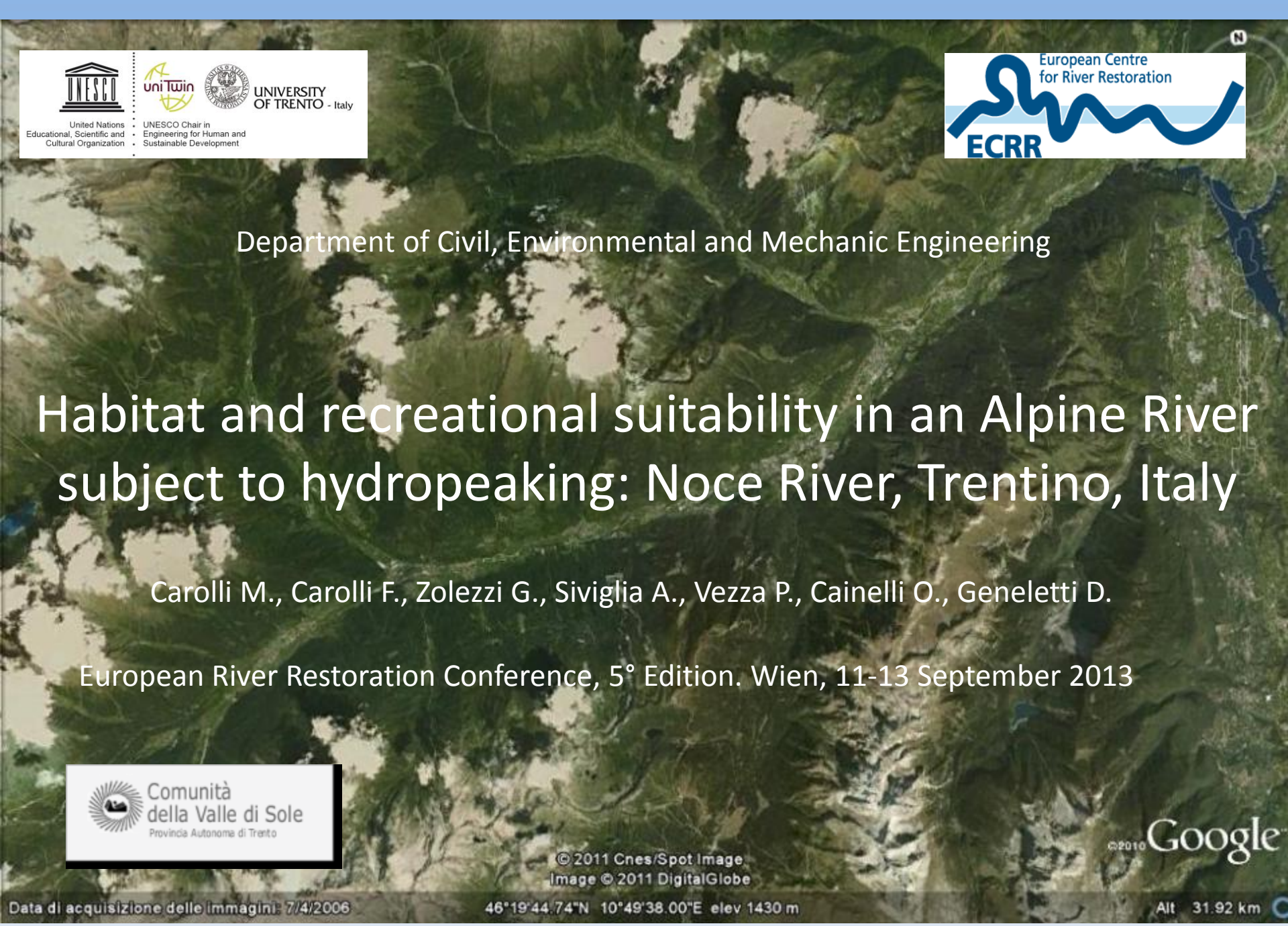
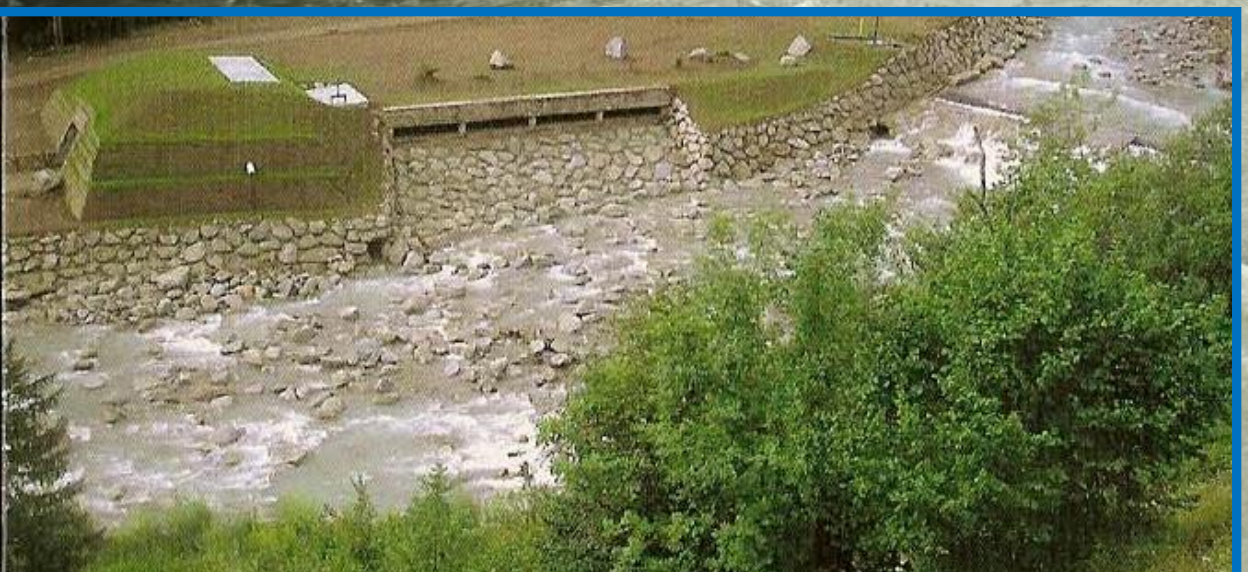

UNESCO
United Nations Educational, Scientific and Cultural Organization
uniTwin
UNESCO Chair in Engineering for Human and Sustainable Development
UNIVERSITY OF TRENTO - Italy
European Centre for River Restoration
ECRR
Department of Civil, Environmental and Mechanic Engineering
Habitat and recreational suitability in an Alpine River subject to hydropeaking: Noce River, Trentino, Italy
Carolli M., Carolli F., Zolezzi G., Siviglia A., Vezza P., Cainelli O., Geneletti D.
European River Restoration Conference, 5° Edition. Wien, 11-13 September 2013
Comunità della Valle di Sole
Provincia Autonoma di Trento
© 2011 Cnes/Spot Image
Image © 2011 DigitalGlobe
©2010 Google
Data di acquisizione delle immagini: 7/4/2006
46°19'44.74"N 10°49'38.00"E elev 1430 m
Alt 31.92 km

