INHABIT

Local hydro-morphology, habitat and RBMPs: new measures to improve ecological quality in South European rivers and lakes

Habitat information, methods and environmental gradients investigated

CNR-IRSA, RAS, ARPA Piemonte

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CARAVAGGIO 2008 - CNR-IRSA, Core Assessment of River hAbitat VAlue and hydro-morpholoGIcal cOndition — pagina 1

Fiume	Sito	Data

Transetto 1 a valle — 10 Transetti (Spot-checks) — car. primaria / car. secondaria

Transetto (Spot-Check)	10	9	8	7	6	5	4	3	2	1

GPS — GPS — Segnare quando pag.1-2 completate — Campionamento invertebrati

Sponda Sinistra

A_L Uso del suolo alla sommità della sponda e struttura della vegetazione di riva

Criteri per sommità sponda sinistra (rottura di pendenza B, uso Stabile, Veg. non igrofila, linea di detrito T, copertura Rocce discontinua; Meandro)

Altezza della sponda (Banktop) (m)

Uso del suolo: scegliere tra nat. BL, CW, MN, MM, SH, TH, GR, MH, RD, OW, WL; agr. BP, CP, EU, PO, OR, OL, VI, TL, RP, WM, RF, FM; urb. UR, IN, SU, WT, MR, SR, WR, RA, QU, PG, AW; nv] - si veda pag. 2 della chiave applicativa o pag. 3 della scheda

Uso del suolo in 5m da sommità sponda sinistra

Sommità sinistra (B, U, S, C) (cerchiare se non omogeneo)

Larghezza della fascia vegetata (m; >m)

Sponda sinistra (B, U, S, C) (cerchiare se non omogeneo)

Estensione della Sponda (m)

su un transetto di 10 m

B_L Attributi fisici - Sponda Sinistra

Caratteri zone marginali e sponde: Pendenza (Vert., Steep, Gentle)/(NV, NO, CoNfluenza, Nat. Berm, Art. Berm)

Ampiezza Berm e/o piana inondabile (m)

Altezza Berm e/o piana inondabile (m)

Modifiche della sponda (NK, NO, RS, RI(N), RT(N), RE(N), PC(B), EM, TR)

Materiale (NV, BE, BO, CO, GS, EA, PE, CL - CC, SP, WP, GA, BR, RR, TD, FA, LR, BI, CW)

su un transetto di 1 m

Sponda Destra

A_R Uso del suolo alla sommità della sponda e struttura della vegetazione di riva

Criteri per sommità sponda destra

Uso del suolo in 5m da somm

Sommità destra (B, U, S, C)

Sponda destra (B, U, S, C)

B_R Attributi fisici - Sponda

Modifiche della sponda

Materiale

Intero Sito

C Numero di caratteristiche

C_1 - Contare sempre

Riffle(s) (Raschi)

Pool(s) (Pozze)

Isola/Isola matura

Barra di meandro non vegetata

Barra di meandro vegetata

Barra laterale non vegetata

Barra laterale vegetata

Note

D Altre caratteristiche di

Stimare il numero se pianifica

Free fall		
Chute flow		
Broken standing waves		
Unbroken standing waves		
Rippled flow		Deposito di limo senza vegetazione
Upwelling		Massi esposti in alveo
Smooth flow		Roccia esposta in alveo
Flusso non percettibile		Roccia/massi con vegetazione
Acque morte marginali		Scarpata verticale in erosione (Eroding cliff)
		Scarpata verticale stabile (Stable cliff)

Note

Bolzano set08

CARAVAGGIO 2008 - CNR-IRSA — 500m SWEEP-UP

I USO DEL SUOLO IN 50m DALLA SOMMITA' E SULLA SPONDA — Spuntare (presente), usare E (> 33% lunghezza della sponda) o W (intero sito)

