Interreg Estonia-Latvia
European Regional Development Fund

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MesoHABSIM Model INTRODUCTION

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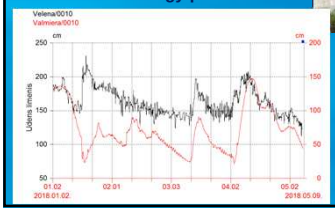
LEGMC, 10.05.2018. Project WBWB

HPP IMPACT ON ENVIRONMENT

Main aspects:

- Fish migration & sediment transport interruption
- Flow regulation
- Green energy production



RIVER HABITAT

Describing of channel hydro-morphology and its relations with biota can be used to evaluate the impact of both hydrological and morphological alterations on the aquatic and riparian communities

Habitat is a metric to evaluate the impact of hydro-morphological alterations

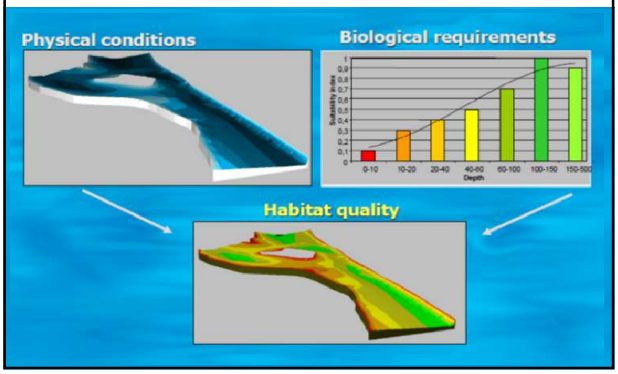
HABITAT RESOURCES FOR BIOTA LINKS

Quantifying HABITAT resources for biota links:

1. Hydrology (hydraulic conditions, flow regims);
2. Morphology (channel geometry, shelters, reproduction areas);
3. Biology (aquatic and riparian communities)

This habitat metrics, based on physical parameters, can overcome the limitation of direct observation of biological indicators, which might not be used for predictions and impact assessment

PRINCIPLE OF HABITAT MODELS



PHYSICAL CONDITIONS

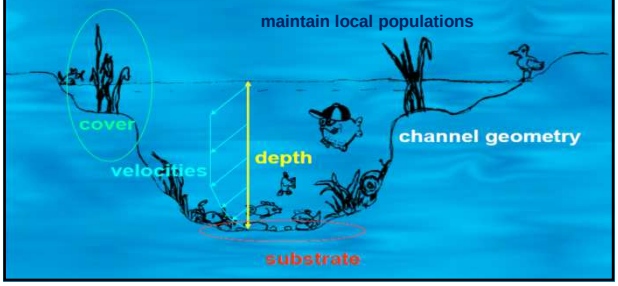
Selection of hydrological conditions:

- Representative in terms of annual hydrological variability
- At least 4 different surveyed discharges
  - minimum to low flow,
  - low to median flow
  - mediam/mean flow
  - mean to high flow
- If possible, select flows separated by homogeneous intervals

PHISICAL CONDITIONS

Habitat survey

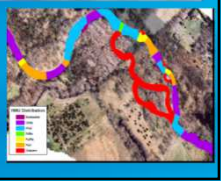
The spatio-temporal variation of these physical characteristics represents HABITAT resources, which are needed to maintain local populations



HABITAT SURVEY

Range finder is used for GU (HMU) area deliniation and QGIS for GU mapping. Water depth and flow velocity measurements are carried out using the magnetic flow meters.

The suitability of mapped GU is based on analysis if the mapped attributes fulfill conditions specified as necessary for species to occur.



BYOLOGICAL CONDITIONS

For fish data collection snorkeling or electro-fishing devices might be used.

Fish data should be collected in natural conditions for development of Fish Conditional Model and in altered conditions for model calibration

FISH CONDITIONAL MODEL

Salmo trutta JUVENILES
Presence

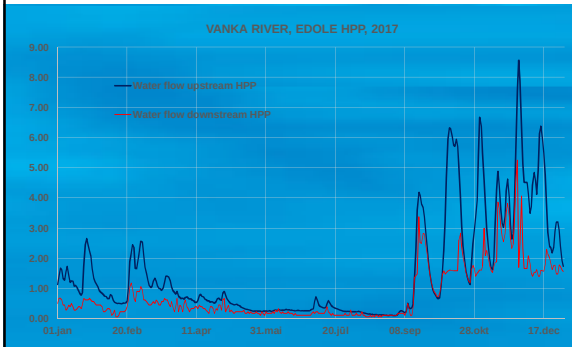
IF
[D_15+D15_30+D30_45+D45_60+D60_75]>0.3
AND
[CV15_30+CV30_45+CV45_60+CV60_75+CV75_90]>0.3
AND
[MESOLITHAL+MICROLITHAL +AKAL]>0.3
AND
[WOODY_DEBR=1 OR BOULDERS=1]