1. Problem focus
2. Study area
3. Objectives
4. Methods
5. Results
6. Preliminary conclusions

Multiple use of river

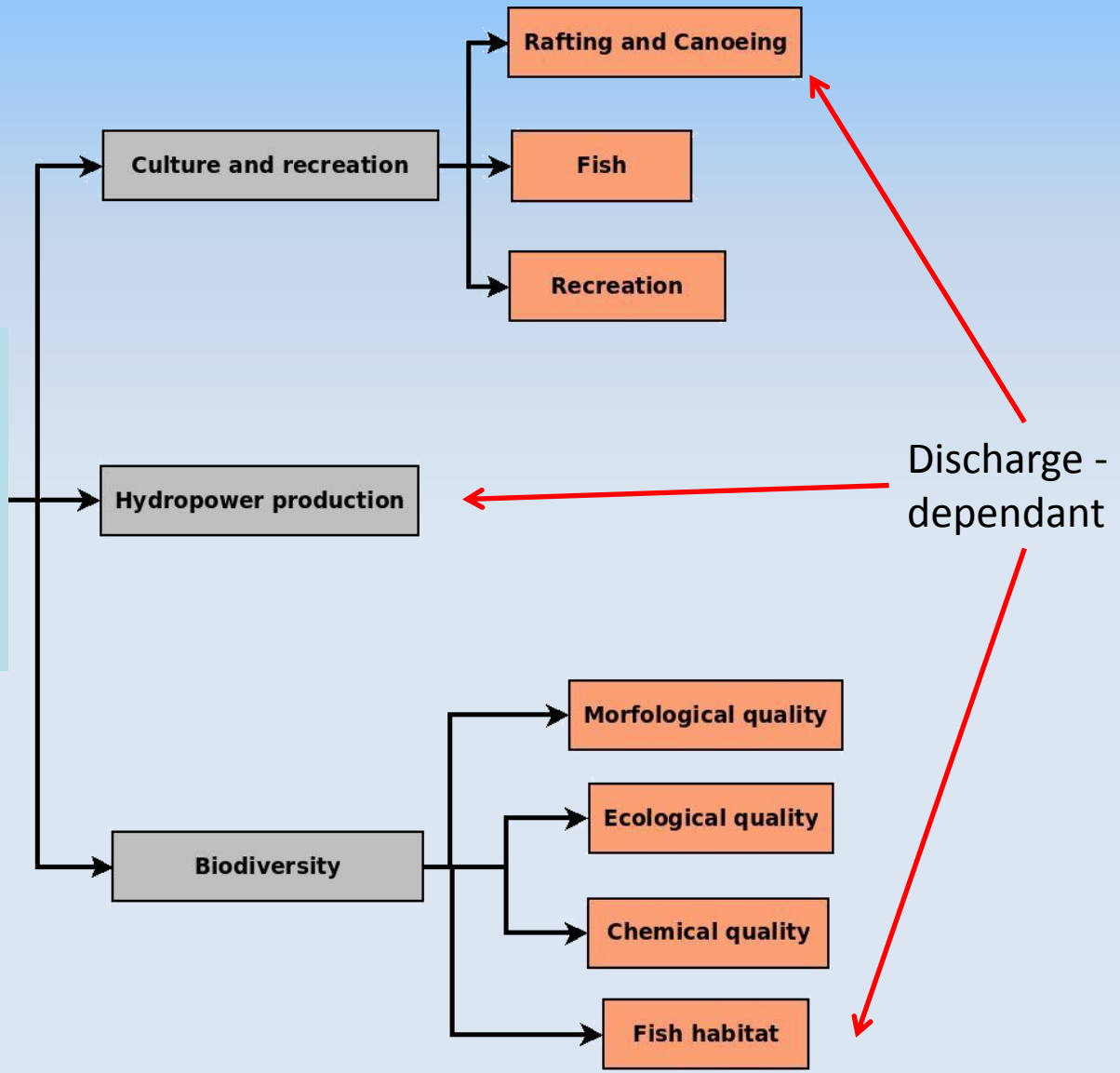
?

?



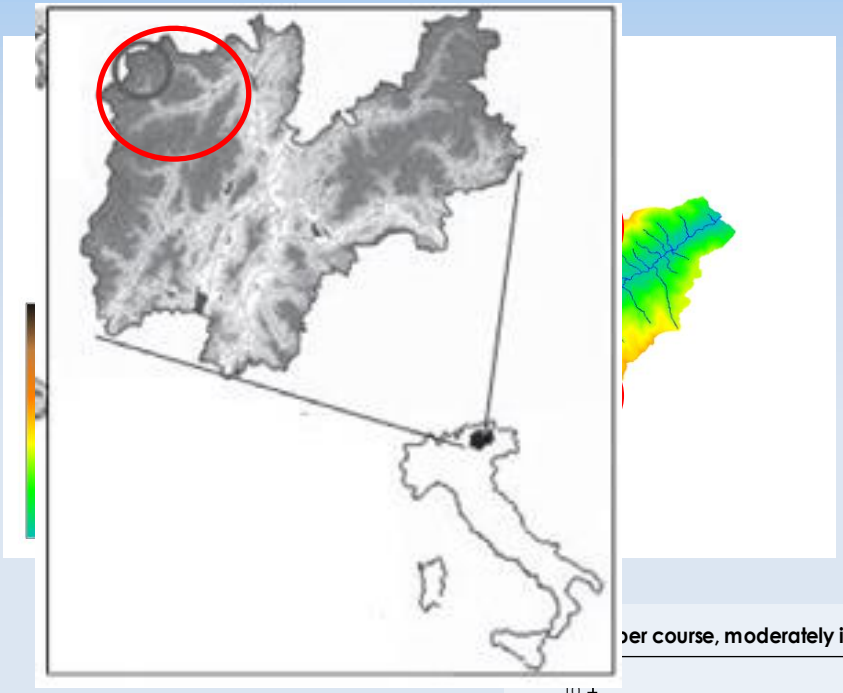
Ecosystem services approach: Spatial Multicriteria Analysis

Ecosystem services: resources and processes supplied by the ecosystems to the humankind (MEA, 2005)



Study Area: upper Noce River basin

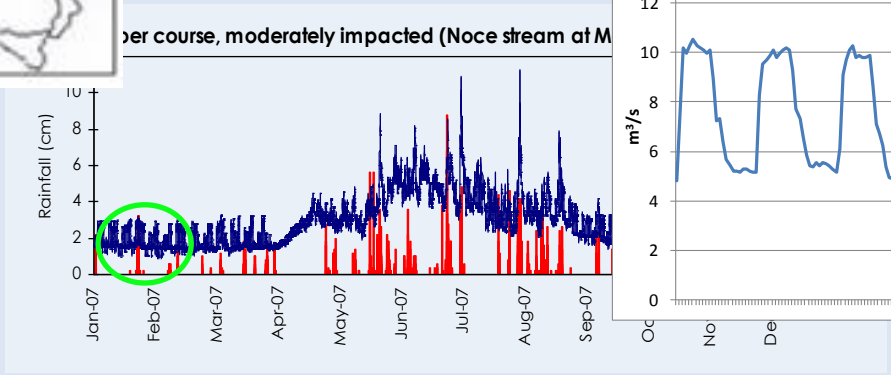
Gravel bed Alpine tributary of the Adige River in Trentino

