

- Return of water to the Foki side arm of the Danube river -

The Slovak stretch of the Danube river is characterised by the formation of a large number of side arms. This is due to the nature of the area, where the flow of the river slows down and branches out on the vast Danube plain.

In the past (in the first half of the 19th century), Foki was a free-flowing Danube arm which, like the other side arms, was favoured by a number of indigenous fish species for spawning. At that time it was connected to the extensive wetlands in the Istragov area, which served as a spawning ground, a rich buffet and a nursery all in one. The whole area was one of the richest in the branch system, as a result of the mosaic of habitats that were created there.

What are the spawning grounds of native Danube fish species?

The typical breeding habitat for most of the Danube's native fish species is not the main riverbed, but the side branches, which have plenty of oxygen, a beautiful gravel bottom and at the same time more shelters and a richer food supply compared to the main Danube channel. For those species that breed in calmer waters, the connection of the side branches of the river to the surrounding wetlands is important. These are very fertile and, if combined with periodically flooded meadows or forests, there is plenty of potential food for herbivorous species and, as a result, there is a rich food supply for predatory fish species as well. An added value in the side arms of the Danube is the safer space for juveniles, guarding them from being adversely affected by boat traffic (waves often wash small fish out of the shallows onto the shore, where they become stranded and die). Moreover, if they are truly side arms with well-functioning dynamics, they are naturally a combination of shallower and deeper parts that serve as wintering grounds for fish during the winter and perform a similar function on hot days.

The fate of the Danube's side arms in Slovakia

The Danube's side branches have been affected by several interventions in the river's course in the past. The first was the adaptation of the Danube for navigation and the associated straightening of the main channel by fixing the banks with large stones and the construction of guiding structures. The straightening of the channel has accelerated the river flow, which has led to a more intensive process of gravel transport from the riverbed. This measure started the process of deepening of the bed of the main channel of the Danube, which is associated with a gradual change in the flow dynamics of the side arms. This does not happen immediately, but gradually in small steps that are imperceptible in themselves. They only become apparent when long-term measurement data are evaluated. The deepening of the stream bed leads to an earlier interruption of the flow of water into the lateral arm systems. The water in the arms thus flows shorter during the year. It is common for side branches or parts of branches/branch systems to be without water or with little water for part of the year - this is also part of the river dynamic, and some animals and plants are directly linked to such intermittently dry river channels, but when the main channel is deepened, the dry periods are prolonged.

Later, further modifications followed on the Danube. The most drastic impact measure in terms of the side arms was the gradual disconnection of the side arms by filling in the entire inlet areas or even the

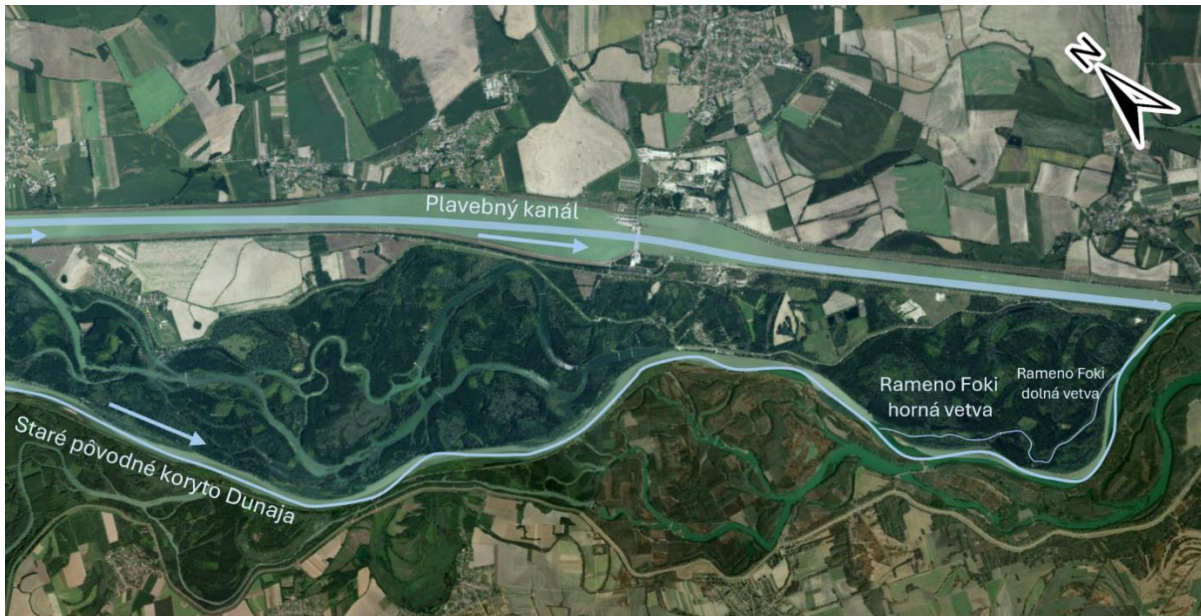
outlets. As part of the modifications for navigation - to improve navigation and, above all, to prolong navigation on the Danube even in periods of lower flows - stone groynes were built in the main course of the river. Their function is to direct the main flow of water into the Danube's navigation fairway. The groynes are stone structures running approximately perpendicular to the bank line and concentrating the flow in one corridor - the fairway.