FISH CONDITIONAL MODEL

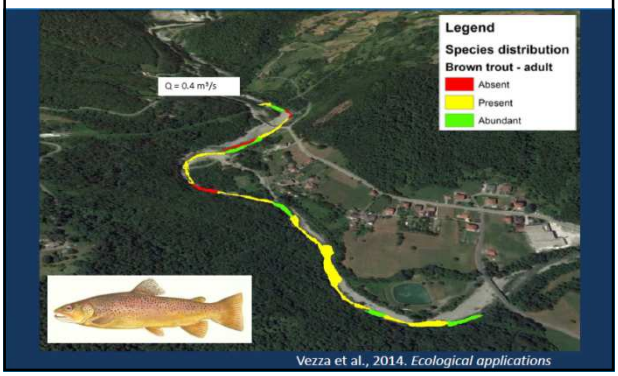
Salmo trutta JUVENILES
High abundance

IF
[D_15+D15_30+D30_45+D45_60]>0.3
AND
[CV15_30+CV30_45+CV45_60]>0.3
AND
[MESOLITHAL+MICROLITHAL +AKAL]>0.7
AND
[WOODY_DEBR=1 OR BOULDERS=1]

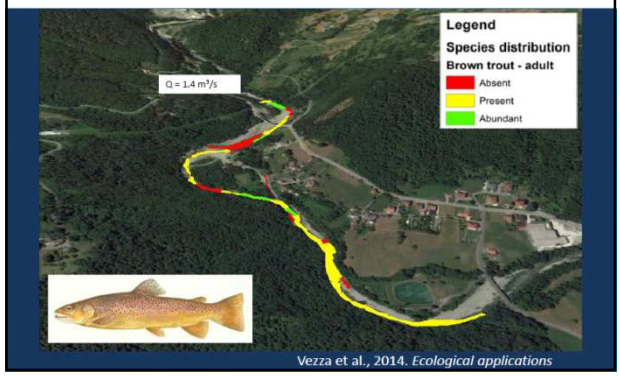
HYDROLOGICAL DATA SERIES



SPATIAL HABITAT AVAILABILITY

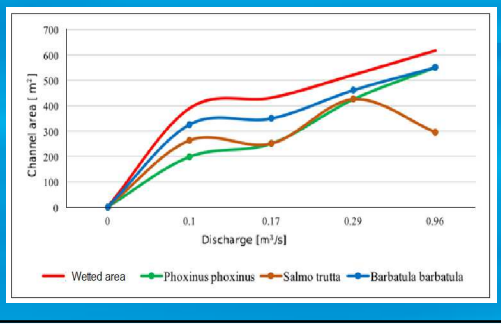


SPATIAL HABITAT AVAILABILITY

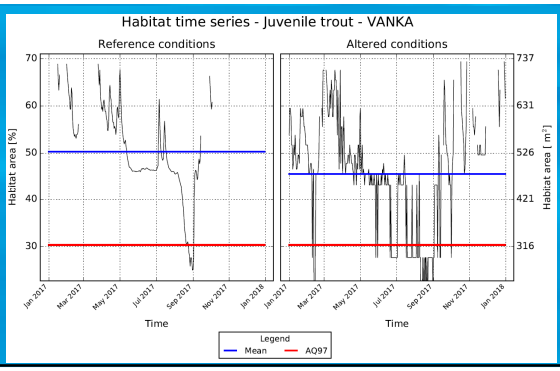


HABITAT MODELLING

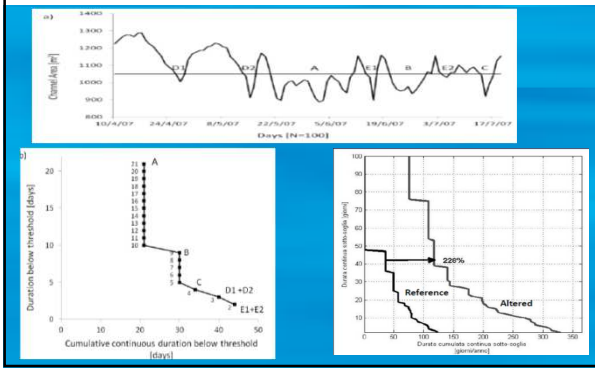
Habitat – flow rating curves (Vanka River)



