Criteri di priorizzazione per la rimozione di ostacoli alla connettività

Bruno Boz - CIRF

Criteri di priorizzazione per la rimozione di ostacoli alla connettività: non solo ostacoli longitudinali per fauna ittica

longitudinale

laterale

fauna ittica

sedimenti

Criteri di priorizzazione per la rimozione di ostacoli alla connettività: necessità di priorizzare

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More than one million barriers fragment Europe's rivers

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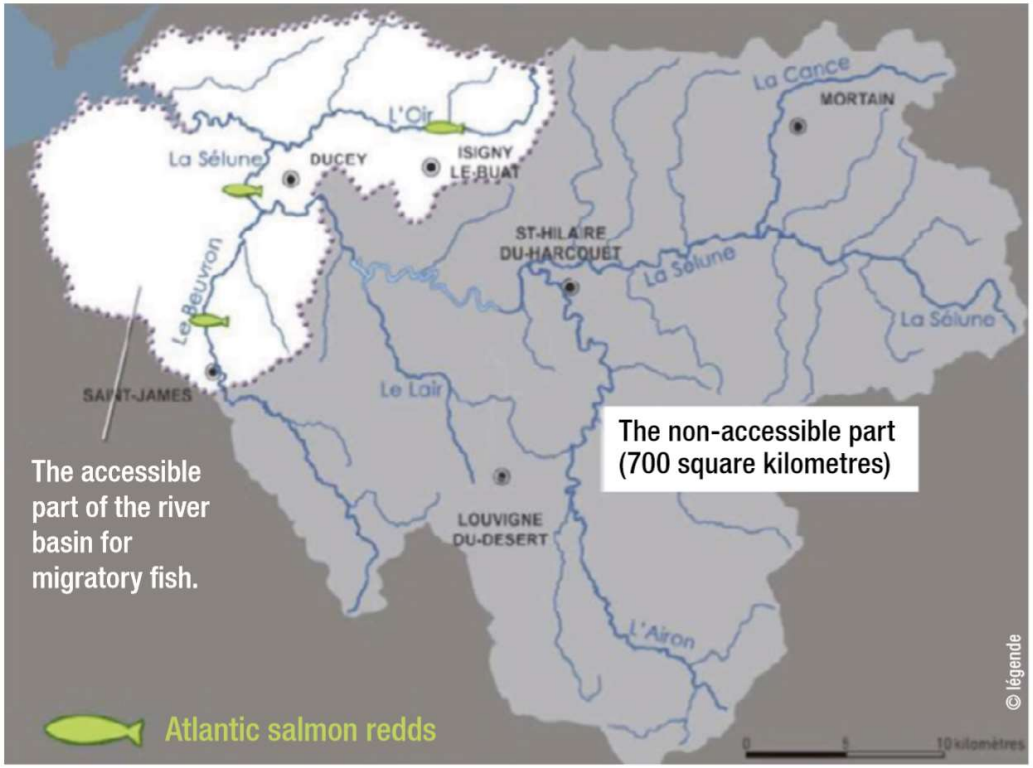
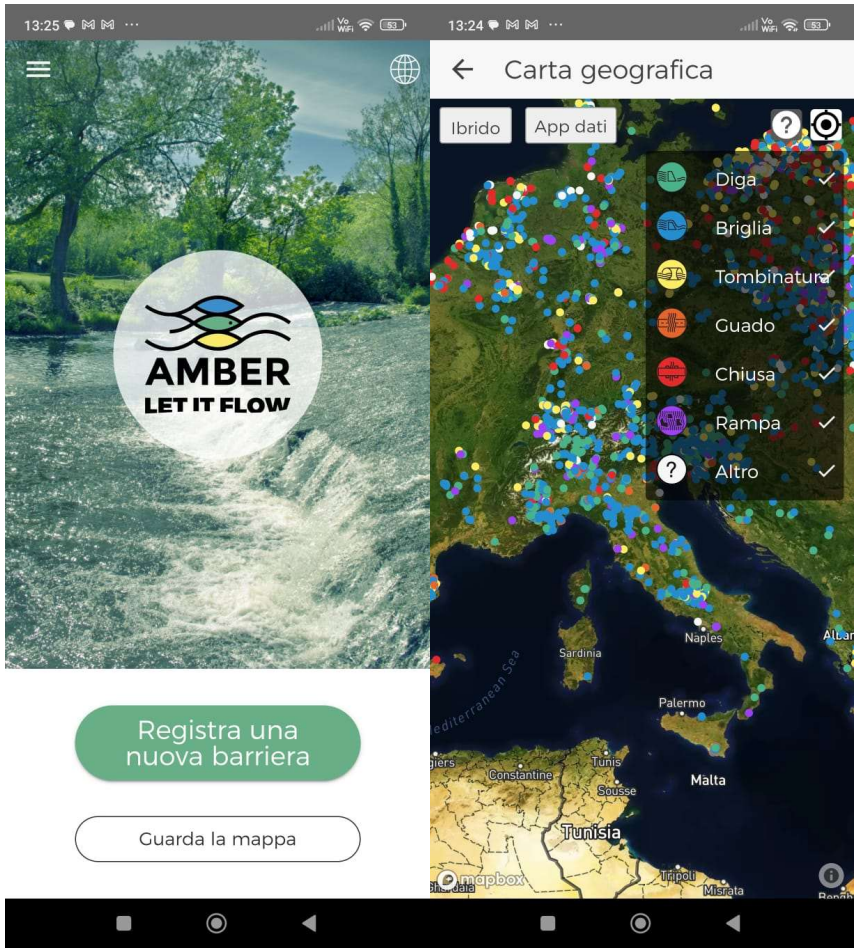
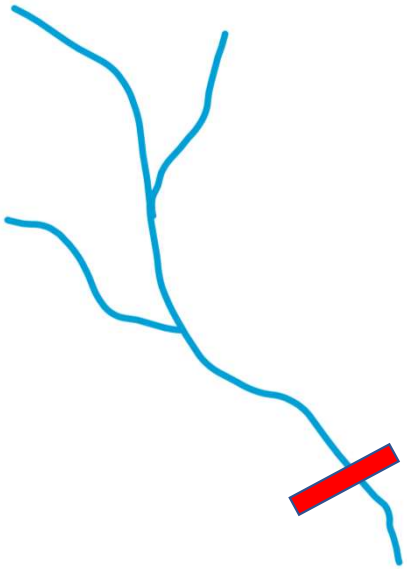
- 1.2 milioni di ostacoli longitudinali in EU (0,74 km)
- 68% h<2m
- Limitatezza risorse
- Alcune hanno impatto molto più significativo



Criteri di priorizzazione per la rimozione di ostacoli alla connettività: dati di partenza



- Stato ecologico tratti fluviali
- Presenza aree riproduttive/rifugio/nutrizione
- Composizione comunità ittica
- Presenza ostacoli naturali
- Etc..