Naturale	Sinistra Sommità	Sinistra Sponda	Destra Sponda	Destra Sommità	Naturale	Sinistra Sommità	Sinistra Sponda
Boschi di latifoglie/Sempreverdi mediterranei - BL					Prati naturali - GR		
Boschi di conifere (anche secondari) - CW					Brughiere - MH		
Sugherete (anche semi-naturali) - MN					Rocce, pietrisco o dune di sabbia - RD		
Macchia mediterranea - MM					Specchi d'acqua naturali - OW		
Arbusti e cespugli - SH					Zone umide (e.g. torbiere, canneti, stagni) - WL		
Erba alta/ vegetazione sparsa - TH					Altro		

Agricolo	Sommità	Sponda	Sponda	Sommità	Urbano	Sommità	Sponda
Piantagione di latifoglie o mista/ceduo intensivo - BP					Area urbana - UR		
Piantagione di Conifere - CP					Zona industriale - IN		
Piantagione di Eucaliptus - EU					Case sparse (sviluppo Suburbano)/incolti - SU		
Piantagione di Populus - PO					Impianto di depurazione - WT		
Frutteti - OR					Strada principale (e.g. > 10 m, viadotto, superstrada) - MR		
Uliveti - OL					Strada semplice (e.g. non modifica alveo e sponde) - SR		
Vigne - VI					Strada bianca/mulattiera - WR		
Campi coltivati - TL					Ferrovia - RA		
Prati/pascoli/alpeggi - RP					Cava - QU		
Marcite - WM					Parchi o giardini - PG		
Risaie - RF					Specchi d'acqua artificiali - AW		
Fattorie/allevamenti - FM					Altro		
Campi/aree irrigati intensivamente					Altro		

J Profilo della sponda — Spuntare (presente), usare E (> 33% lunghezza della sponda) o W (intero sito)

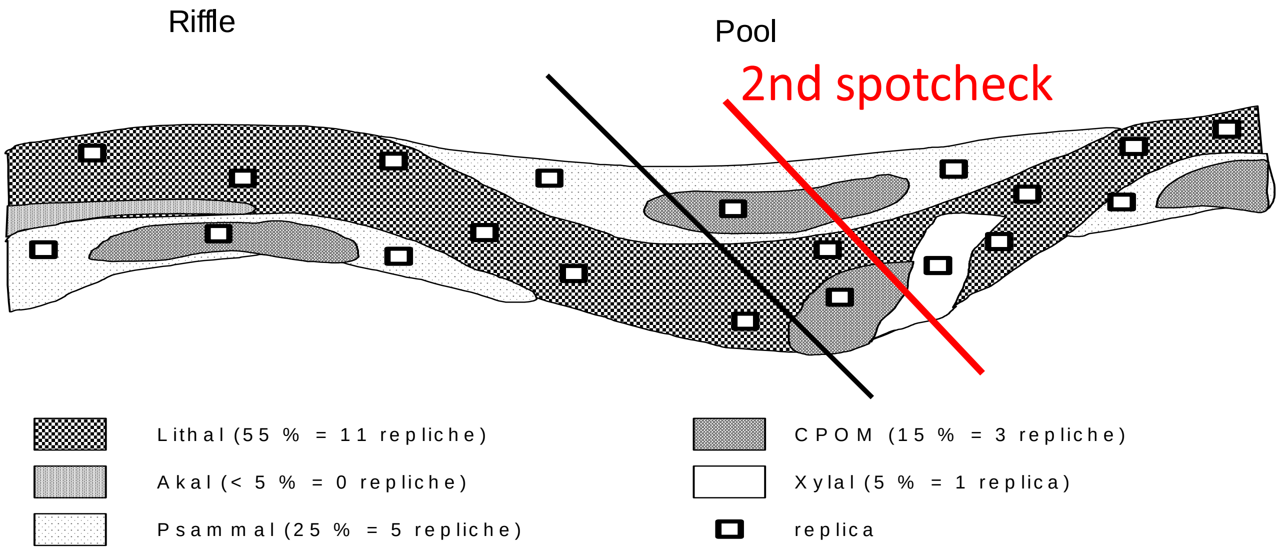
Naturale/Non modificato	Sx	Dx	Artificiale/Modificato	Sx

Ombreggiatura; Rami; Grosse radici esposte; Parti vive di radici sommerse; Detriti legnosi; Alberi caduti/inclinati sulla sponda