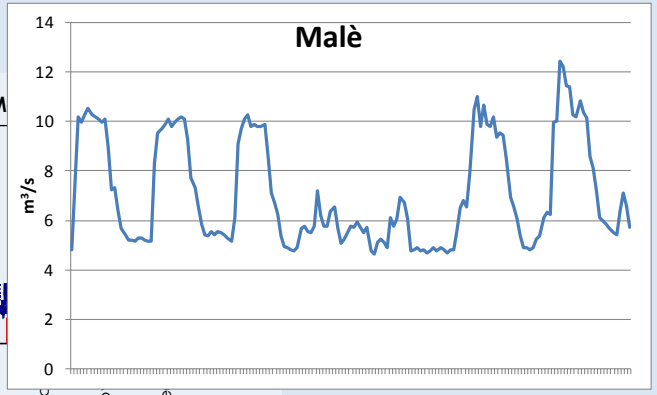


Three main tributaries:
Vermigliana
Meledrio
Rabbies

Two large dams close to the source

Hydropeaking





Objectives

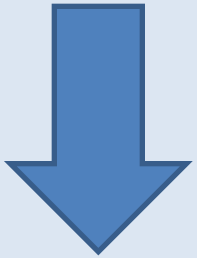
Four different discharge scenarios

Environmental flow

Habitat modelling of a target specie (marble trout)

Recreational flow

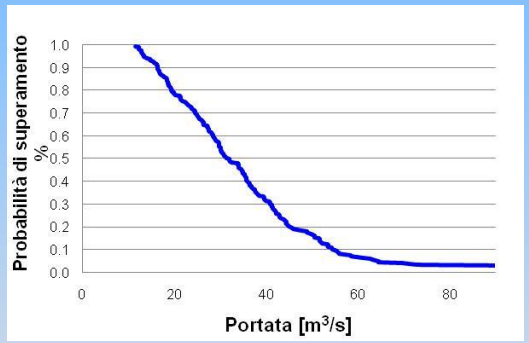
Modelling of navigability for rafting and canoeing



Suitability for trout and rafting in different discharge scenarios

Methods

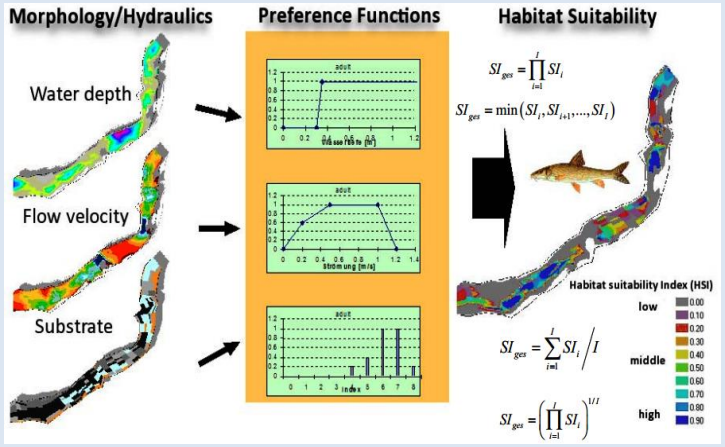
Hydrological model (Cainelli, GEOTRANSF)



Hydraulic model (Hec Ras, 1-D model)

US Army Corps of Engineers ®

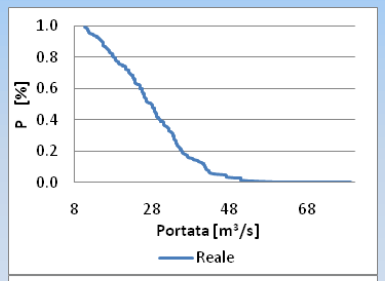
Habitat modelling : **Casimir** **C**omputer **A**ided **Sim**ulation system for **I**nstream flow **R**equiriments (www.casimir-software.de)



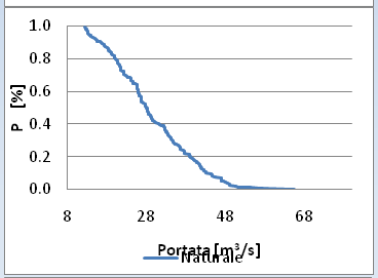
4 different hydrological scenarios
Time series of daily discharges

Flow duration curve (spatially distributed)

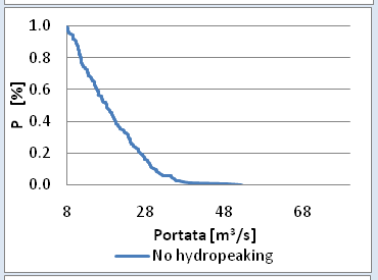
Real — Actual time series



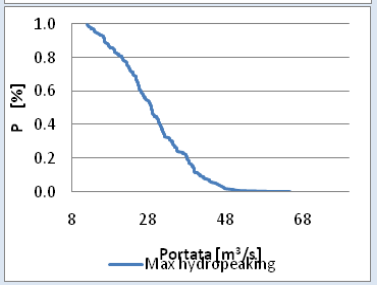
Natural — Modelled time series without dams and anthropic effects



No hydropeaking — Modelled time series with dams only release MVF



Max hydropeaking — Maximum daily hydropeaking over the calibration period (2001-2006)



Hydraulic model

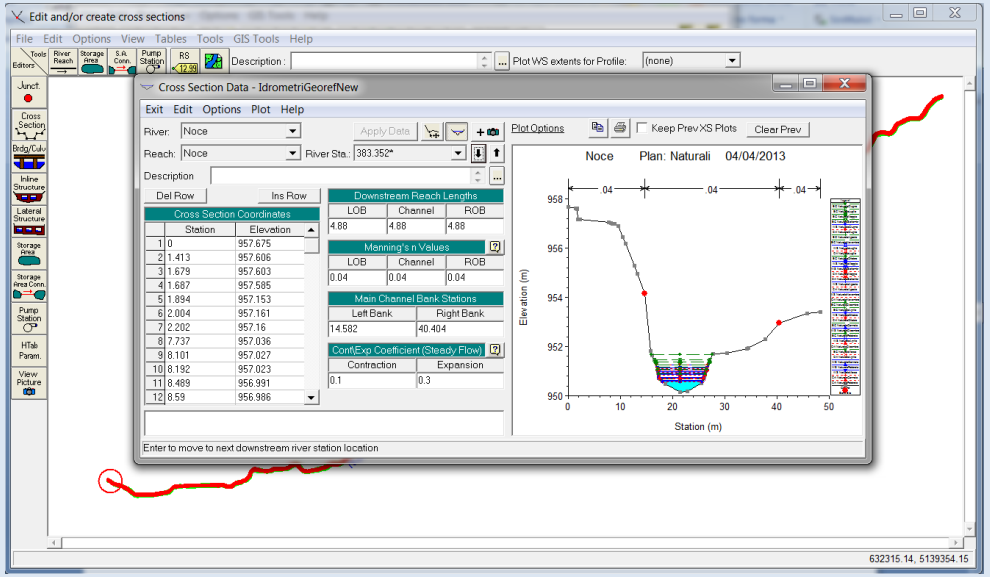
River Analysis System **Hec-Ras 4.1** (www.hec.usace.army.mil/software/hec-ras/)

1-D model

River geometry provided by the Servizio Bacini Montani – Provincia Autonoma di Trento

The river was divided in sub-reaches according with significant variations of discharge