Criteri di priorizzazione per la rimozione di ostacoli alla connettività: moltissimi metodi e approcci

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Review

Operational methods for prioritizing the removal of river barriers: Synthesis and guidance

Carlos Garcia de Leaniz [a], Jesse R. O'Hanley [b c]

Fisheries Management and Ecology

Procedures for evaluating and prioritising the removal of fish passage barriers: a synthesis

P. S. KEMP, J. R. O'HANLEY

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ARENA PAPERS
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A comparison of approaches for prioritizing removal and repair of barriers to stream connectivity

S. Kyle McKay[1] | Erik H. Martin[2] | Peter B. McIntyre[3] | Austin W. Milt[4] | Allison T. Moody[4] | Thomas M. Neeson[5]

TABLE 2 Families of methods for prioritizing barrier removal projects, ranging from strategic to purely reactive

Approach	Examples	Strengths	Weaknesses
Mathematical optimization given a specific set of objectives, time-scale, and budget	Kuby, Fagan, ReVelle, and Graf (2005) King and O'Hanley (2014) Neeson et al. (2015) Moody et al. (2017) Milt et al. (2017)	• Transparent, analytical framework • Optimal solution is provided to maximize benefit for a given budget • Solution set can be designed to effectively handle barriers in a series • Multiple objectives may be quantitatively incorporated into priorities	• Outcome may be too prescriptive and not accounting for issues such as structures beyond an entity's jurisdiction (Milt et al., 2017) • Often solutions require action on a set of barriers, requiring cooperation which may or may not be available • Uncertainties or changes to budgets and project costs can have a substantial impact on priorities • Challenging to account for factors that are not easily quantified (e.g., sense of place, Sarakinos & Johnson, 2003) • Problems can arise from incomplete, coarse, or variable resolution in data
Scoring and ranking used to target removal requests and inform the reaction to opportunities as they arise	Mader and Maier (2008) Martin (2019) Hoenke, Kumar, and Batt (2014)	• Flexible to multiple objectives (even those challenging to quantify) • Reduced mathematical expertise relative to optimization • Minimally prescriptive and easier to align with implementation constraints • Facilitates stakeholder buy-in	• Barrier sets may be inefficient if dependency between actions is not incorporated (i.e., barriers in series) • Typically, multi-objective analyses rely on subjective weighting schemes, which can require time consuming, iterative development
Local knowledge used to qualitatively inform ecological, engineering, and social priorities	Fox et al. (2016)	• Flexible to multiple economical, ecological, social, feasibility, and environmental factors • Often rapidly developed with minimal computational expertise or effort	• Requires substantial local knowledge • Difficult to implement at regional scales • May introduce bias of local participants (e.g., disciplinary, a priori preferences, etc.)
Reactive response when requested by owner	American Rivers	• Few planning constraints allows for large number of projects to be executed	• Inefficient use of resources is possible
Unexpected failures	Gillespie et al. (2014)	• No planning required	• Potential for significant negative side effects (e.g., loss of life and property, emergency response costs)

Criteri di priorizzazione per la rimozione di ostacoli alla connettività: metodi consigliati in base a scala

https://environment.ec.europa.eu/system/files/2021-12/Barrier%20removal%20for%20river%20restoration.pdf

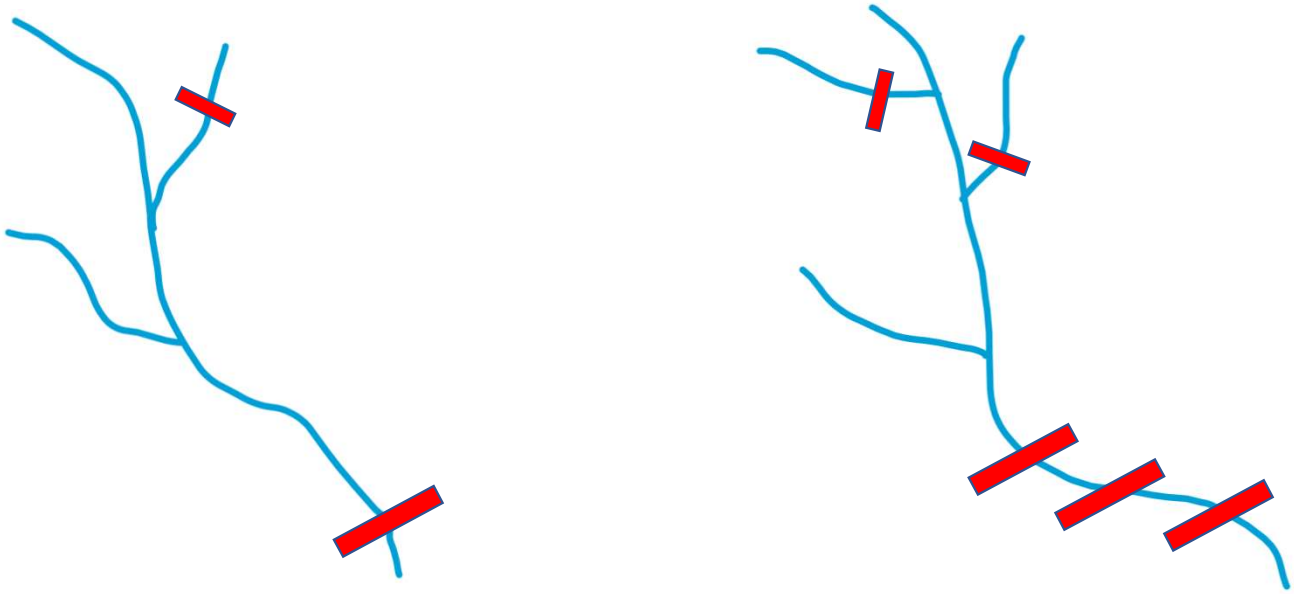
TABLE 3 Recommended methods for prioritizing barrier removals given the spatial scale of planning, dimensionality and complexity of project objectives, and the expected uncertainty of a barrier removal project (i.e., unpredictability of economic and sociopolitical costs of removals, budget availability, and risk of barrier collapse). The final column indicates the resources needed to implement the prioritization method, which we define broadly to include biological data sets, estimates of economic and sociopolitical costs of removal, and computational/mathematical modelling expertise

