



**Making the
Iron Gate Dams
Passable!**

Making the Iron Gate Dams Passable

The DANUBE RIVER BASIN

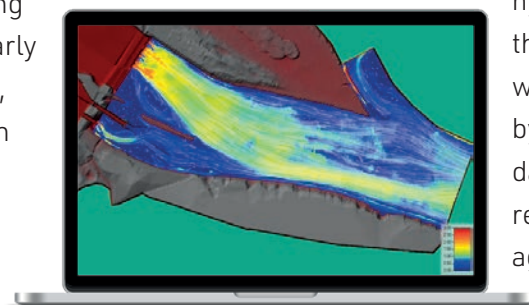
is the most international river basin in the world, covering 817,000 km² and extending into the territories of 19 countries. The Danube ecosystem contains about 2,000 plant species and 5,000 animal species, 135 of which are fish. Notably, the Danube is a critical habitat for endangered sturgeon, the flagship species of the river. These sturgeons grow up in the Black Sea and migrate upstream in the Danube to spawn. However, the construction of the Iron Gate 1 and 2 Dams has significantly impacted sturgeon and other migratory fish populations, as these structures act as impassable barriers that block fish migration to their upstream spawning grounds. This interrupted fish migration also negatively affects the overall ecosystem of the Danube River Basin.

The WePass2 project aims to overcome these obstacles and restore fish migration for sturgeon and other migratory fish species between the Black Sea and the upper Danube River Basin. This effort includes the preliminary design of the largest fish passages and descent systems in Europe.



Designing the LARGEST FISHWAYS IN EUROPE

Creating an effective fish passage requires considering various factors during the preliminary design, particularly biological and hydraulic aspects, as well as spatial constraints such as infrastructure and EU habitat areas.

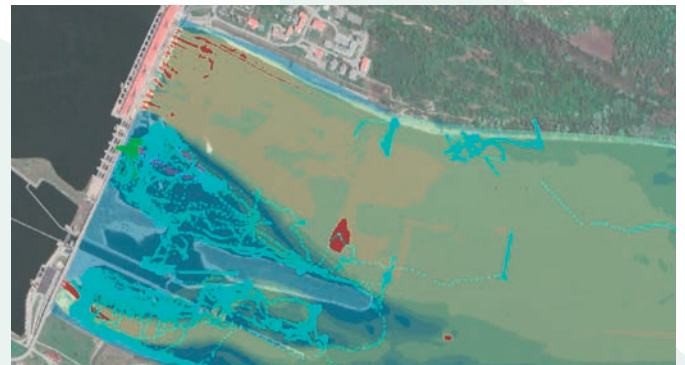


Hydraulic modelling

FISH MOVEMENT STUDY

The fish movement study aimed to track the movements of different species downstream of the dams and within the reservoir to identify potential fish pass entrance locations. To do this, 228 individuals from five different fish species were tagged with acoustic transmitters that sent unique signals.

From November 2021 to August 2022, multiple acoustic receivers tracked approximately 6 million movements of tagged fish downstream of the Iron Gate 2 Dam. The data helped identify fish movement patterns and pinpoint areas that would be suitable for fish pass entrances.



Results of the hydraulic model: Velocities during a typical fish movement scenario combined with tracked fish movement in turquoise

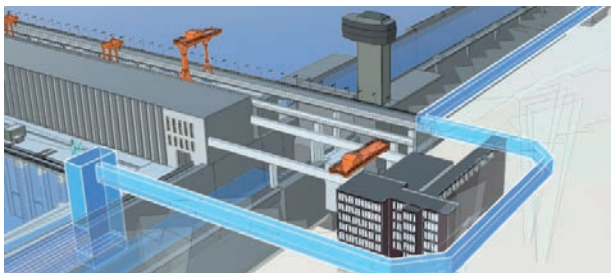
HYDRAULIC MODELLING

In addition to biological input, examining the hydraulic conditions of the river is crucial. Factors such as river discharge, turbine operation, and water levels downstream of the dam influence fish movements. Understanding areas where fish gather is essential for optimally positioning fish pass entrances. The planning process included

hydraulic modeling to assess these conditions. Heat maps were created for each species by combining fish movement data with hydraulic model results, highlighting key aggregation areas.