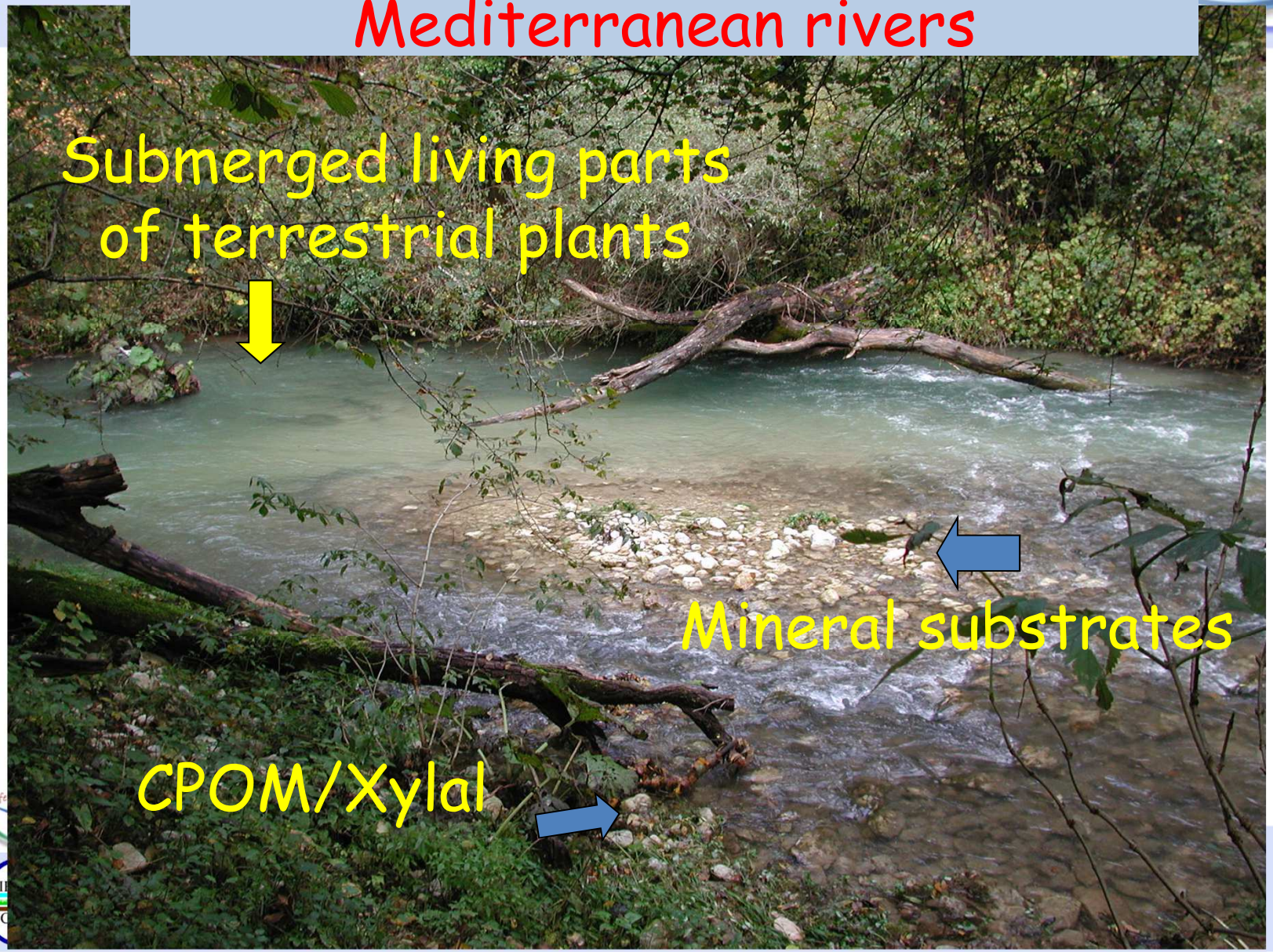
Frassino (Fraxinus); Tamerice (Tamarix); Oleandro (Nerium oleander); Platano (Platanus)