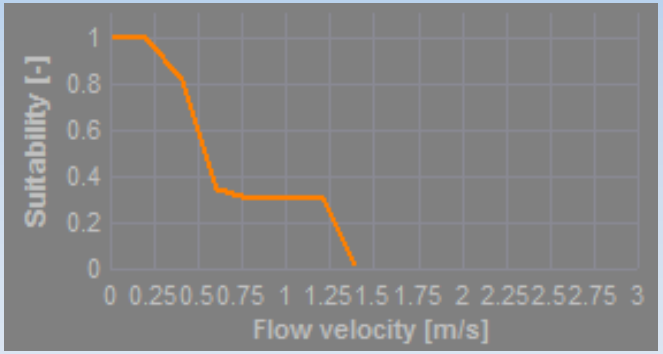
Simultaneous measurements of discharge and water level with different methods to calibrate the roughness coefficient



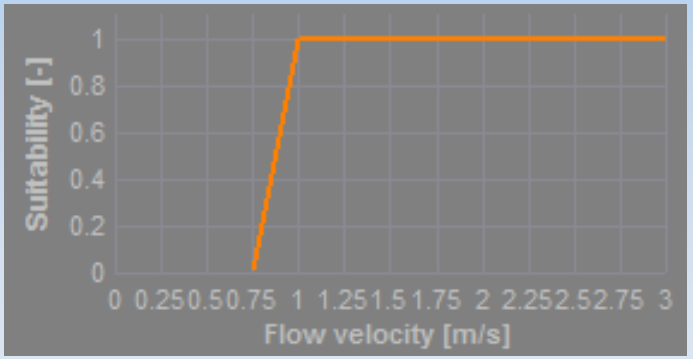
Habitat modelling

Preference curves

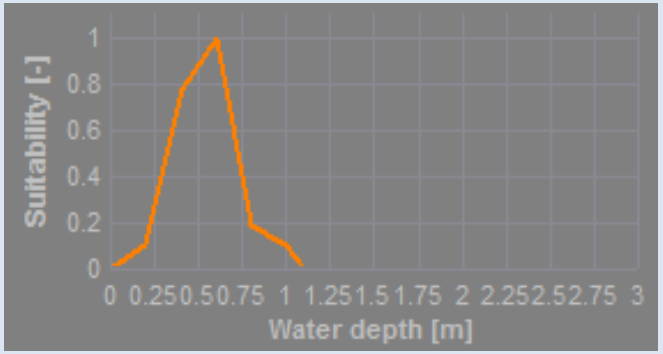
Adult trout



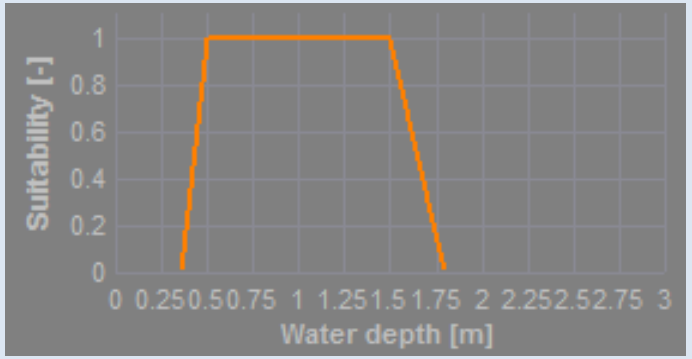
Rafting



Velocity



Depth

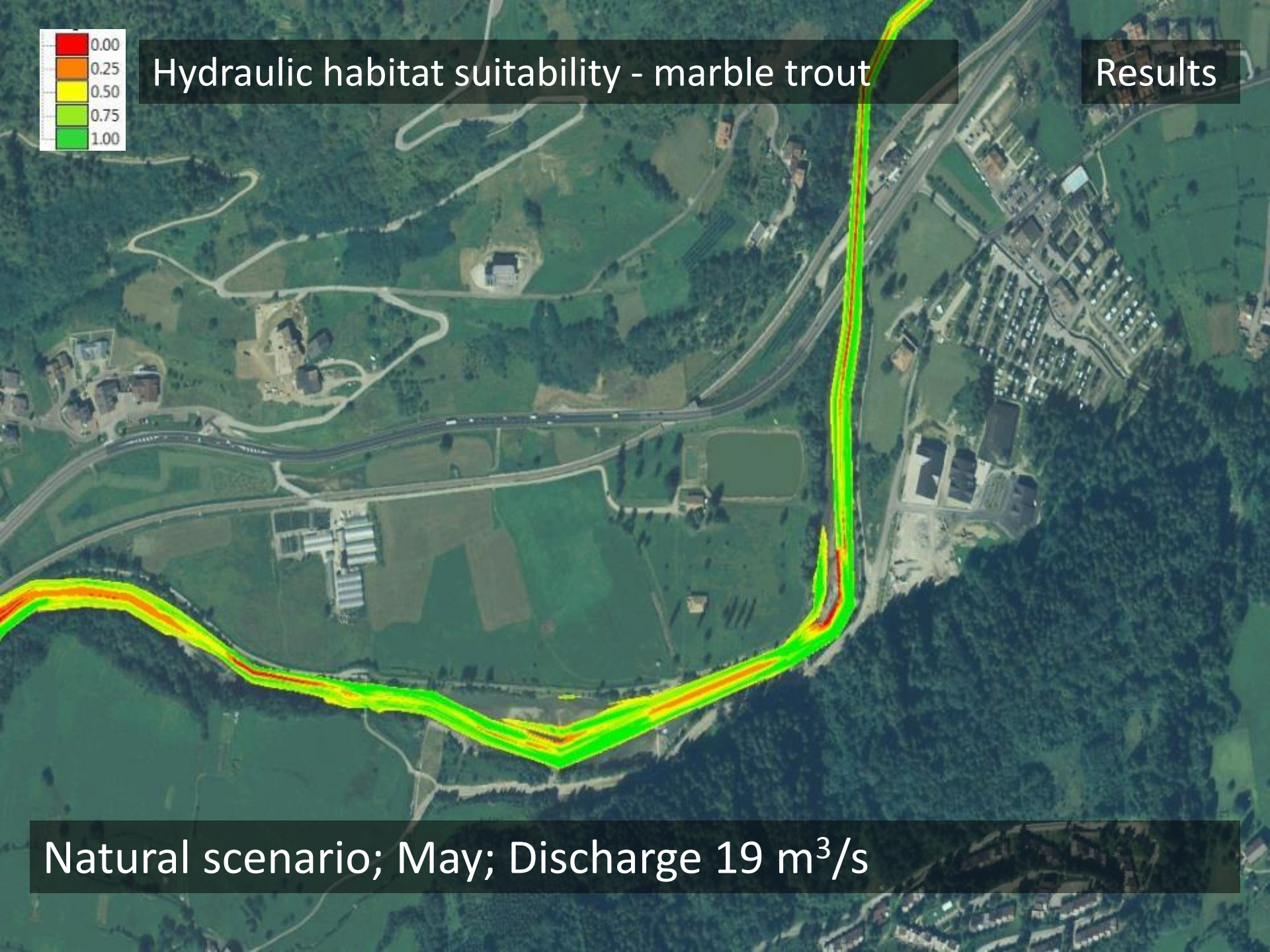


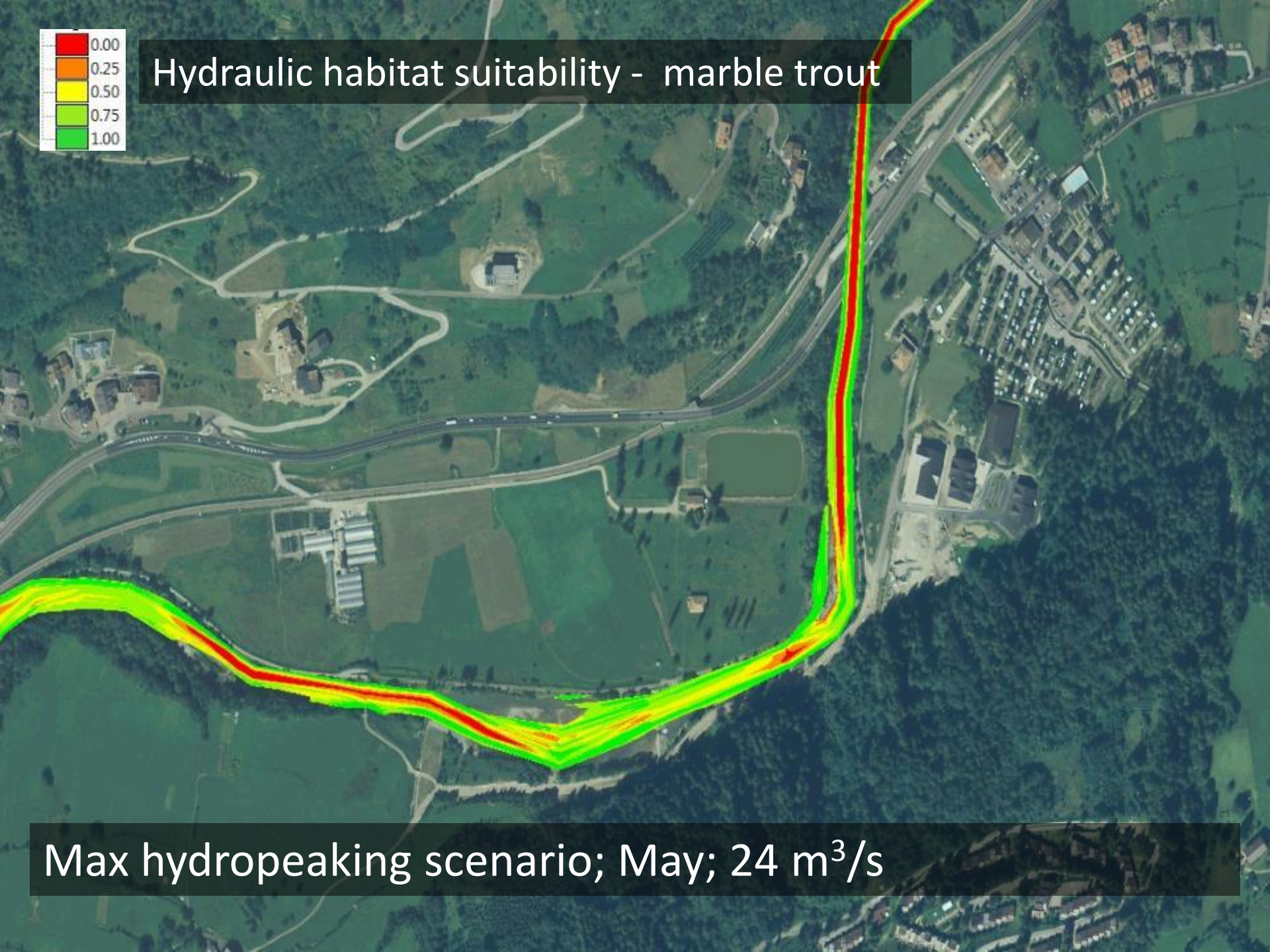
WUA
(Weighted Usable Area)