Fish Migration Options

Various fish migration restoration options were identified and evaluated for feasibility at Iron Gate 1 and 2, focusing on upstream and downstream fish passage in the Danube. The designs considered the size and hydraulic needs of sturgeons, based on previous studies of their migration behavior. Initially, 27 fish passage concepts were developed and discussed at a stakeholder meeting in 2023. Preferred options for both Iron Gates 1 and 2 were then selected as options for possible implementation.



NON-VOLITIONAL FISHWAY

Suitable for Iron Gate 1 and 2

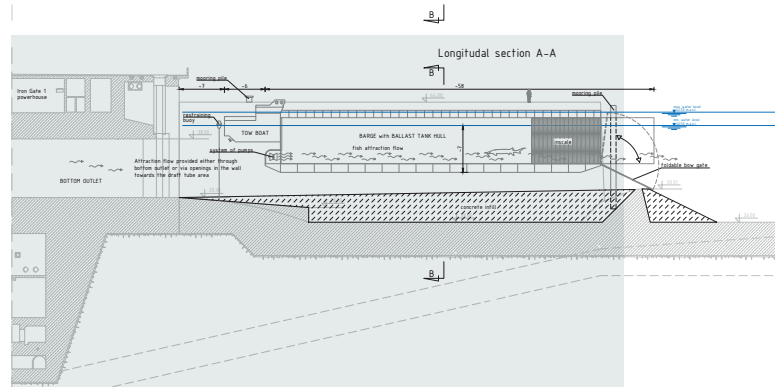
Also known as fish lifts and locks, these non-volitional fishways are alternative solutions for pool-type fish passes when the head exceeds 10-15 meters. They have a small footprint, making them ideal for sites with limited space due to dam and hydropower station constraints. The fish lift operates in four phases: Fishing, Filling/Crowding and Raising, Exit/Releasing, and Draining/Lowering.



NATURE-LIKE BYPASS CHANNEL

Suitable for Iron Gate 2

This hybrid option combines technical pool-type sections with nature-like reaches that mimic natural flow and habitat features. The fish pass starts with a technical entrance and vertical slot pass, followed by a nature-like channel. Depending on land availability, the end of the channel could feature either a vertical slot pass or a full nature-like bypass.



TRAP & BARGE

Suitable for Iron Gate 1 and 2

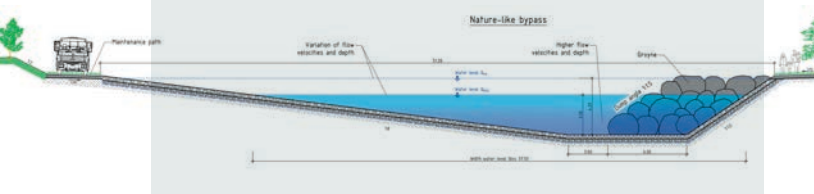
This method is inspired by existing floating trap and barge systems and is considered only as an interim solution. Fish are trapped downstream of the dams and transported upstream by ship, which then releases them in the upper reservoir. Though temporary, this method helps optimize entrance positions for permanent fishway solutions.

