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Elaboration of expertise for habitat and population conservation of Danube salmon (*Hucho hucho*) in the middle Sava river

Target research programme

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About the project

Partners on a project:

- **University of Ljubljana, Biotechnical faculty** – the leading partner
dr. Simona Sušnik Bajec, [Tel:+386\(0\)1 3203944](tel:+386(0)13203944), e-mail: simona.susnik@bf.uni-lj.si
- **Fisheries Research Institute of Slovenia**
- **Institute For Water Of The Republic Of Slovenia**
mag. Sašo Šantl, [tel:+386\(0\)14775367](tel:+386(0)14775367), e-mail: saso.santl@izvrs.si

Duration of the project:

1.7.2014 – 30.6.2016

The project is supported by:

Slovenian Research Agency and Ministry of agriculture, forestry and food

The goal of the project is to elaborate an expertise on Danube salmon's biology, ecology and genetics which are not yet sufficiently investigated. The expertise will represent a basis for a national strategic decision on the utilization of the energy potential of the middle Sava (the stretch between HPP Medvode and confluence of The Sava and The Savinja).

The objectives of the project

The main objectives:

- To perform ichthyological investigations which we'll result in new data and complete the distribution map of the Danube salmon in the middle Sava;
- To survey the spawning grounds;
- To evaluate the passability of the existing water obstacles by Danube salmon and common nase (*Chondrostoma nasus*) in the middle Sava;
- To present and evaluate the existing mitigation measures used at the HPP outside of Slovenia
- To show the changes in the suitability of the habitat for Danube salmon and common nase by the use of habitat modelling as a tool, in the case of:
 - water extraction (derivation type of HPP) and
 - accumulated water (accumulation type of HPP);
- To determine the genetic structure of Danube salmon in the middle Sava and compare it to structure of other populations in Slovenia and abroad.

Geographic range of Danube salmon

Native only in the Danube drainage, where it has a very fragmented distribution.



Population in Slovenia represents an important fragment.

The core area, representing the largest and the healthiest population of Danube salmon in Slovenia is in the Sava River.