Spatial scale	Project complexity	Uncertainty	Example	Recommended prioritization method(s)	Resources required
Small	Low	High	Watershed non-profit with substantial field expertise and goal of increasing access to upstream habitat for a single species, where individual owner attitudes are difficult to predict	Multi-stakeholder priority setting by discussion/committee	Low
Small	Low	Low	Local transportation authority with good asset database and jurisdiction over the universe of barriers	Optimization within jurisdictional constraints	Medium
Small	High	High	Watershed non-profit focused on balancing habitat gains for multiple focal taxa alongside recreational opportunities, where individual owner attitudes are difficult to predict	Standing priorities to inform reaction to opportunities as they arise	Medium
Small	High	Low	Watershed non-profit balancing multiple conservation objectives, but economic costs of removal are well known and predictable	Optimization with extensive local data	High
Large	Low	High	Regional prioritization of dams to maximize total accessible river miles, where sociopolitical costs depend on individual owner attitudes and are difficult to predict	Combination of mathematical optimization and/or multi-stakeholder priority setting	Medium
Large	Low	Low	Regional prioritization of road culverts to maximize total accessible river miles	Optimization in conjunction with infrastructure asset needs	High
Large	High	High	Regional prioritization of dams to benefit a suite of migratory fish and non-fishery objectives	Standing priorities addressing a suite of ecological metrics	High
Large	High	Low	Regional prioritization to benefit a suite of migratory fish species while minimizing spread of invasive species	Iterative process of mathematical optimization and stakeholder goal-setting, ideally facilitated by decision support tools	High

Rimozione/mitigazione di ostacoli alla connettività (longitudinale): come priorizzare gli interventi?

1) Fauna ittica

- **Estensione di corso d'acqua/habitat non frammentato che viene riconnesso**



Rimozione/mitigazione di ostacoli alla connettività (longitudinale): come priorizzare gli interventi?

1) Fauna ittica

- **Estensione di corso d'acqua/habitat non frammentato che viene riconnesso**

Es. di Indice di Priorità (Pini Prato, Comoglio C. and Calles O., 2011)

$$IP = \frac{L_{monte}}{H} \cdot F$$

Lm = Lunghezza del tratto di fiume a monte dell'ostacolo considerato che verrebbe nuovamente reso accessibile all'ittiofauna;
H = altezza ostacolo

F = fattore ittico

$$F = \sum k_i = \sum (Mob_i + Vc_i)^2$$

A ciascuna specie autoctona presente (i) viene assegnato un coefficiente di priorità (k_i), somma di un valore di mobilità (Mob_i) e di un valore di conservazione (c_i). Per specie alloctone $k_i = 0$.
Il valore di mobilità (Mob_i) varia da 1 a 5 a seconda delle esigenze della specie: es. = 5 per specie migratrici diadrome (anguilla, cheppia, etc.). Il valore di conservazione per le specie (c_i) varia da 0,5 a 2: in funzione dello stato nella IUCN Red List – Italia

Rimozione/mitigazione di ostacoli alla connettività (longitudinale): come priorizzare gli interventi?

1) Fauna ittica

- **Qualità/rilevanza dell'habitat riconnesso per il ciclo di vita delle specie target**