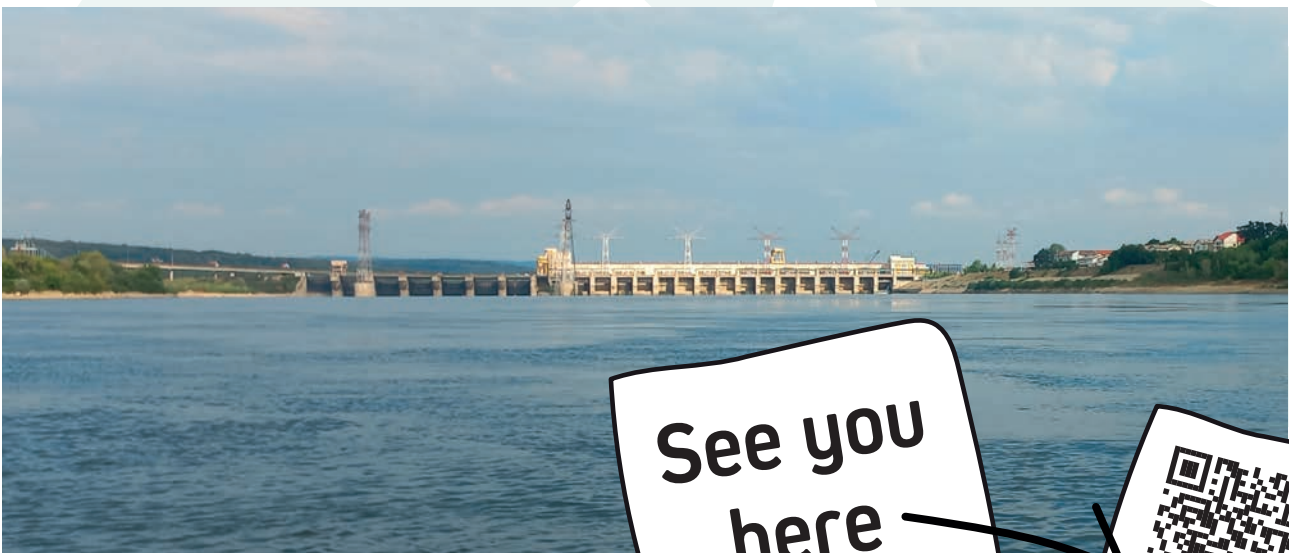


POOL-TYPE FISH PASS

Suitable for Iron Gate 2

A pool-type fish pass divides the total height ascent into a series of small drops within pools, each providing resting areas and fish passage slots. The success of this fish pass depends on the proper dimensions and design of the pools and cross-walls, which together with the water slope, influence the hydraulic conditions of the fish pass.




Iron Gate 1

Iron Gate 2

WePass2 is an initiative dedicated to enhancing fish migration in the one of the world's most international river basins: the Danube River Basin. A multidisciplinary team of experts from CDM Smith, ICPDR, DDNI, DTU, IMSI, Jaroslav Cerni Institute, NINA and OAK is focused on restoring migration routes for common and endangered fish species in the Danube River, its tributaries, and specifically around the Iron Gate Dams.

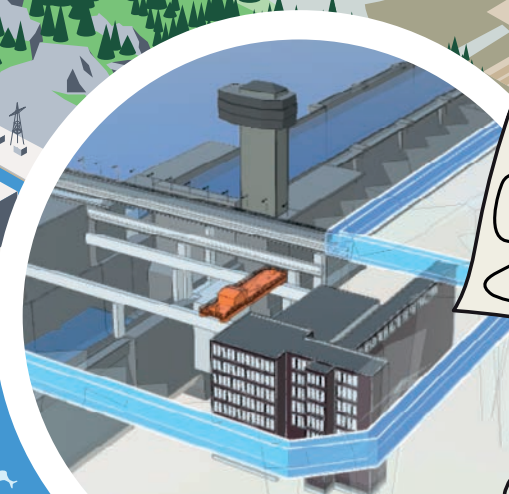
More about WePass2:
<https://www.cdmsmith.com/en-EU/Client-Solutions/Projects/WePass2>

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Fish Lift
That's so cool - a lift for fish!
Perfect for sites with limited space where the head is greater than 15 m.



Fish Lift with Exit Channel
I find my way easily!
Fish lifts and locks have a small footprint.



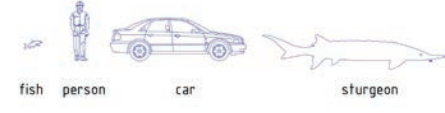
Let me pass!



Danube Ecosystem
Home to:
2,000 plant species
5,000 animal species
135 fish species

Making the Iron Gate Dams Passable
Help us swim upstream!
Sturgeons grow up in the Black Sea and use the Danube's middle and upper river course as their spawning grounds. However, since the construction of Iron Gate 1 and 2, these dams have blocked migration paths, severely impacting sturgeon and other migratory fish populations.

Sturgeon
Did you know?
The largest sturgeon ever caught weighed 1,571 kg and was 7.2 meters long, making it the largest freshwater fish in Europe!



Bypass Channel
Traveling through a nature-like channel makes me happy!



Pool-type Fish Pass
I make my way one pool after another.
That's how I travel!



Movement Study
Where am I?
Tracking fish movements helps identify the best spots for fish pass entrances.