Sommità — Sponda

Note e/o Eserc trasversale sito



Why CARAVAGGIO → good characterization of the habitat Mediterranean rivers



What we can get from CARAVAGGIO: Indices/descriptors actually derived from CARAVAGGIO

- **Morphological alteration → HMS - Habitat Modification Score**
- **Habitat Diversification → HQA - Habitat Quality Assessment**
- **Land Use → LUI – Land Use Index**
- **Local hydromorphological condition → LRD - Lentic-lotic River Descriptor**
- **All indices/descriptors available at Pd3 – "Guideline and field protocols for deriving hydro-morphological and habitat information"; http://www.life-inhabit.it/en/inhabit-themes-results/dissemination**

Habitat Modification Score (HMS)

The principle of HMS: different scores are assigned to different morphological alteration (and than summed)

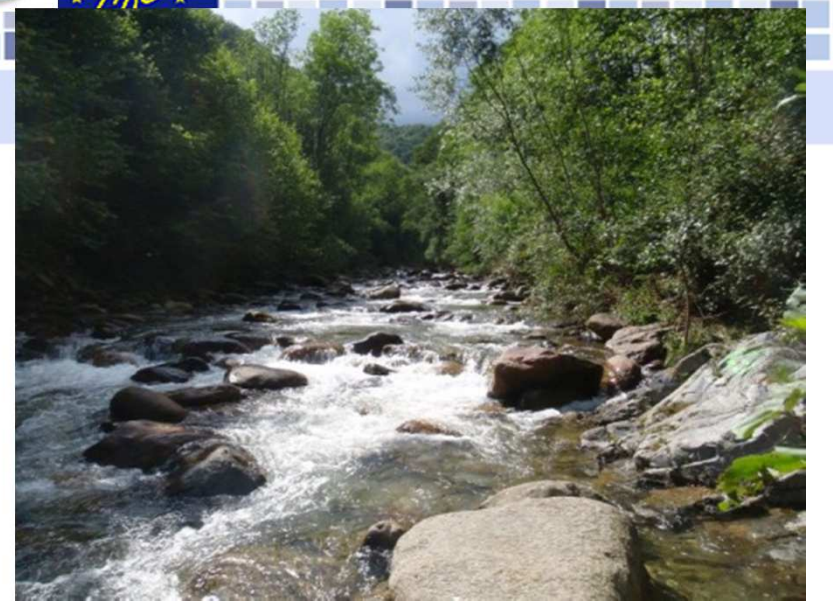
High HMS values → high morphological alteration

Features		Scores			
From Raven et al., 1998		Each SC	# of SC <3	# of SC 3-5	# of SC 6≥
Spotcheck	Reinforcement to banks (RI)	2			
	Reinforcement to bed (AR)	2			
	Resectioned bank or bed (RS)	1			
	Two-stage bank modification (BM)	1			
	Embankment (EM)	1			
	Culvert	8			
	Dam, weir, ford (DA, FO)	2			
	Bank poached by livestock (PC)		0	1	2
Sweep-up		Bank one		Bank both	
	Artificial bed material	1			
	Reinforced whole bank	2		3	
	Reinforced top or bottom only	1		2	
	Resectioned bank	1		2	
	Embankment	1		1	
	Set-back embankment	1		1	
	Two-stage channel	1		3	
	Weed-cutting	1			
	Bank mowing	1		1	
	Culvert	8 each			
	Dam, weir, ford	2 each			
		# of features 1		# of features 2≥	
	Roadbridge	1		2	
	Enhancements, such as groynes	1		2	
		Partly		Extensively	
	Site affected by flow control	1		2	
	Realigned channel	5		10	

Habitat quality assessment (HQA)