Sampling of Danube salmon

Sampling methods

Angling

Sport fishing

Fishing with electricity by boat

Fishing with electricity by wading

Information gathered

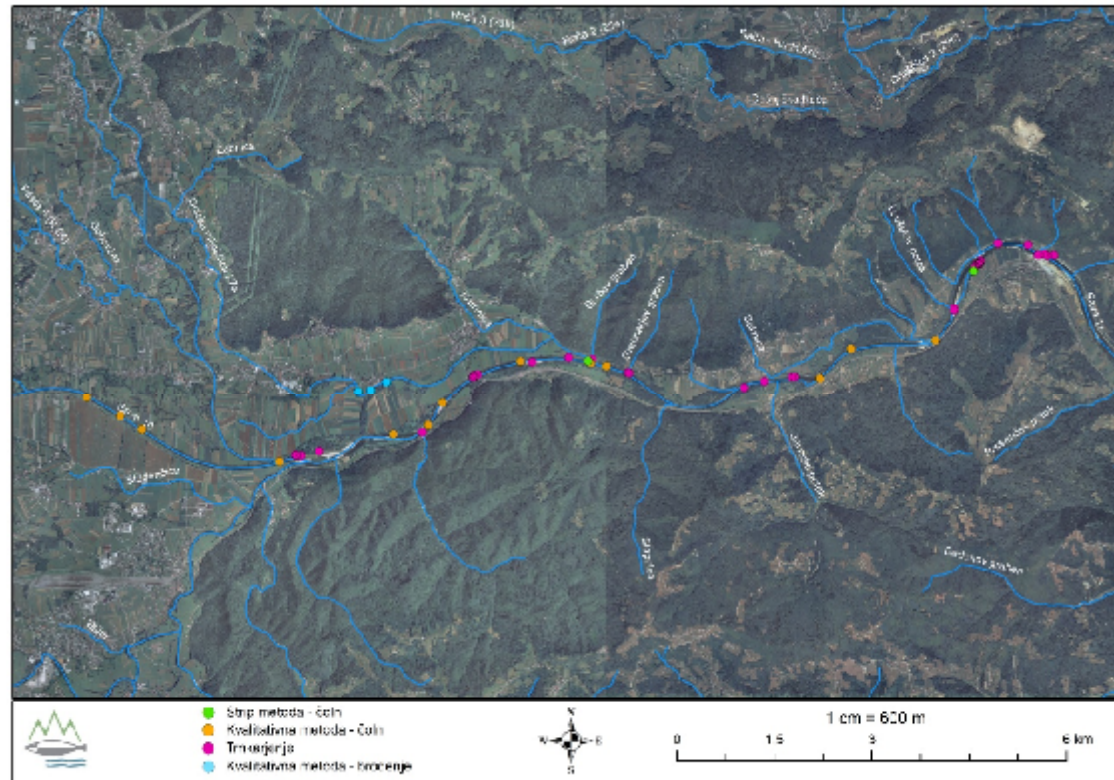
Length and weight measurements

Tagging

Taking samples for DNA analysis



Locations of Danube salmon



The Sava between Šentjakob and Vernek was sampled by **four different sampling methods**. **66 specimens were caught** and measured.

Tagging of Danube salmon

Tagging of Danube salmon has been performed since 2008.

The middle Sava with tributaries:

- 2183 specimens tagged
- 32 recaptured

The record holder

(tag number SLO 7692)

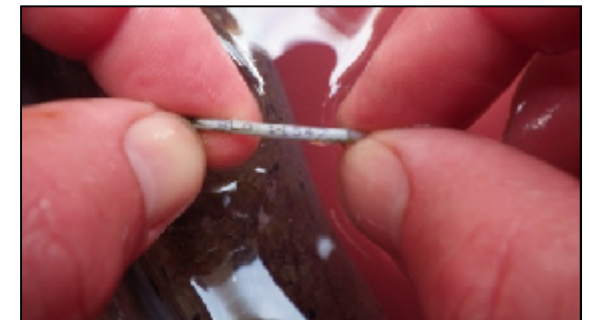
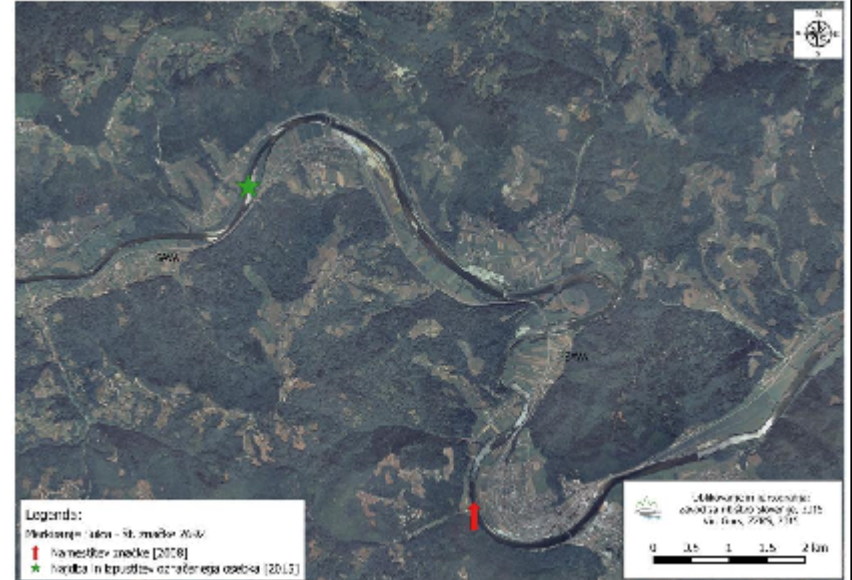
Release - capture time: 7 years