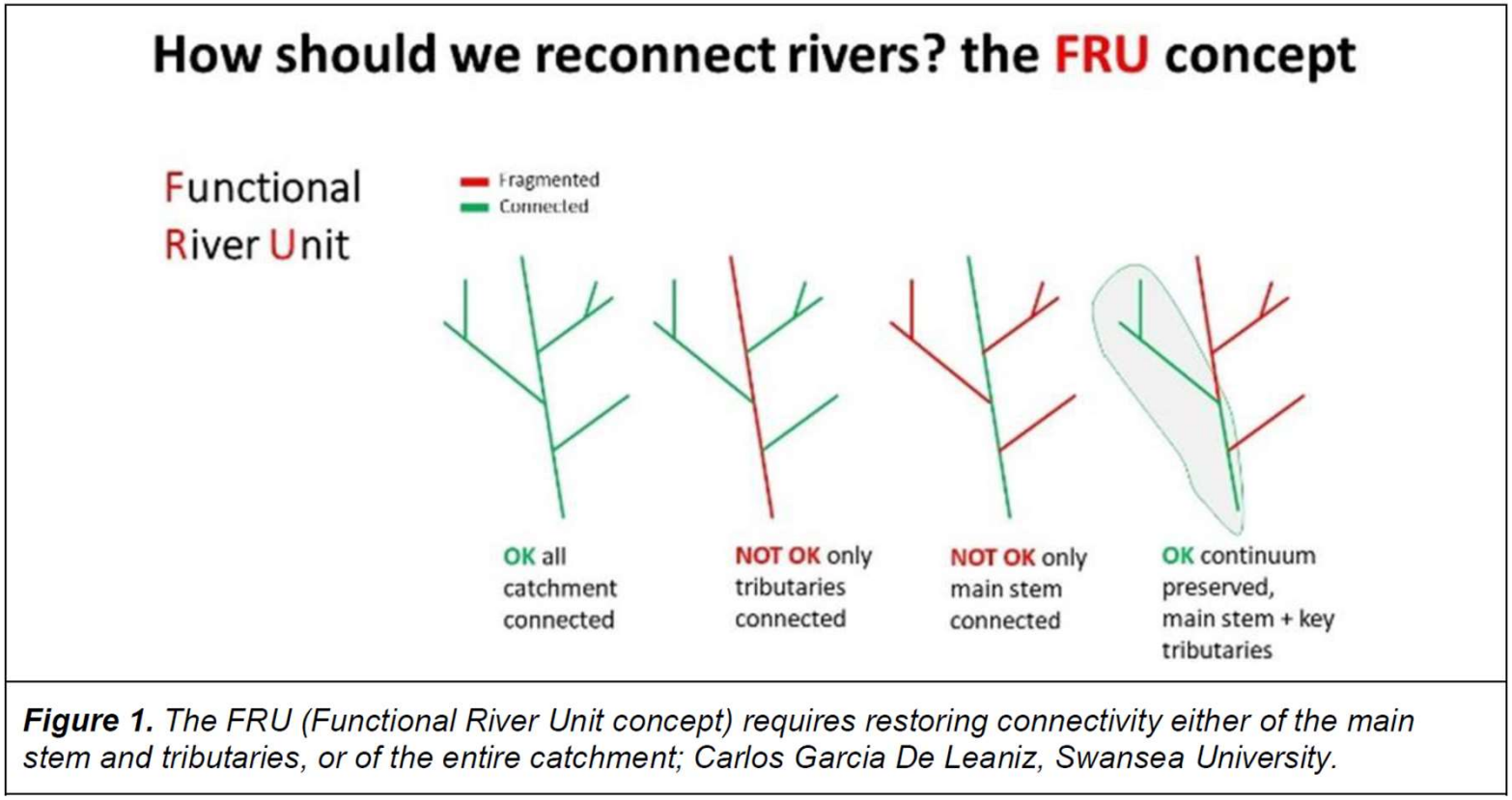


Figure 1. *The FRU (Functional River Unit concept) requires restoring connectivity either of the main stem and tributaries, or of the entire catchment; Carlos Garcia De Leaniz, Swansea University.*

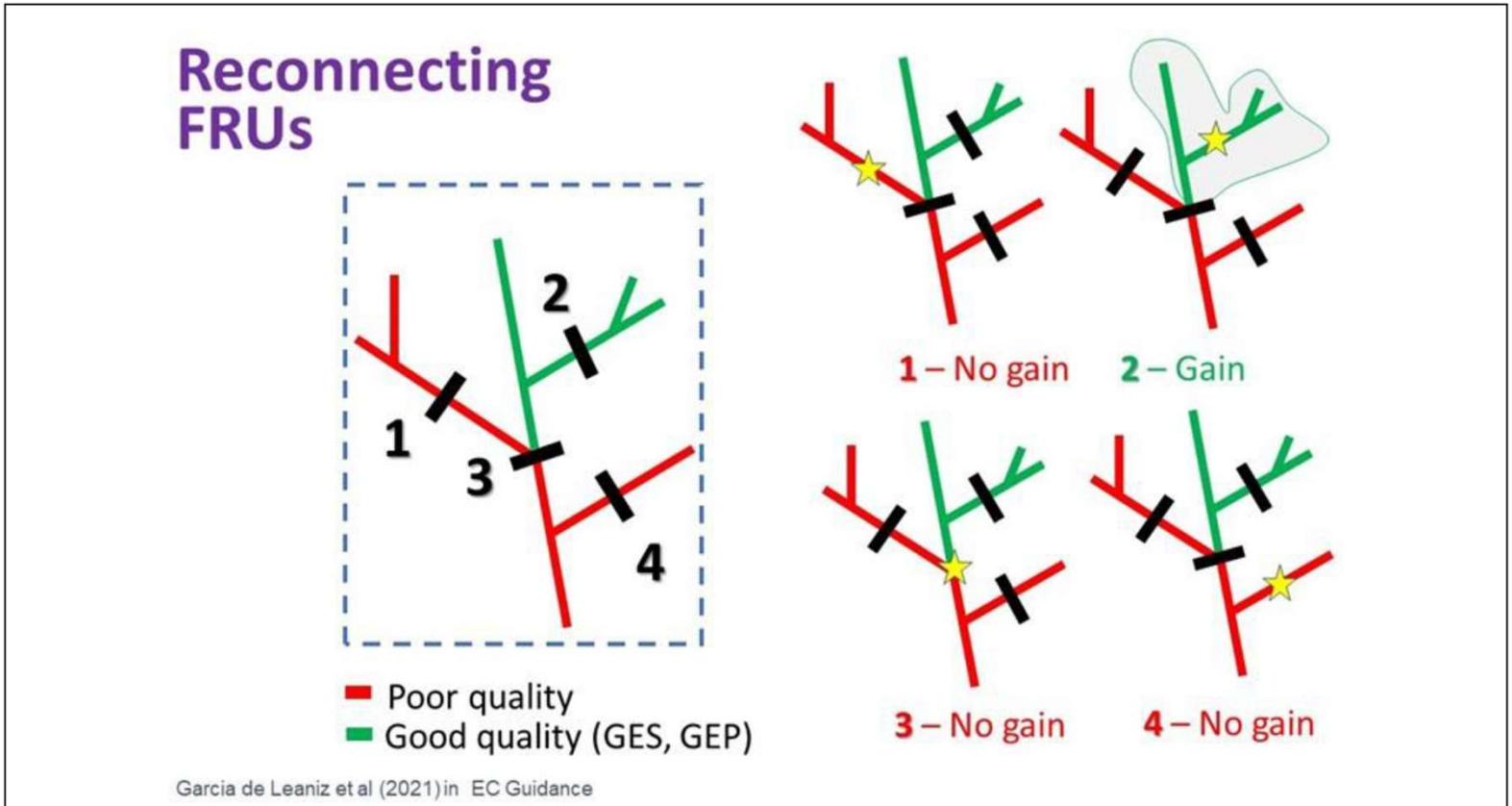


Figure 2. *The concept of restoring river to a "free-flowing state" should focus on restoring functional river units; Carlos Garcia De Leaniz, Swansea University.*

Rimozione/mitigazione di ostacoli alla connettività (longitudinale): come priorizzare gli interventi?