High HQA values → high habitat diversification

Category (note)	Features	Spotcheck #1	#2-3	#4≥	Sweep-up (note)
Flow types	Every features	1	2	3	1 each (if not in the SC)
Channel substrates	Every features (NV score 1 only if 6≥)	1	2	3	
Natural channel features	Every features	1	2	3	1 each (if not in the SC)
Bank features	EC, SC, PB, VP, SB, VS	1	2	3	
Bars	VP, PB, SB, VS				1 each (if not in the SC)
					# of features 3-8 / 9≥
	PB+VP (count together)				1 / 2
Bank vegetation structure (each bank is scored separately)	Bankface (S or C)	1	2	3	
	Banktop (S or C)	1	2	3	
In-stream channel vegetation (either present or extensive)	Liverworts/mosses	1	1	2	
	emergent broad-leaved herbs	1	1	2	
	emergent reeds/rushes/sedges	1	1	2	
	floating-leaved, free floating and amphibious	1	1	2	
	submerged broadleaved	1	1	2	
	submerged linear and fine-leaved	1	1	2	
Land-use within 50 m (each bank is scored separately)					P / E
	Broadleaf woodland, moorland/heath and wetland				1 / 2
	Exclusively recorded: Broadleaf woodland, moorland/heath and wetland				7
Trees (each bank is scored separately)	Isolated/scattered				1
	Regularly-spaced or occasional clumps				2
	Semi-continuos or continuos				3
Associated features					P / E
	Overhanging boughs				1
	Exposed bankside roots, underwater tree roots				1 / 2
	Coarse woody debris				1 / 3
	Fallen trees				1 / 5
Special features	Waterfall more than 5m high, braided or side-channels, debris dams, natural open, fen, carr, flush, bog				5