Increase in mass: 7545 g

Increase in length: 580 mm

Avg. growth rate: 82 mm/year

Distance traveled: 10,8 km
upstream



Survey of the spawning grounds

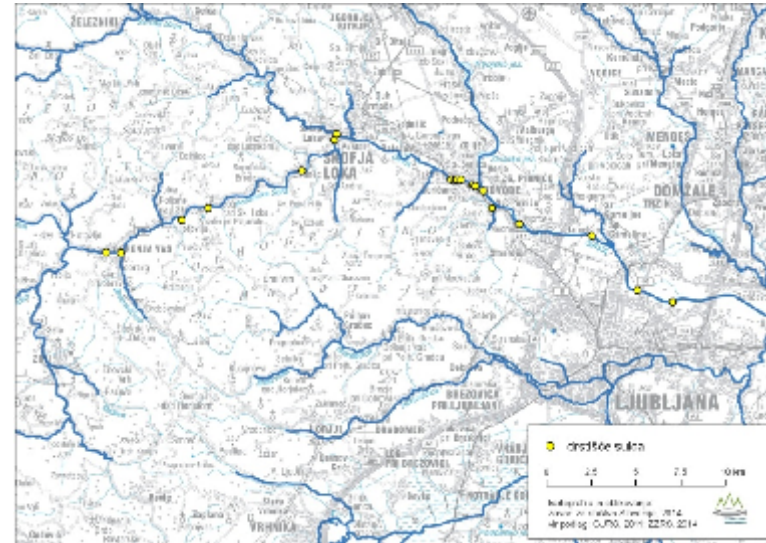
Survey of the Danube salmon's spawning grounds has been performed since 2013.

The middle Sava:

- 7 fishing clubs involved + FRIS
- 28 spawning grounds surveyed

Data has been gathered:

- water temperature
- time and duration of spawning



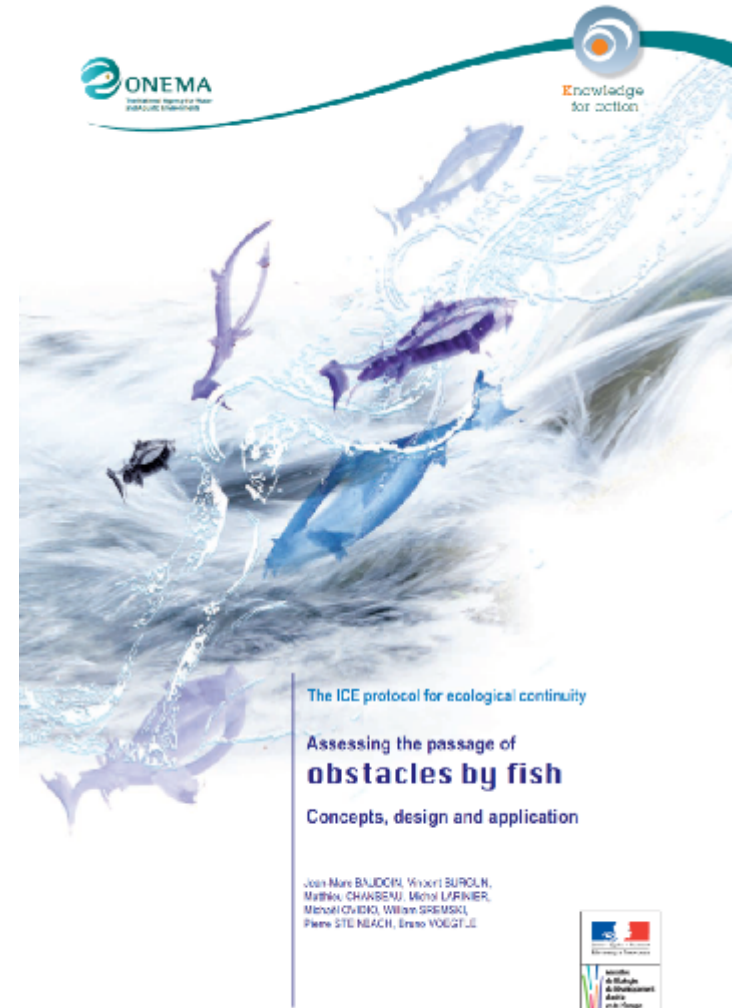
Assesment of the passability of obstacles by Danube salmon and common nase

Detection of water obstacles in the middle Sava and the tributaries that significantly influence the fragmentation of the population of Danube salmon.