How have the modifications affected the Foki arm?

Originally more than 10 km long, the magnificent Foki arm was dammed during the modifications and divided into an upper still-flowing section (approximately 2 km long) separating a group of smaller islands and a lower section (approximately 8 km long), which had a closed inlet and separated a group of several larger islands. In the upper part of the arm, stone directional structures were built, as well as a set of groynes. This had a significant impact on life in the arm - the flow slowed down, which encouraged increased gravel accumulation, and the islands in the upper part of the arm became progressively larger. During this period the fish still had access to the Foki arm and further into the extensive wetlands in the Istragov area - both of which were important areas for reproduction.



Topographic map of the Foki arm and Istragov area from 1990 - before the start of the VDG operation (source: www.staremapy.sk)



Closer localization of the side arm Foki in the left-side arm system of the Danube (the arm is divided into upper and lower parts) (BROZ archive)

The most dramatic change for the Foki arm came with the construction of the Gabčíkovo Dam and navigation channel, when most of the water (80%) from the old Danube channel was diverted into the artificially constructed navigation channel. After these interventions, the old Danube channel from Čunovo to Sap (more than 40 km of the river), including the Foki arm, remained almost dry - with only a minimal amount of water. Instead of the original average flow of 2000 m³/s, only 200-400 m³/s of water was flowing through the original Danube channel. The stone linear constructions and groynes in the upper part of the Foki arm have since become unbreachable barriers, as the normal levels in the old Danube channel have dropped by several metres. Since then, water has flowed into the arm only exceptionally and the whole section of the side arm has gradually become silted up and degraded. The connection of the Foki arm to the extensive wetlands of more than 100 ha in the Istragov area (which dried up completely within a short time) and the connection of the wetlands and arms in the area below Istragov - a total area of approximately 300 ha - was completely severed. The fish have lost the opportunity to find suitable spawning grounds in this area.

The current and future Foki side arm

Within the Slovak stretch of the Danube, some side branches have already been reconnected to the main river channel, improving their water regime, accessibility for fish and overall flow dynamics. Since the construction of the VDG, the Foki arm has had a very non-standard water regime for the conditions in the Slovak section of the Danube, which is related to its location near the confluence of the old Danube channel and the waste channel leading away from the VDG. The Foki arm is located in the lower part of the arm system in the municipalities of Gabčíkovo and Sap. It is situated along the old Danube riverbed, i.e. in the section with the most negatively affected water regime as a result of the diversion of water into the artificial navigation channel. At the same time, it is located in close proximity to the confluence of the old Danube riverbed and the waste channel leading from the

Gabčíkovo hydroelectric power station (at the level of the village of Sap). Therefore, if the flow in the waste channel is significantly higher than the flow in the old Danube riverbed, water flows from the confluence in the opposite direction into the old channel, in other words the water swells in the direction away from the waste channel. There are therefore situations where water flows in the opposite direction through the arm.

The in-situ restoration of the water regime in the upper part of the Foki arm started in September 2024. The first step and the fundamental basis for the design of the revitalisation measures was an expert hydrological study (Holubová & Mravcová, 2021). Based on its results, technical documentation for the reconnection of the arm to the old Danube riverbed and the restoration of the water regime in the upper section (length 2 km) was prepared in 2022 by experts from the Slovak Water Management Company (SVP, š.p.).

The revitalisation measures are divided into two stages. The first stage is aimed at removing the obstacles in the flow - two stone traverses in the arm. They are removed in the width proposed for the restoration of the channel of the arm. This stage also includes the modification of three old stone groynes to re-establish water flow in the Foki side arm. The second phase consists of the restoration of the basin of the side arm for a total length of more than 2 km and its reconnection to the main basin of the Danube.

The restoration of the water regime in the arm and its connection to the main channel of the Danube will allow Danube fish species to access their spawning grounds located in the side arm and will improve the overall water regime in this part of Danube nature. This is important for many animal species, but also for one of the most endangered habitats, which is directly linked to the river dynamics - the floodplain forest.

An important advantage for us – humans

Revitalisation measures in the Foki side arm will have a positive effect for the Danube nature, but also for humans. This is another activity where the cooperation of water managers and conservationists is having a positive effect. Thanks to these measures, the capacity of the floodplain in this area will be increased. This is important for the management of flood flows in the Danube and protection against flood damage.

Thanks for supporting the project

The above revitalisation measures are part of the international LIFE project Dynamic Lifelines Danube (LIFE18 NAT/AT/000733) supported by the European Commission as well as the Ministry of Environment of the Slovak Republic. They are also financially supported by the Open Rivers Programme for removing barriers from rivers called Foki for Fish (Foki for Fish 2023 - 04 - 431) and by the Telekom Foundation - grant No. STPG 24_05 Removing Barriers - for living rivers.



Isolated relics in the upper part of the former side arm of the Foki (upstream view; the old Danube riverbed is on the left) (BROZ archive)



Isolated relics in the upper part of the former side arm of the Foki (view downstream; the old Danube riverbed is on the right) (BROZ archive)



Work on removing of stone barriers in the basin of the Foki side arm (BROZ archive)



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