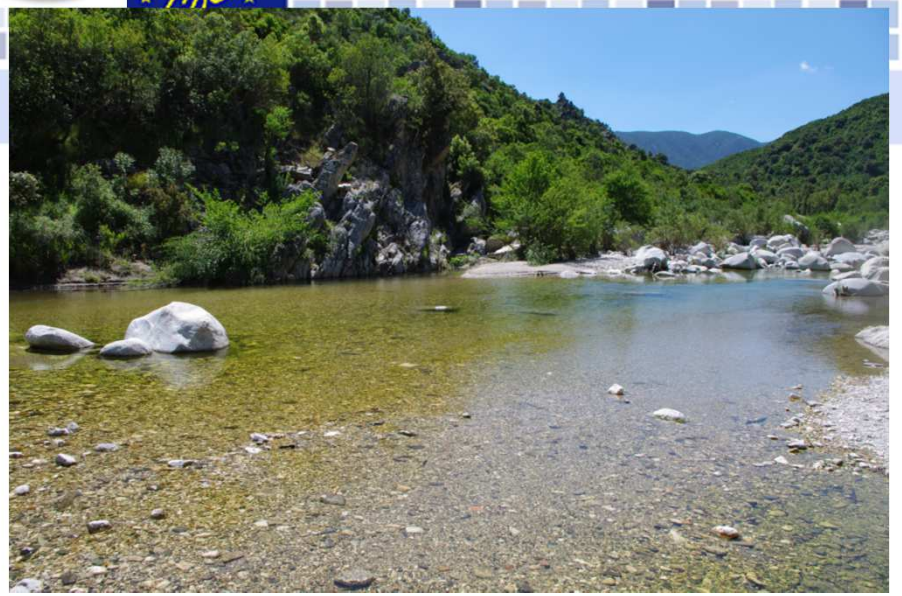


Savenca Reference (Alps, Piemonte):
HMS 1
HQA 49

Savenca ponte (Alps, Piemonte):
HMS 37
HQA 35

Sizzone (Po Plain, Piemonte):
HMS 4
HQA 51

Guarabione ponte (Po Plain, Piemonte):
HMS 46
HQA 22



Flumineddu (Sardegna):
HMS 0
HQA 61

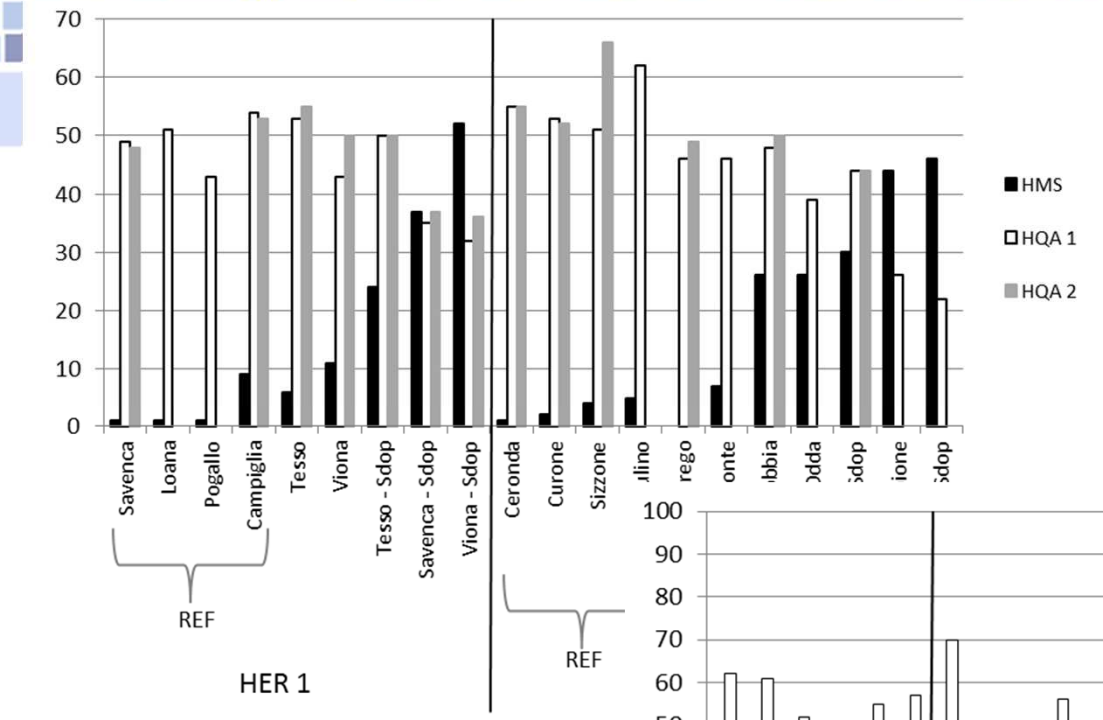
Affluente Posada (Sardegna):
HMS 0
HQA 50

Corre pruna ponte (Sardegna):
HMS 79
HQA 26

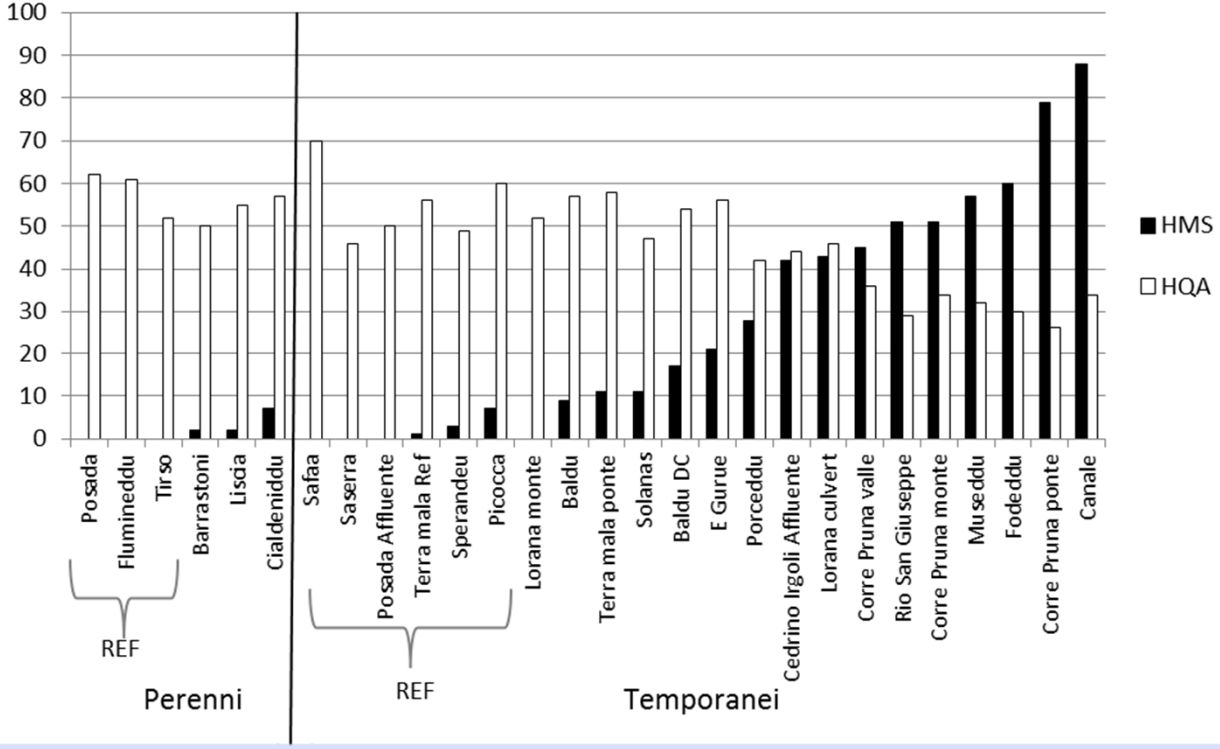
Baldu Downstream (Sardegna):
HMS 26
HQA 54

