methodology against the species is to maintain a dense canopy on plantations, as the false indigo-bush is a sun-loving species. Flooding also negatively affects it. The tested mixed methodologies for the removal of invasive species – mechanical and chemical (unselective herbicides) – also give satisfying results. However, it is important to bear in mind that the use of unselective herbicides can be harmful to the protected species in the Natura 2000 protected areas.
- » **Flooding:** experience from various projects with flooding for up to three months shows that the saplings of oak, black poplar, white willow and elm survive.
- » **Acorns or saplings?** With acorn-sowing the acorns can be dug out by badgers, rats or wild boar, leading to the need of supplementary planting. At the same time, the surviving acorn-sprouted saplings are more resilient.

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