Assesing the passability of some chosen water obstacles by the use of ICE protocol.



22.10.2015



Evaluation of the mitigation measures

- Mostly used mitigation measures to compensate the negative impacts of the HPP:
 - fish passages;
 - close-to-nature compensatory streams;
 - close-to-nature shores of accumulation lakes, islands and renaturated tributaries;
 - operational regime of the HPP that is adapted to the ecological requirements of the fish (e.g. during spawning season).

HPP Gössendorf and HPP Kalsdorf (AUT)



River Aare, Ruppoldingen (CH)



Habitat modelling

Main phases of habitat modelling:

Data acquisition:

Bathymetry, substrate, water flow type and cover. Ichthyological study and water flow/depth measurements to support calibration.

Input data preparation:

Hydraulic modelling -> data on water depths and velocities for sets of discharges; data on substratum, cover and water flow type.

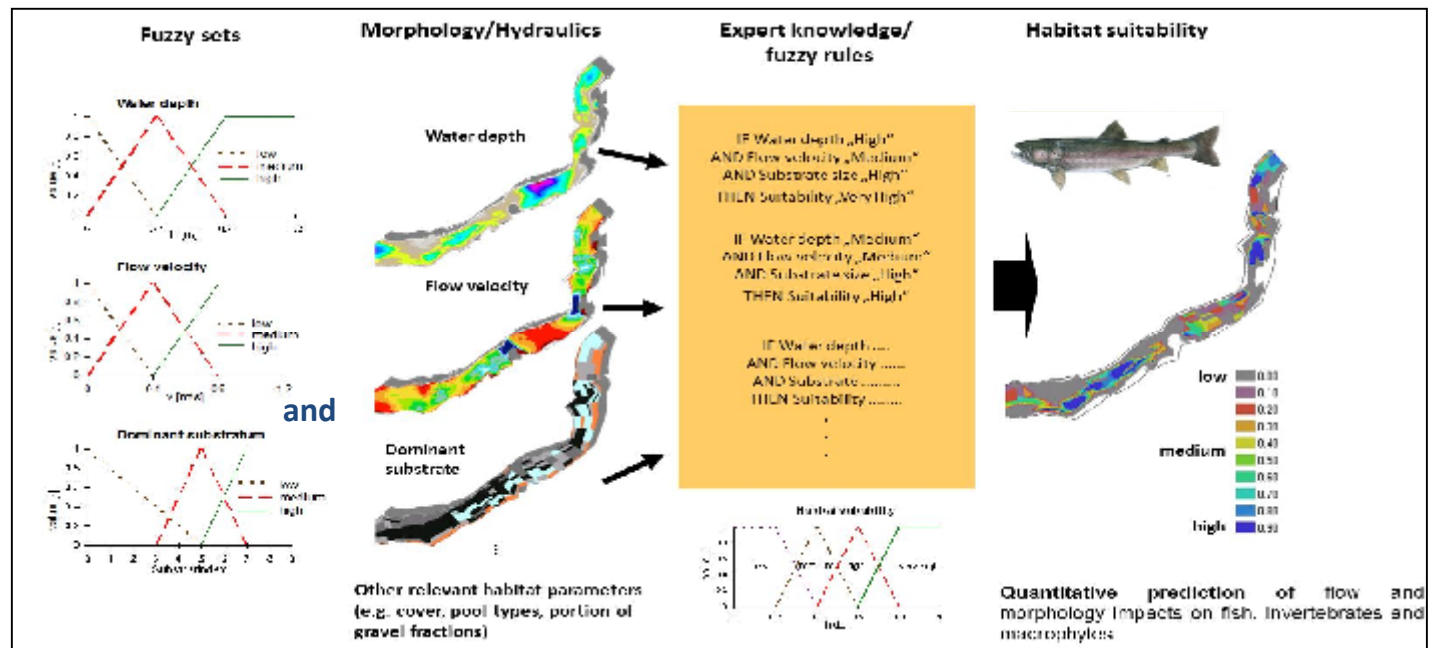
Setting fuzzy sets/rules:

Determination of dependencies and classes of suitability on the basis of expert knowledge and ichthyologic studies.

Habitat suitability analysis: three situations ->

- Unmodified river
- Accumulation lake
- Extraction of water

Applied principal of the fuzzy rule-based approach:



Taken from:



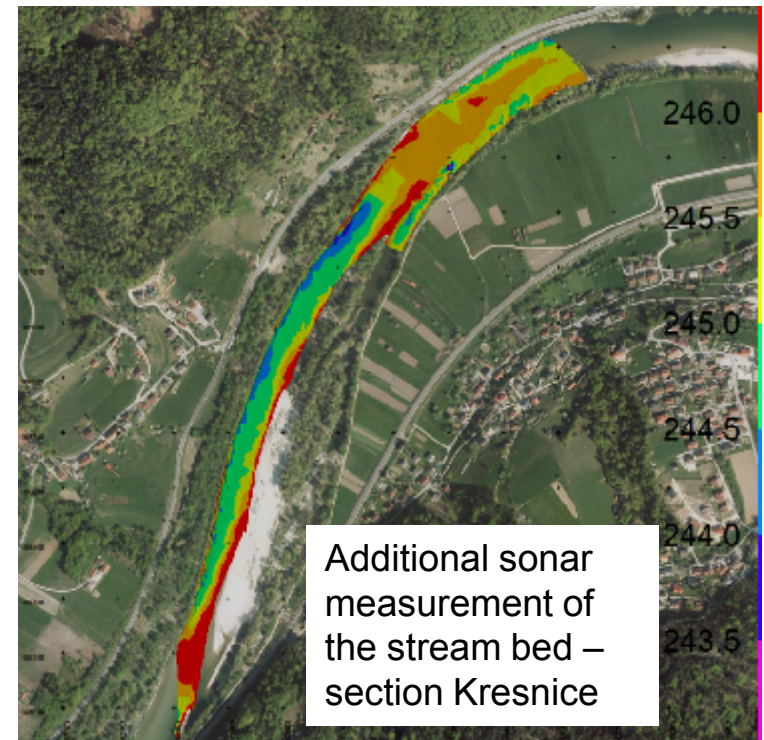
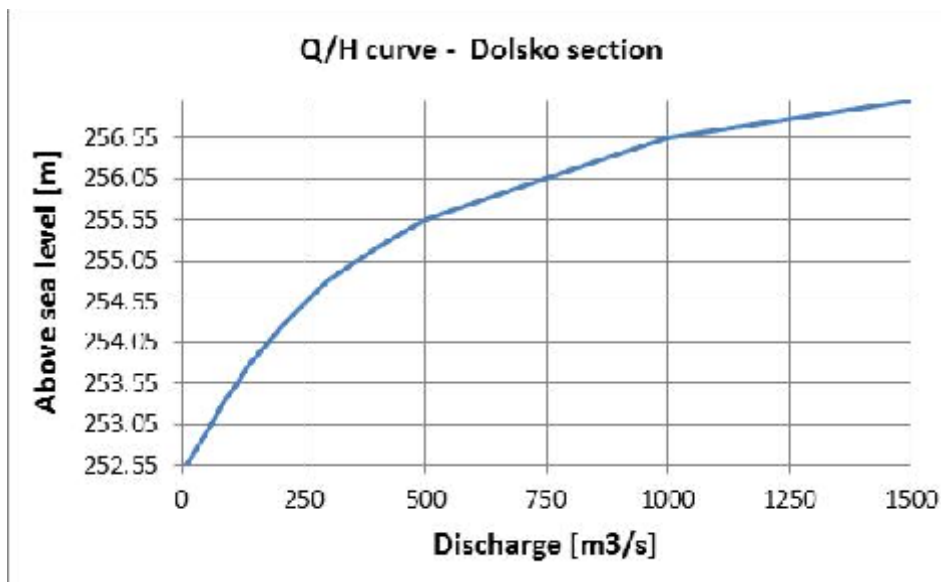