1) Fauna ittica

- **Eventuale effetto negativo della rimozione di opere che impediscono l'espansione di specie alloctone invasive**

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MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA Y EL RETO DEMOGRÁFICO

Priorization criteria

1. WB with barriers whose removal or permeabilization is indicated as part of the PoM
2. WB located in protected areas (e.g., N2000) whose management plans indicate the necessity of improving river continuity
3. WB with barriers whose removal or permeabilization would maximize the unfragmented river length
4. WB with significant fish populations under risk due to alien species
5. WB particularly sensitive to the effect of climate change

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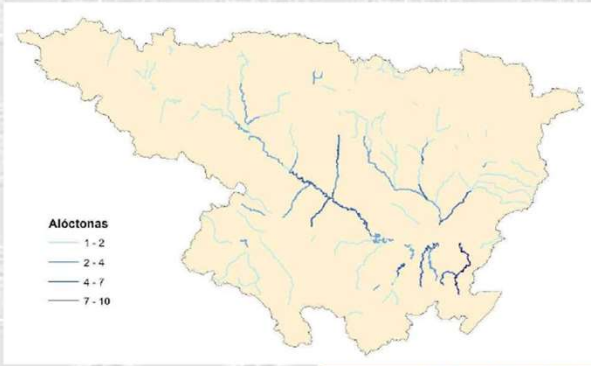
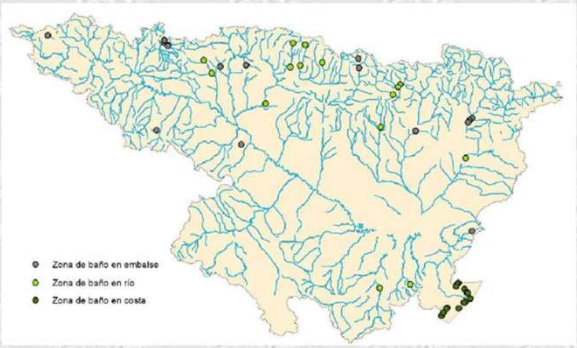
Limiting factors

- Distribution of alien species to avoid contamination of pristine areas

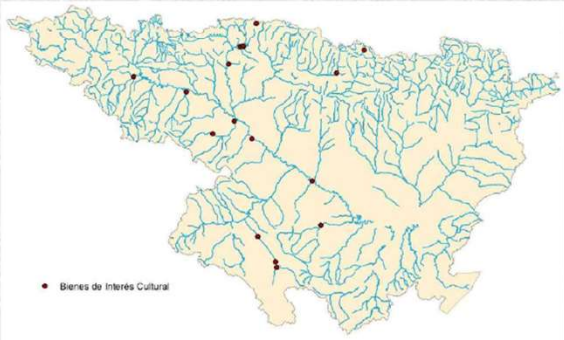


- Bathing sites



Ictiofauna alóctona DHEbro	
Alburnus alburnus	*Micropterus salmoides*
Ameiurus melas	*Oncorhynchus mykiss*
Carassius auratus	*Perca fluviatilis*
Carassius carassius	*Pseudorasbora parva*
Cyprinus carpio	*Rutilus rutilus*
Esox lucius	*Salvelinus fontinalis*
Gambusia holbrooki	*Sander lucioperca*
Ictalurus punctatus	*Scardinius erythrophthalmus*
Lepomis gibbosus	*Silurus glanis*

- Cultural protected sites



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OPEN RIVERS PROGRAMME

aqua viva

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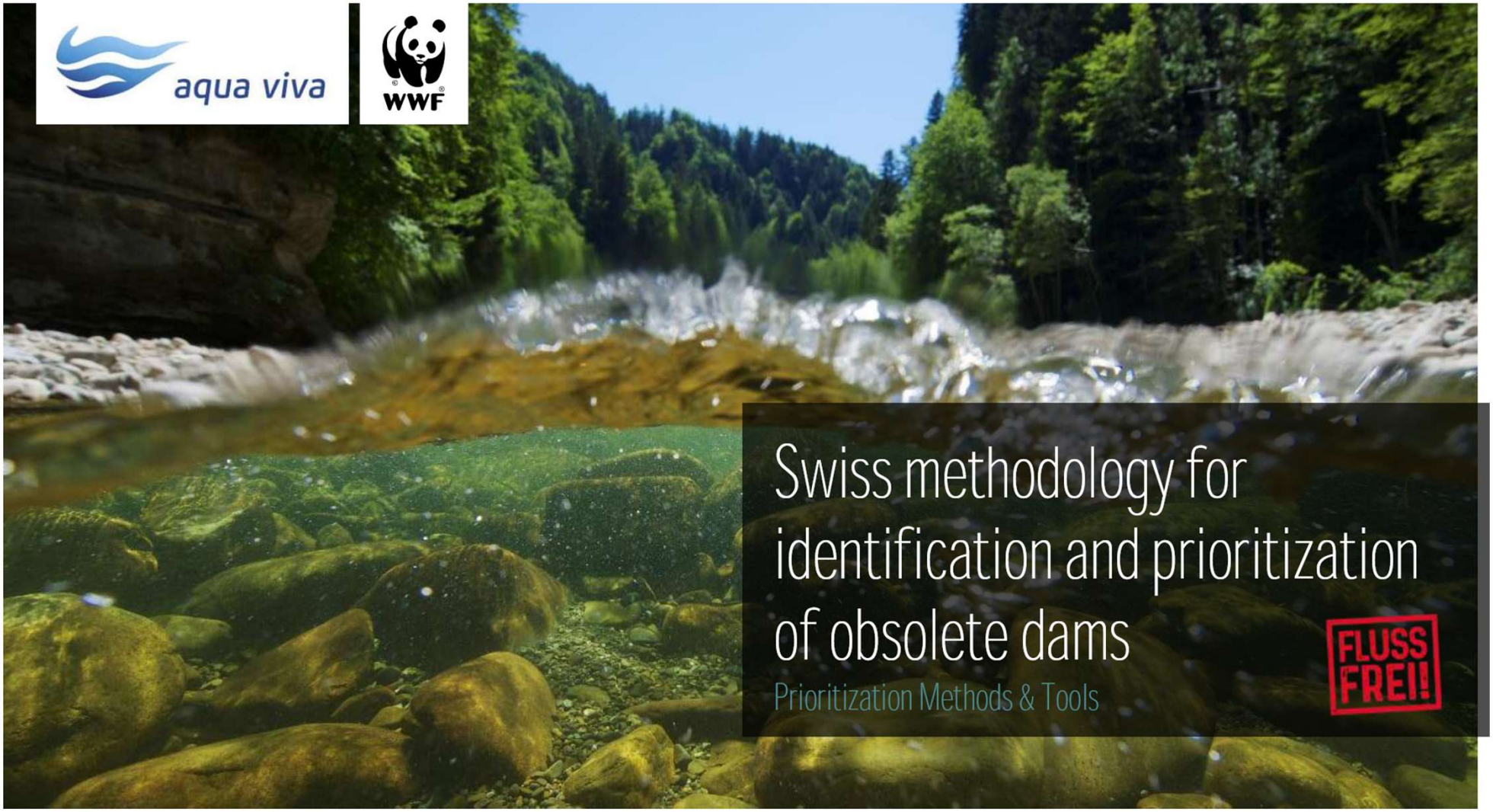