HABITAT MODELLING



STRESS DAYS ALTERATION BY UCUT CURVE



HABITAT INDICES FOR E-FLOW DEFINITION

ISH – Index of Spatial Habitat availability

$$ISH = \min\left(\begin{cases} 1 - \frac{|A_{Hd,r} - A_{Hd}|}{A_{Hd,r}}, & \frac{|A_{Hd,r} - A_{Hd}|}{A_{Hd,r}} \le 1 \\ 0, & \frac{|A_{Hd,r} - A_{Hd}|}{A_{Hd,r}} > 1 \end{cases}\right)_{specie}$$

ITN – Index of Temporal Habitat availability

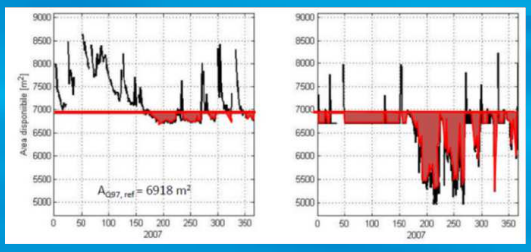
$$ASD = \frac{1}{d_{max,r}} \cdot \sum_{k=1}^{k=d_{max,r}} \left(\frac{|d_{c,AQ97} - d_{c,r,AQ97}|}{d_{c,r,AQ97}}\right) \qquad ITH = \min\left(e^{-0.38\,ASD}\right)_{specie}$$

IH - Index of Habitat Integrity

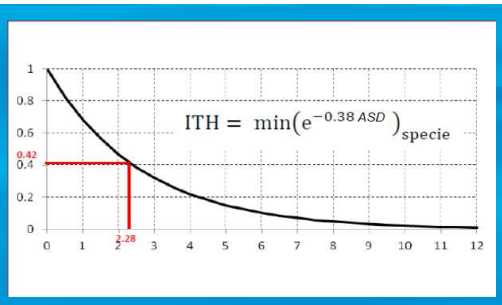
$$IH = min(ISH; ITH)$$

ISH – INDEX OF SPATIAL HABITAT AVAILABILITY

Reference conditions | Altered conditions



ITH – INDEX OF TEMPORAL HABITAT AVAILABILITY



ASD_{Barbel} = 228% ⟶ ITH_{Barbel} = 0.42

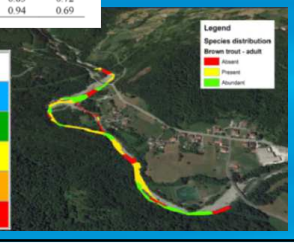
INDEX OF HABITAT INTEGRITY & ECOLOGICAL STATUS

Tabella A4.2 - Valori di ISH, AGS e ITH calcolati per il caso del F. Taro a Piane di Carniglia.

Specie/stadio vitale	ISH	AGS	ITH
Trota fario - adulta	0.92	1.60	0.54
Trota sp. - giovane	0.97	0.86	0.72
Vairone - adulto	0.95	0.13	0.95
Vairone - giovane	0.99	0.93	0.70
Barbo – Barbus sp.	**0.90**	2.28	**0.42**
Cavedano - adulto	0.97	0.83	0.72
Ghiozzo - adulto	0.91	0.94	0.69

IH = min (0.90;0.42) = 0.42

IH	Class
IH ≥ 0.80	High
0.60 ≤ IH < 0.80	Good
0.40 ≤ IH < 0.60	Moderate
0.20 ≤ IH < 0.40	Poor
IH < 0.20	Bad



E-FLOW CALCULATION

$$Q_{sef,k} = p_b * q_{MBLF,k} * A_k$$

p_b - tabulated value of coefficient obtained from pilot studies specificē for bioperiods and fish ecological type

$q_{MBLF,k}$ - specificē mean low flow for the bioperiod at the cross-section k

A_k - catchment area at the cross-section k

KEY CHARACTERISTICS

- E-flows for bioperiods: spring spawning, rearing and growth, fall spawning, overwintering.
- Adaptive E-flow depends on the continuous duration of habitat deficit events.
- Standardization of specific E-flows by q_{MBLF} ⟶ transfer correcting for hydrological variability.
- The resulting coefficient p_b has the similar values in the rivers of the same fish biological type.
- Valid for good HYMO.

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Thank you for attention!