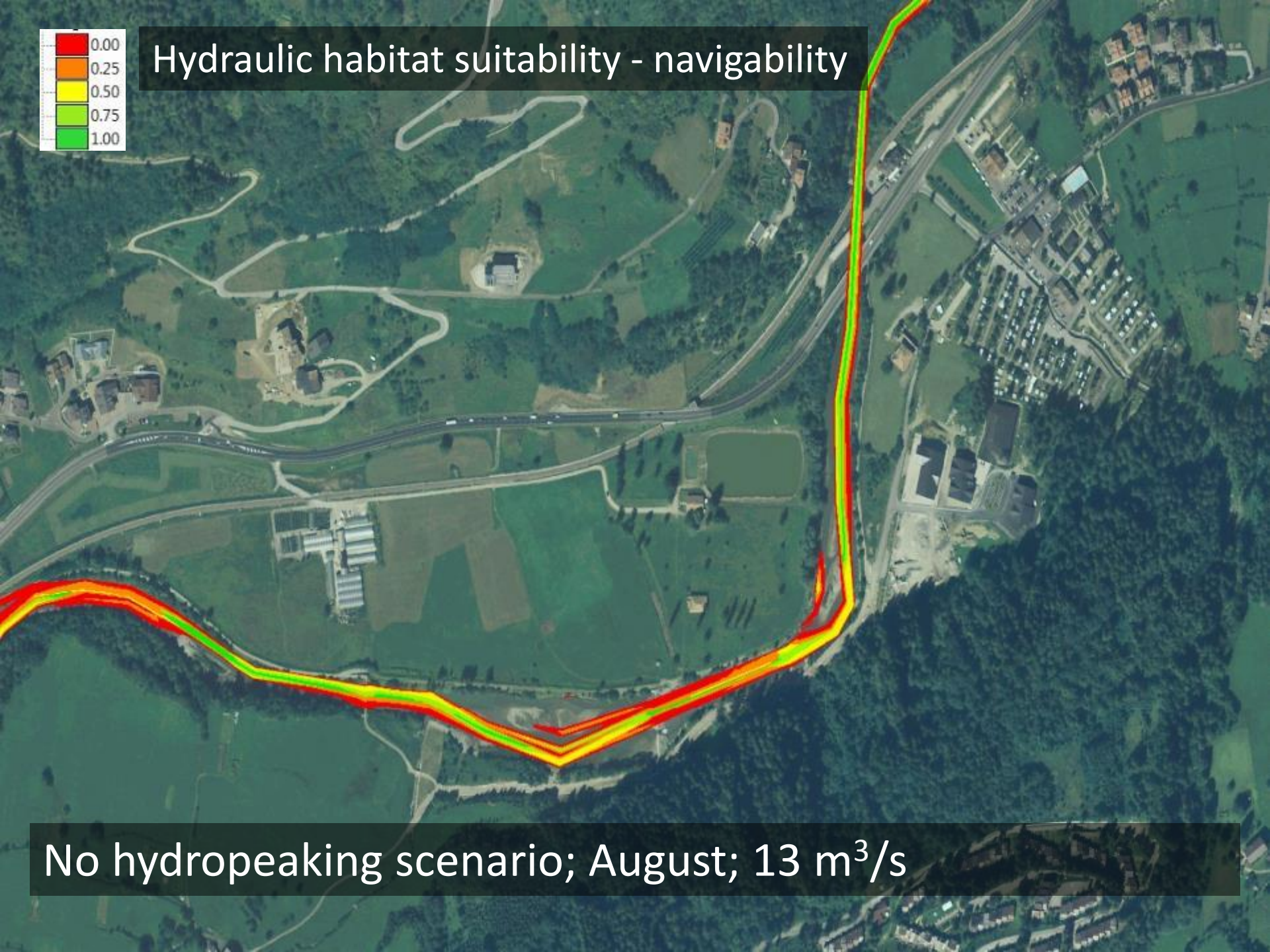
$$WUA = \sum_{i=1}^{n} A_i * HSI_i$$

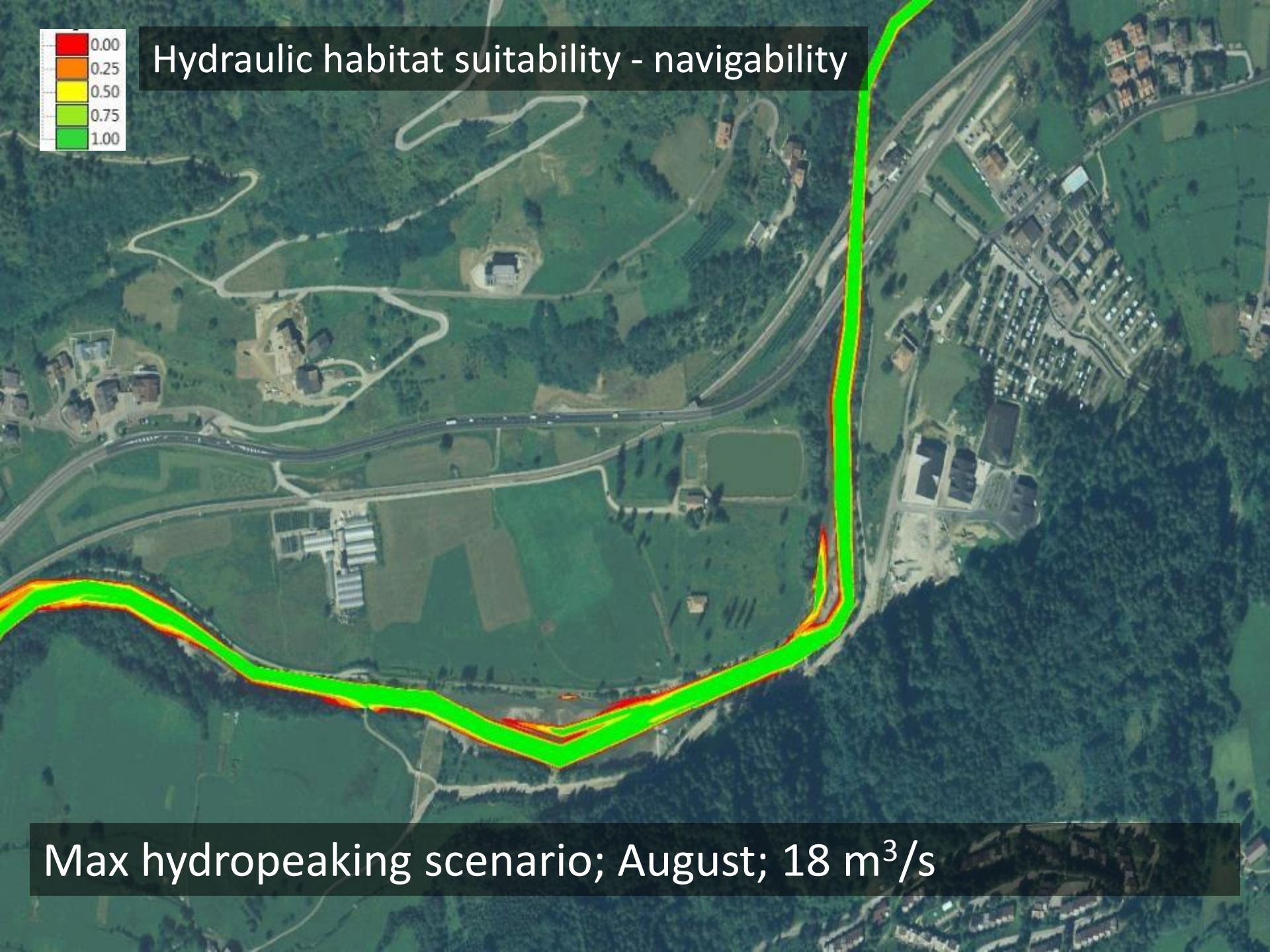
HHS
(Hydraulic Habitat Suitability index)

$$HHS = \frac{1}{Atot} * \sum_{i=1}^{n} A_i * HSI_i$$

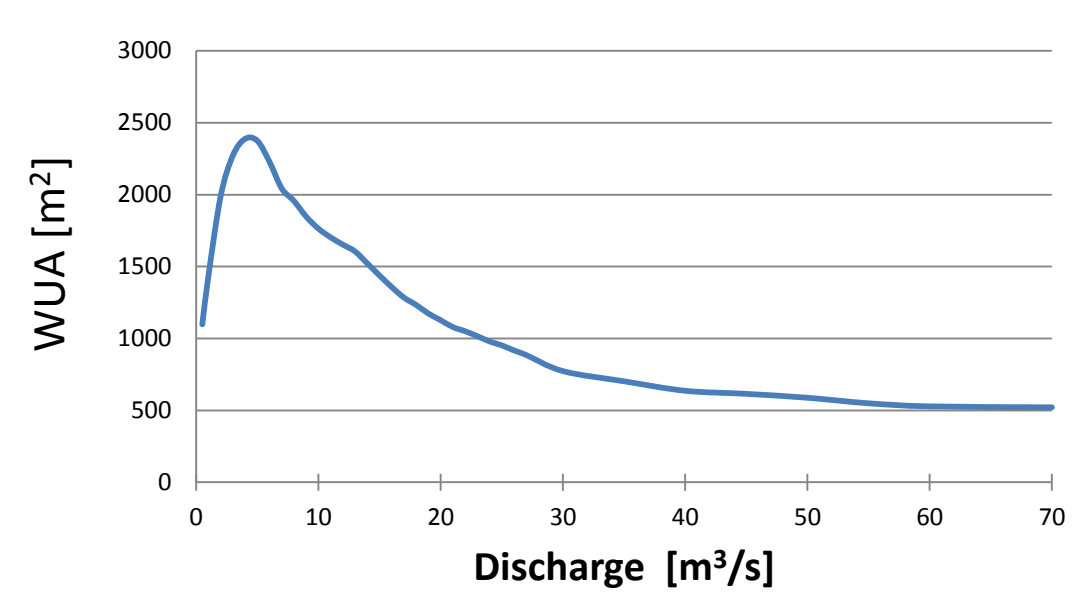

0.00
0.25
0.50
0.75
1.00
Hydraulic habitat suitability - marble trout
Results
Natural scenario; May; Discharge 19 m3/s


0.00
0.25
0.50
0.75
1.00
Hydraulic habitat suitability - marble trout
Max hydropeaking scenario; May; 24 m3/s