Swiss methodology for identification and prioritization of obsolete dams

Prioritization Methods & Tools

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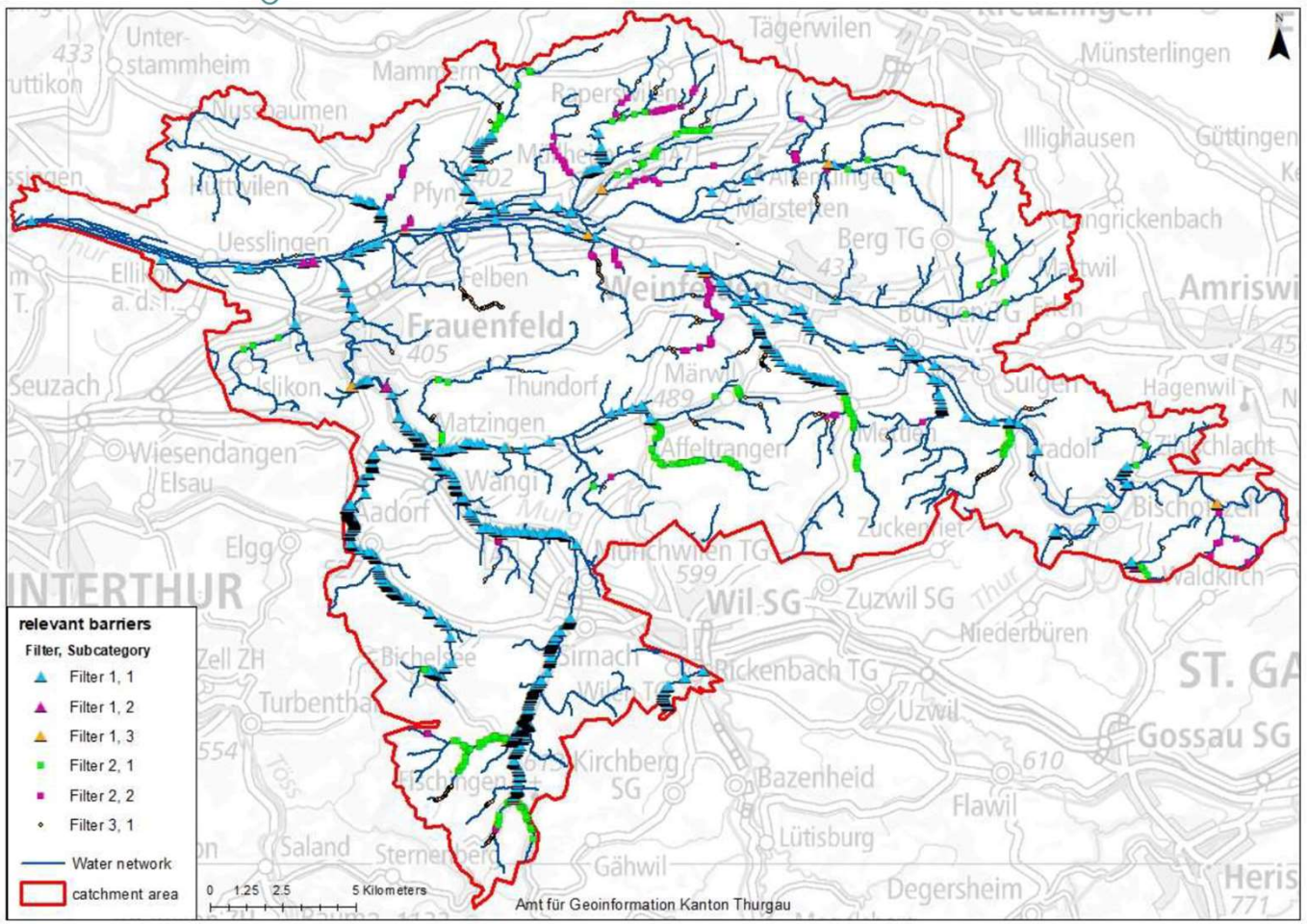
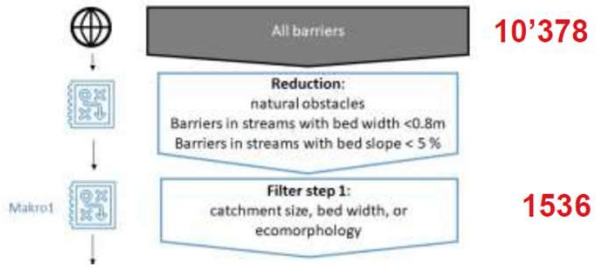
1. Filtering for the «relevant» barriers in a catchment