 Schneider & Jorde
 Ecological Engineering

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Habitat modelling

Data acquisition and preparation:

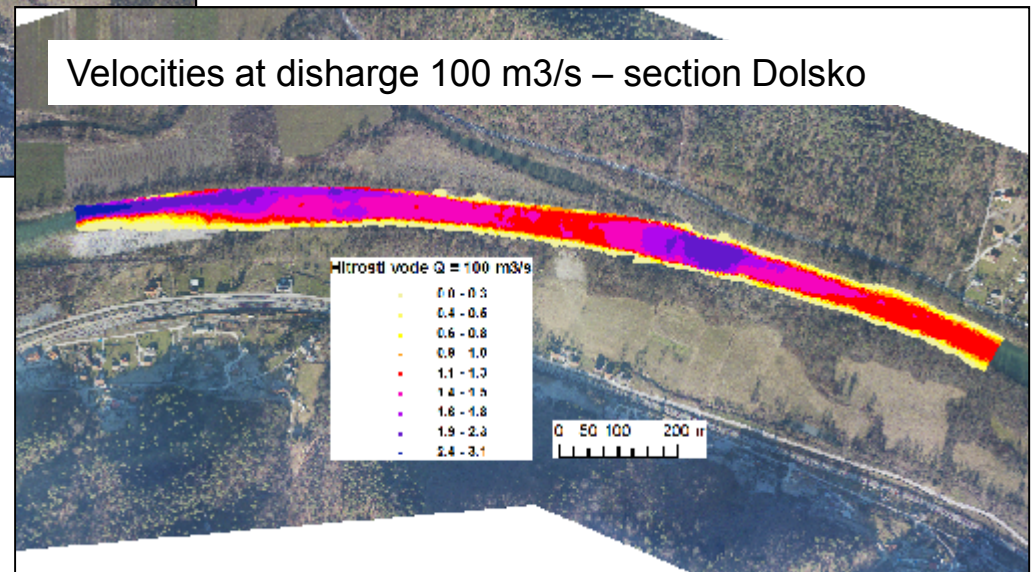
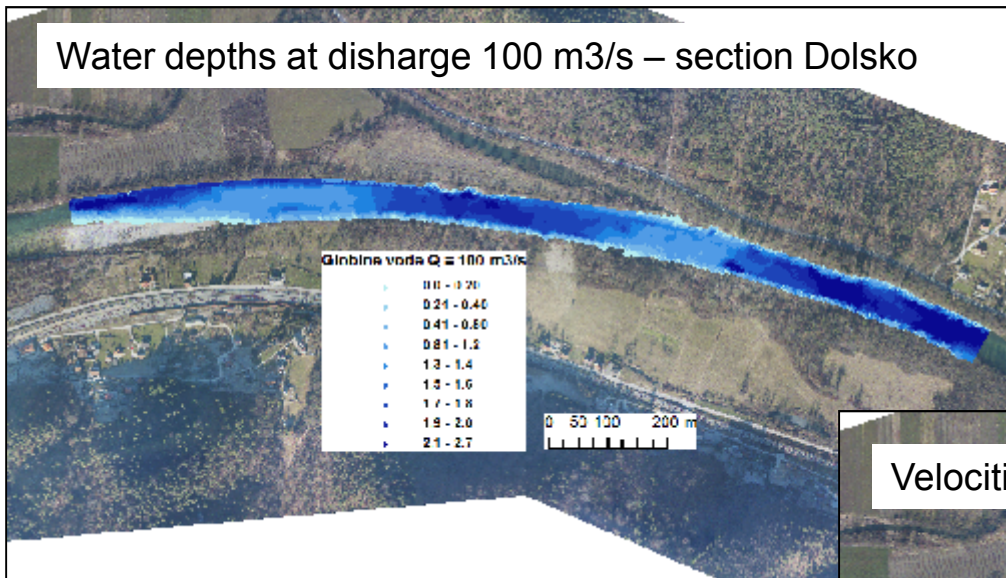
- Two sections of middle Sava were chosen, Dolsko (1.7 km) and Kresnice (1.3 km).
- Bathymetry was prepared on existing LIDAR data and additional sonar measurements of stream bed,
- Hydraulic modelling with calibration phase