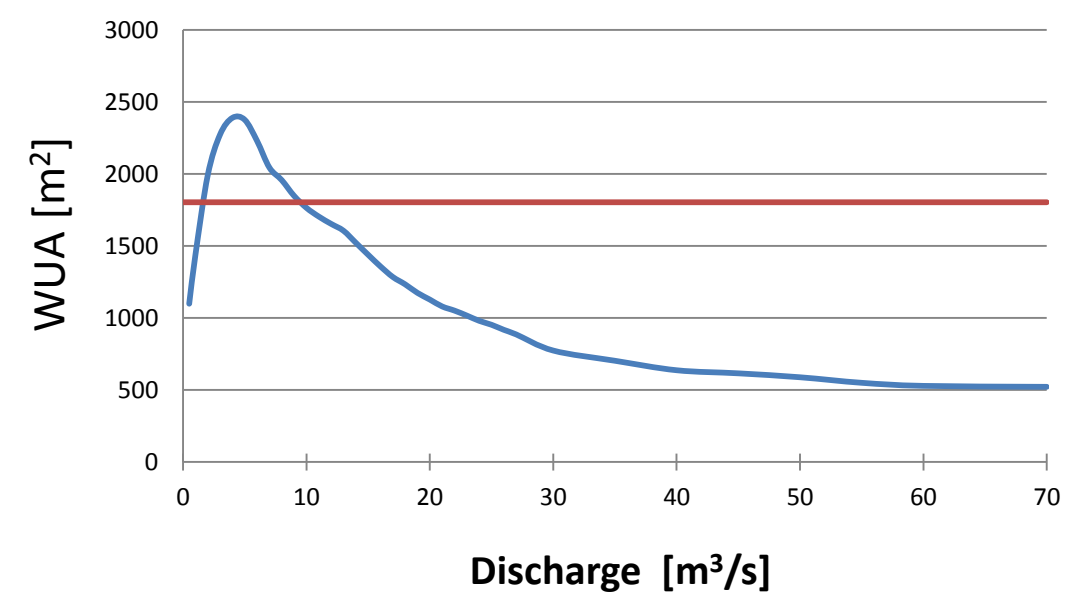

0.00
0.25
0.50
0.75
1.00
Hydraulic habitat suitability - navigability
No hydropeaking scenario; August; 13 m3/s


0.00
0.25
0.50
0.75
1.00
Hydraulic habitat suitability - navigability
Max hydropeaking scenario; August; 18 m3/s