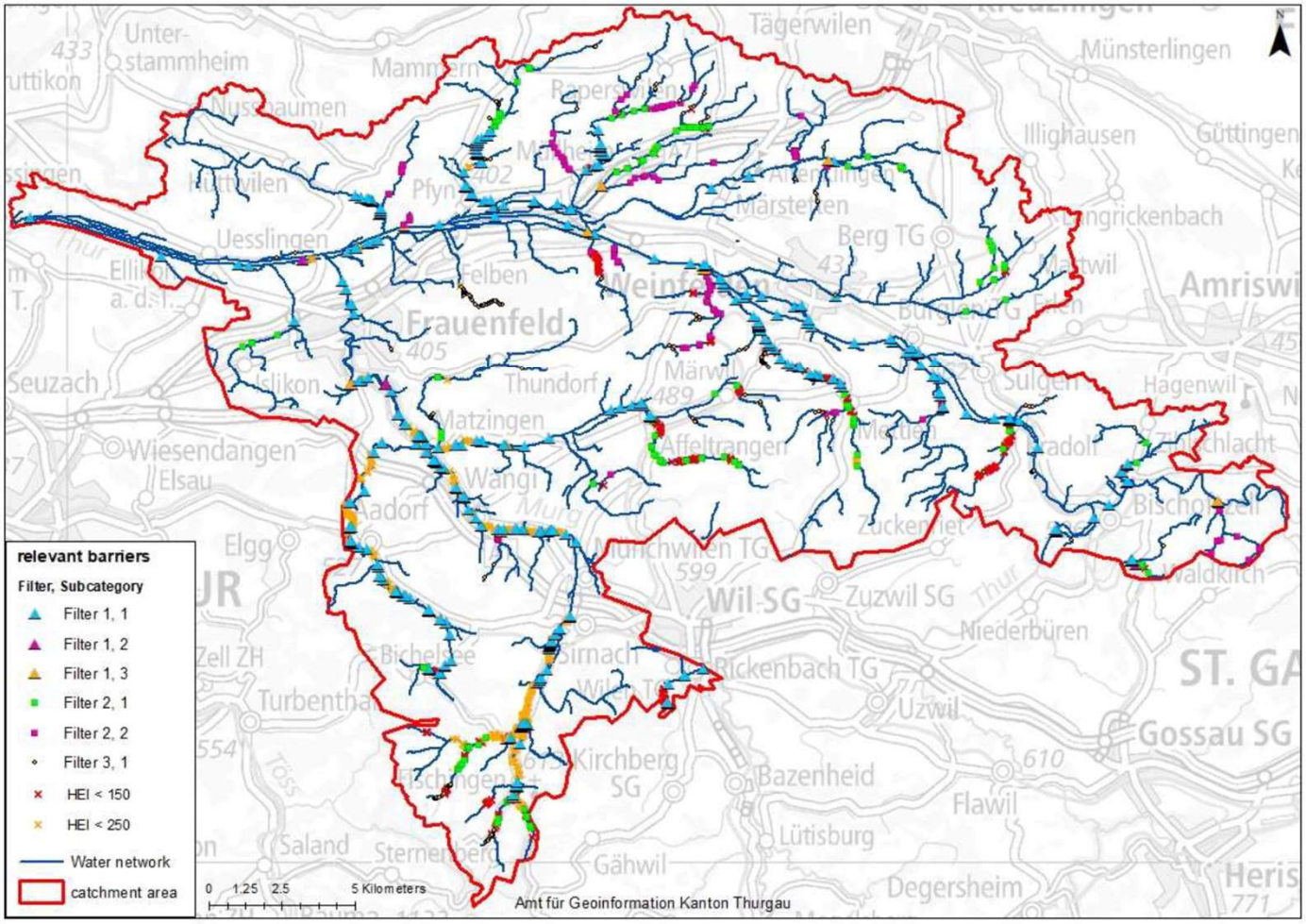


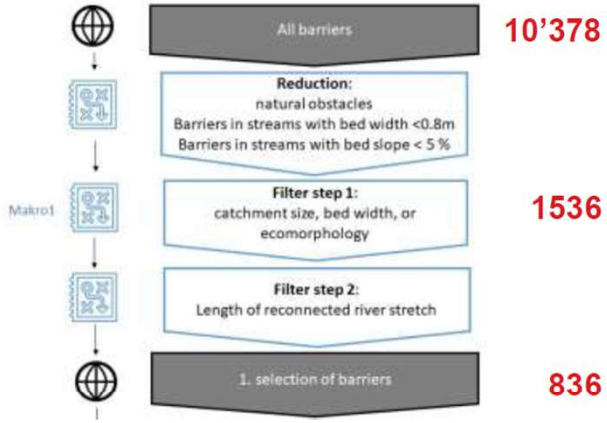


Barriers …

- which are natural
- in very small rivers
- in very steep rivers
- in the main channel
- in river mouths
- in bigger tributaries
- in tributaries with a lot of natural/near natural stretches

2. Filtering based on the length of reconnected river





Barriers…

- − with a small «habitat extension index»
- − in relation to hydropower
- \+ in river mouths
- \+ in natural/near natural stretches

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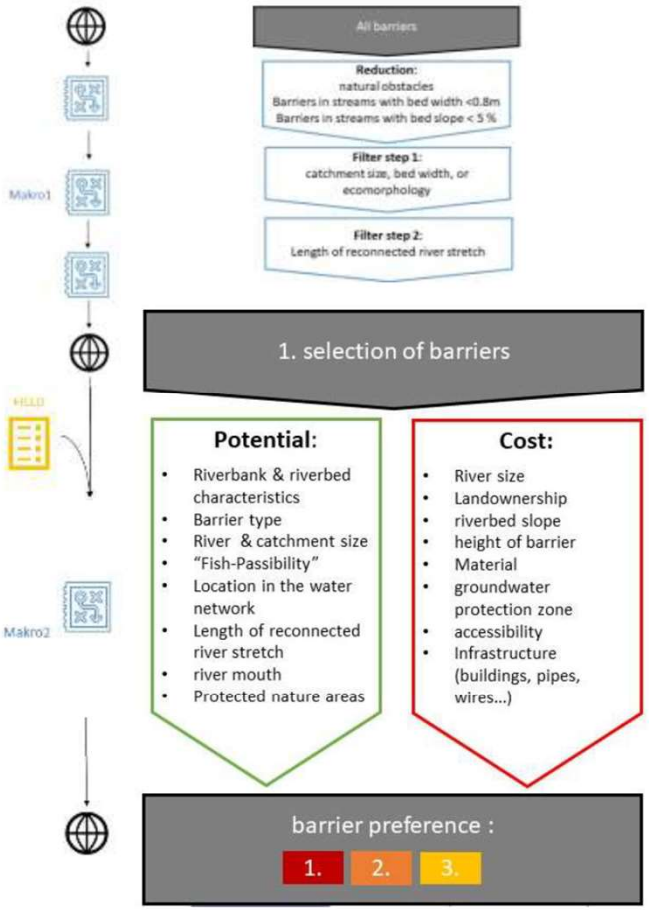
Assessment of the potential of dam removal (cost-benefit)