Habitat modelling

Data acquisition and preparation:

- Depth and velocity was calculated for series of discharges from 10 to 200 m³/s

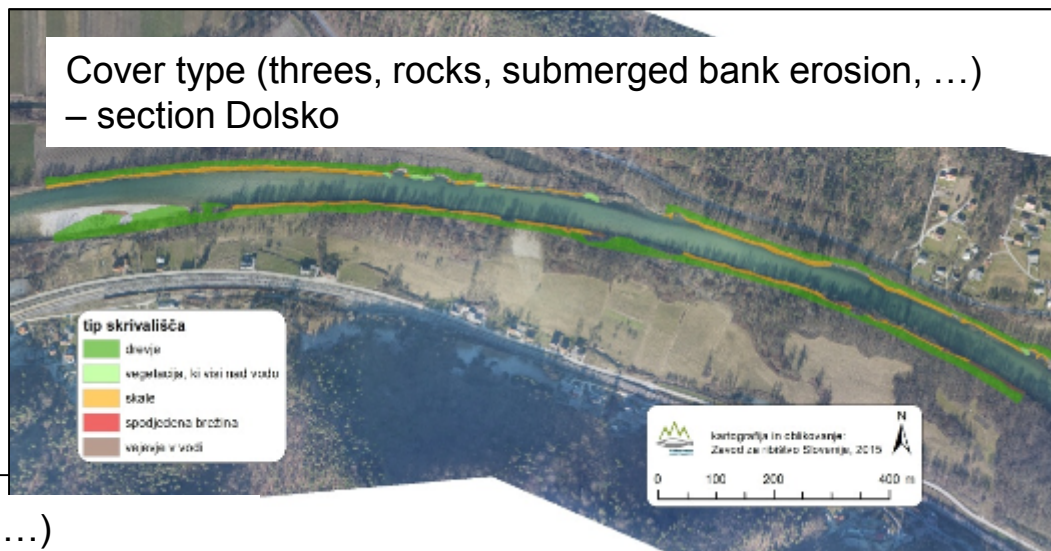


Habitat modelling

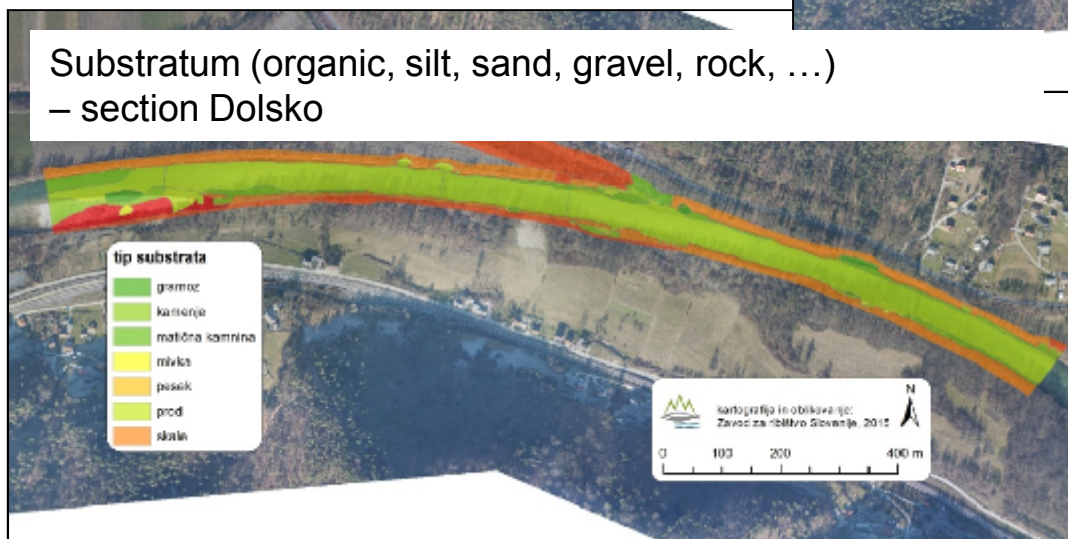
Data acquisition and preparation:

- Preparation of data for cover, substratum and type of water flow

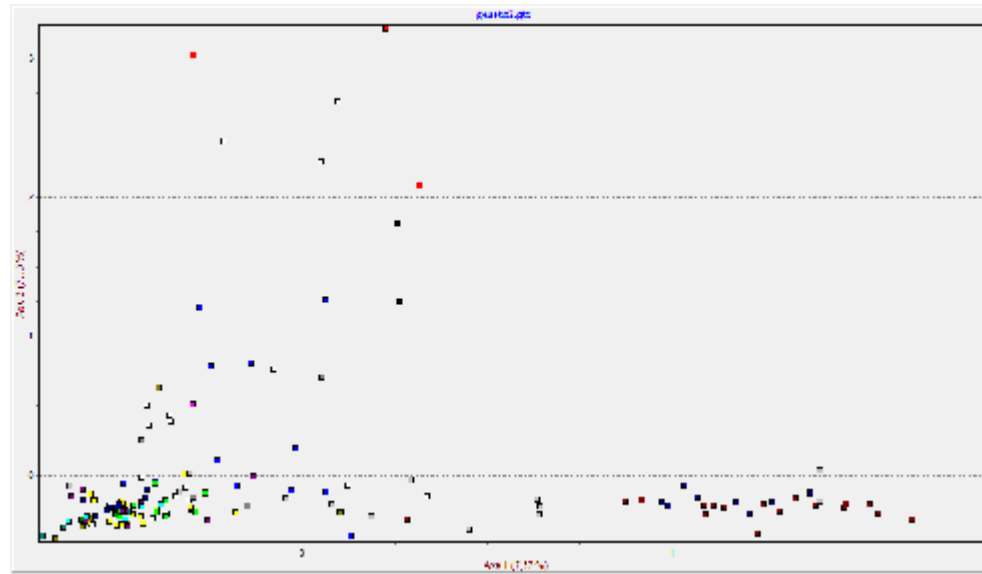
Cover type (trees, rocks, submerged bank erosion, ...) – section Dolsko



Substratum (organic, silt, sand, gravel, rock, ...) – section Dolsko



- 40 samples, collected in 2014 and 2015
- Analyses of mtDNA (ND gene) and 12 microsatellite markers
- Preliminary results: homogenous but polymorphic population of Danube salmon in the middle Sava



- Future perspectives: analyses of samples from other locations in Slovenia, analyses of historical samples (scales), detailed statistical analyses including all analysed samples from Danube salmon.

Action plan

One of the results of the project will be a creation of **The Action plan for the conservation of the population of Danube salmon and its habitat in the middle Sava.**

Action plan:

- will be based on the **findings** that will result from the project and the **knowledge** on Danube salmon.
- Will include the **guidelines** for the **fisheries management**, opening the corridor of now disconnected or poorly connected parts of population to improve **longitudinal connectivity** and suggestions for the further **monitoring and investigations.**
- **Will not include guidelines how to build a chain of HPP and protect the population of Danube salmon at the same time.**



Thank you for your attention!

22.10.2015