Weighted Usable Area and discharge



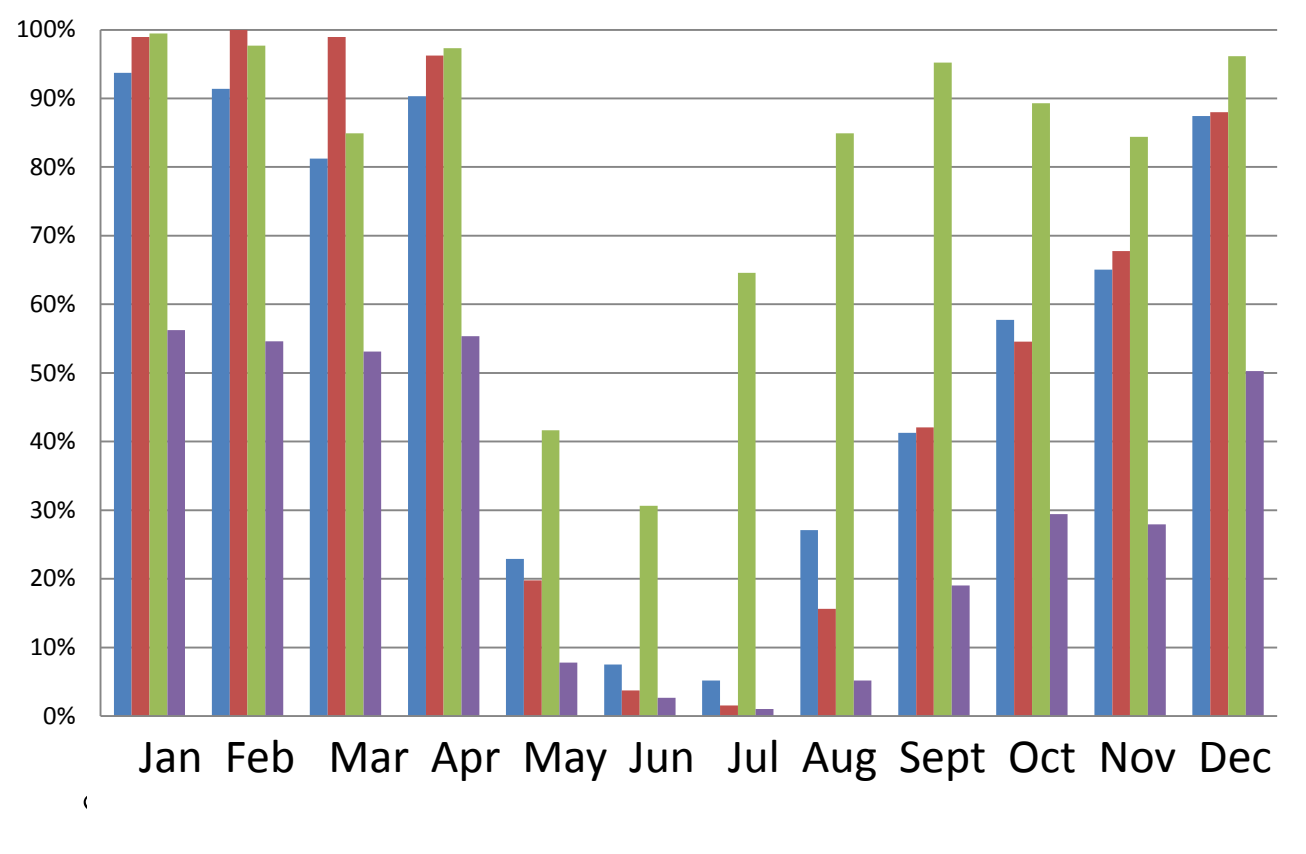
Correlation between discharge and WUA



Minimum threshold for HHS

Minimum threshold for WUA

Adult trout: Percentages of suitable habitat



Real

Natural

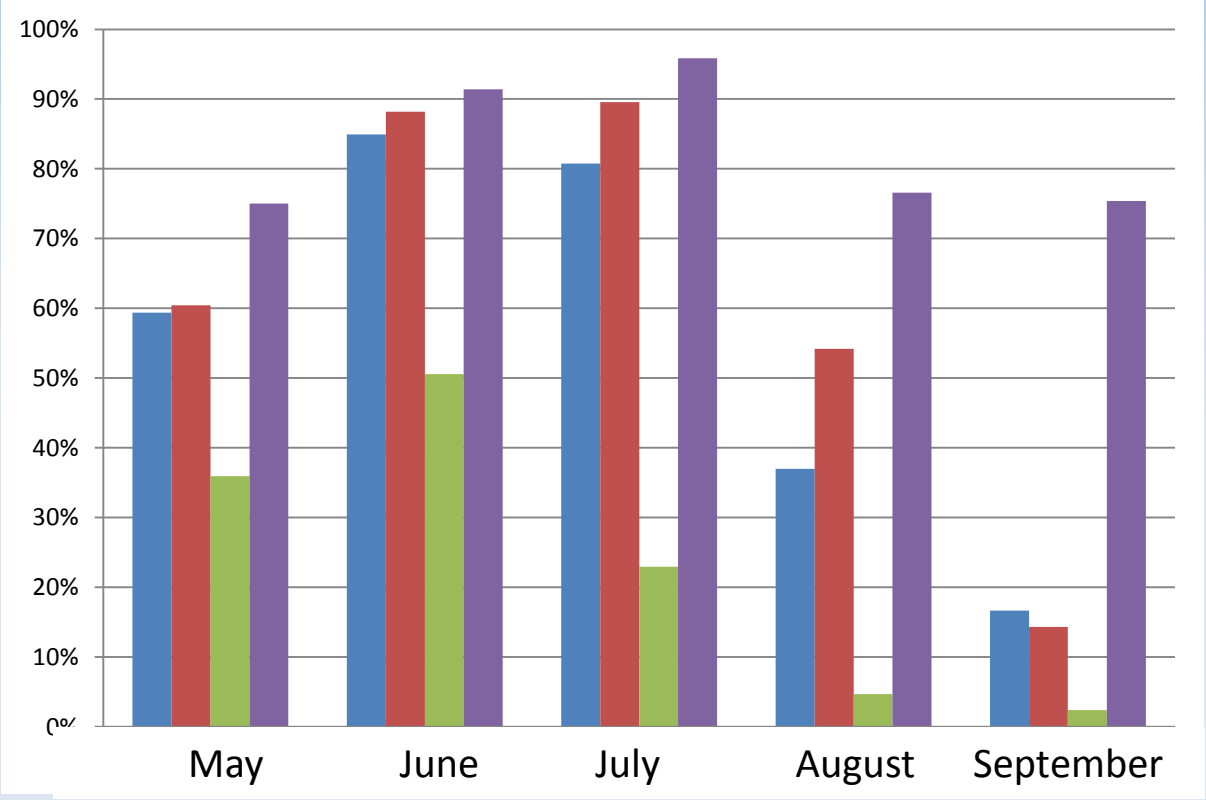
No hydropeaking

Max hydropeaking

Good conditions in winter months except for max hydropeaking scenario

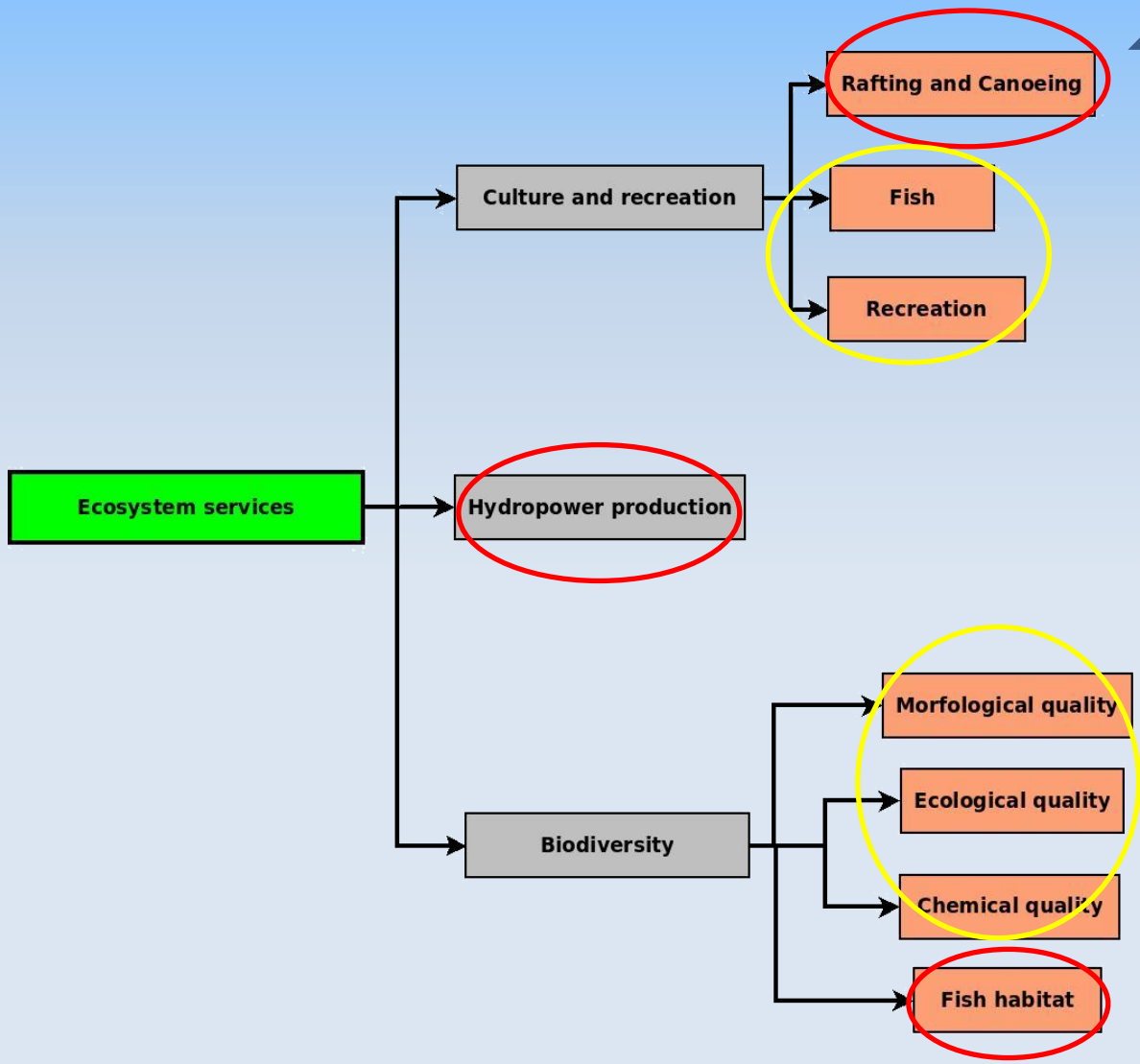
Bad conditions in summer months, good conditions just for no hydropeaking scenarios

Rafting: percentages of suitable areas