Ecological potential

Riverbank	Bank walls	1
	Solid shoring (square stones etc.)	0.5
	Stocked bank	0
Riverbed	Fixed without pond	1
	Riverbed with pond	0
Barrier type	Drop floor / paving of the riverbed	2
	drop / smooth block ramp	1
	rough block ramp	0
Fish passability	not passable	2
	just / moderatly passable	0
River size	Big stream: Riverbed > 15 m	1
	Medium stream: Riverbed 2 – 15 m	0.5
	Small stream: Riverbed < 2 m	0
River mouth	The barrier is located within a river mouth.	2
	The barrier is not located within a river mouth.	0
Catchment area size	Catchment area size > 10 km^2	2
	Catchment area size 2- 10 km^2	1
Habitat extension index	HEI > 1500	2
	HEI 701 -1500	1
	HEI 250 - 700	0.5
	HEI < 250	0
Connectivity	The barrier is located in a section which is connected with the main channel of the	1
	The barrier is located in a section separated from the main watercourse by high natural barriers or long embankments.	0
Nature reserve	The barrier ist located in a...	
	...national floodplain	2
	...national nature reserve	1.5
	...cantonal nature reserve or a floodplain outside the national inventory	1
	...Pro Natura nature reserve, regional or communal nature reserve, the Swiss national park, a regional park or a biosphere reserve	0.5

Cost for removal

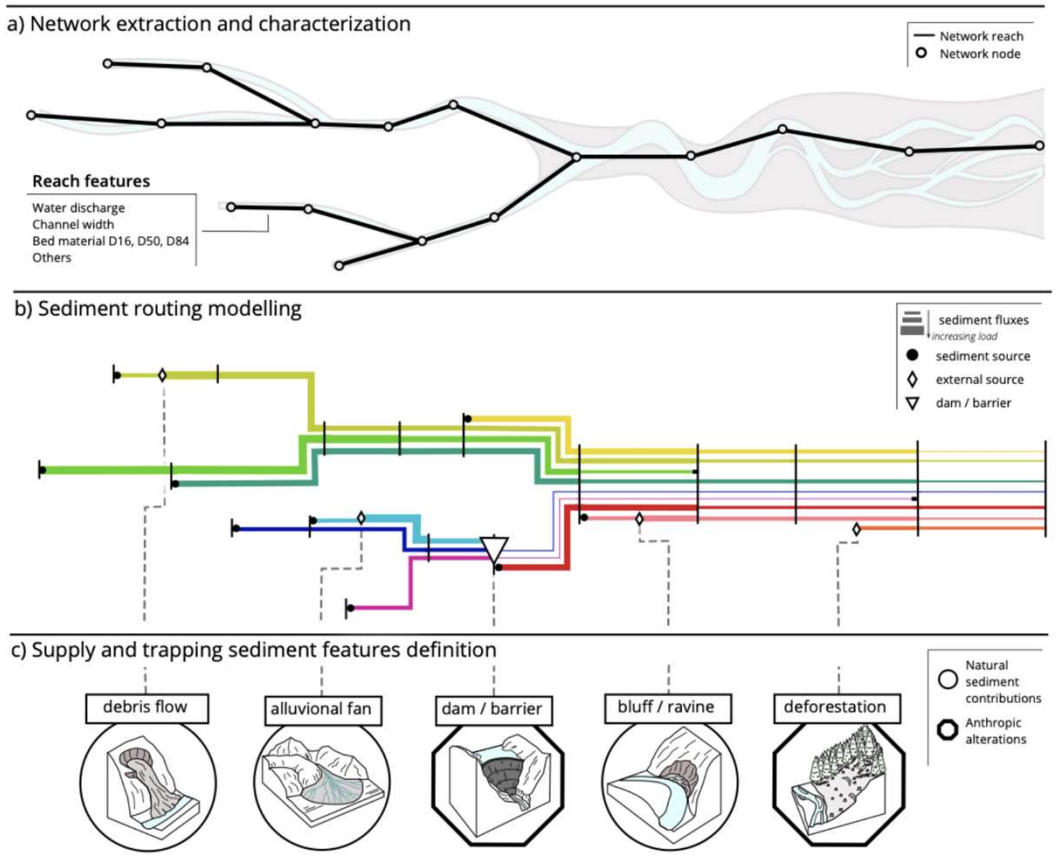
River size	Small stream: Riverbed < 2 m	2
	Medium stream: Riverbed 2 – 15 m	1
	Big stream: Riverbed > 15 m	0
State parcel	Barrier is located within a state parcel.	3
	Barrier is located within a communal parcel.	1
	Barrier is located within a private parcel.	0
River slope	River slope ≤ 2.5%	3
	River slope > 2.5%	0
Barrier height	Barrier height < 40 cm	3
	Barrier height ≥ 40 cm – 80 cm	2
	Barrier height ≥ 80 cm – 120 cm	1
	Barrier height ≥ 120 cm	0
Groundwater protection zone	Barrier is in S1	-10
	Barrier is in S2 or S3	-2
	Barrier is not in a groundwater protection zone	0
Barrier material	Concrete structure	-2
	Structure with blocks set in concrete	-1
	Building with loose blocks	0
	Wooden structure with loose blocks	0.5
	Wooden structure	1
	Other material (scoring depends on the removal effort)	
Cables	There are wastewater pipes around the barrier.	-10
	There are other pipes around the barrier.	-2
	There are no pipes around the barrier	0
Infrastructre	There is other infrastructre around the barrier.	-2
	There is no other infrastructre around the barrier.	0
Effort for removal	Removal should be easy.	3
	Removal looks complicated.	0
Accessibility	Accessibility to the barrier is good.	2
	Accessibility to the barrier is limited.	1
	Accessibility to the barrier is poor.	0

Cost / Ecological potential	Simple realisation	Complex realisation	Difficult realisation	Realisation barely possible
large	1st preference	1st preference	2nd preference	3rd preference
medium	1st preference	2nd preference	3rd preference	3rd preference
low	3rd preference	3rd preference	3rd preference	3rd preference

Rimozione/mitigazione di ostacoli alla connettività (longitudinale): come priorizzare gli interventi?

2) Trasporto sedimenti

- Rilevanza deficit di sedimenti a valle (tratti incisi, erosione costiera…)
- Quantità di sedimenti che può essere mobilizzata
- Connettività a valle/tempo necessario perché i sedimenti raggiungano il tratto critico
- Eventuali colli di bottiglia che non consentono il transito di portate solide >> (es. perché imcrementerebbero troppo il rischio di alluvioni)
- …



CASCADE (CAtchment Sediment Connectivity And DElivery) (Schmitt et al., 2016)

Rimozione/mitigazione di ostacoli alla connettività (laterale): come priorizzare gli interventi?

Possibili criteri di valutazione:

Es. servizi ecosistemici associati al ripristino della connettività (riduzione rischio di alluvioni, ricarica falda, rimozione nutrienti, fruizione, ecc.)


Grazie per l'attenzione
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