Hydropeaking guarantees the suitable conditions. Navigability is neglected in summer months <u>without</u> hydropeaking.

Conclusions



Increasing HHS

Ecosystem services approach

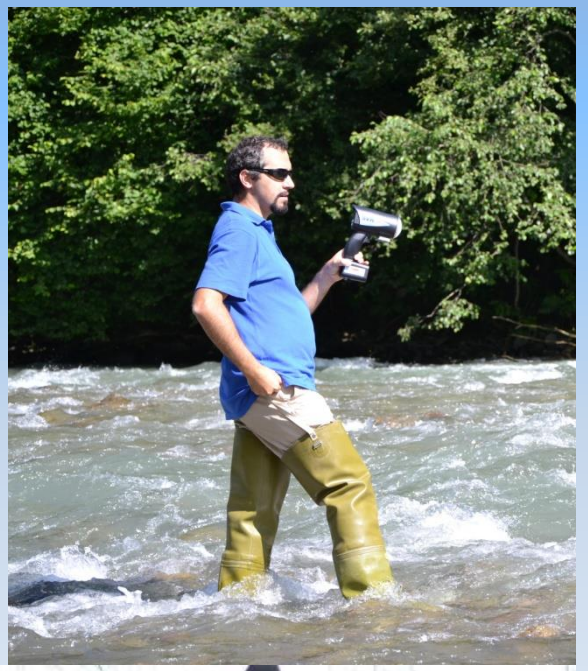
✓Evaluation of rafting and fish habitat: controversial role of HP

Future Step: Including hydropower production in analysis

Evaluation of recreational and environmental services (interviews, indicators)

Decreasing HHS

Final aim: trade-off discharge to optimize the ecosystem services



Thank you for your attention!