Risultati INHABIT - HMS HQA

Piemonte



Sardegna



Land Use Index (LUI)

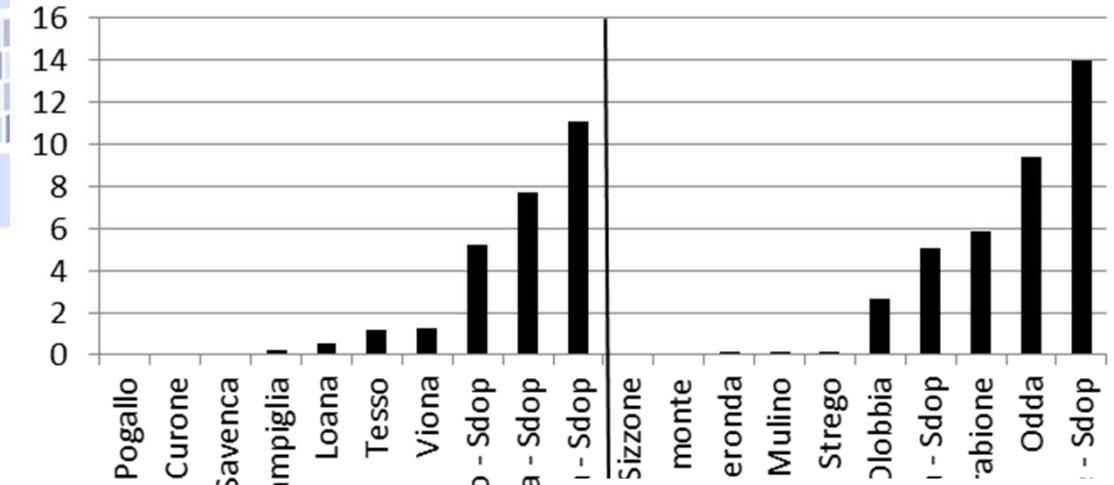
Features recorded with the CARAVAGGIO method included in the calculation of LUIr and related sections of the field form. WF: the feature is used as a Weight Factor.

Sec.	Spot-checks / Sweep-up	Feature	River section	Score / WF
A	Spot-checks	Land use within 50 m of bankt		
		Banktop height (m)		
		Bankface extension (m)		
E		Total channel width		
I	Sweep-up	Land use within 50 m of banktop		
		Land use on bankface		
J		Bank profiles - Embanked		
		Bank profiles - Set back embankment		
Q	Sweep-up	Tillage of fileds perpendicular t river course		

Natural land uses: all receiving 0

	Score			
Land Use (agriculture)	Spot-checks and Sweep-up	Adjusted scores for spot-checks if tillage of fields is perpendicular to river course		
		P	E	W
BP, CP, EU, PO, FM	3			
OR, VI, TL, RF	3	3.3	3.9	4.5
RP, WM	1			
OL	1	1.1	1.3	1.5

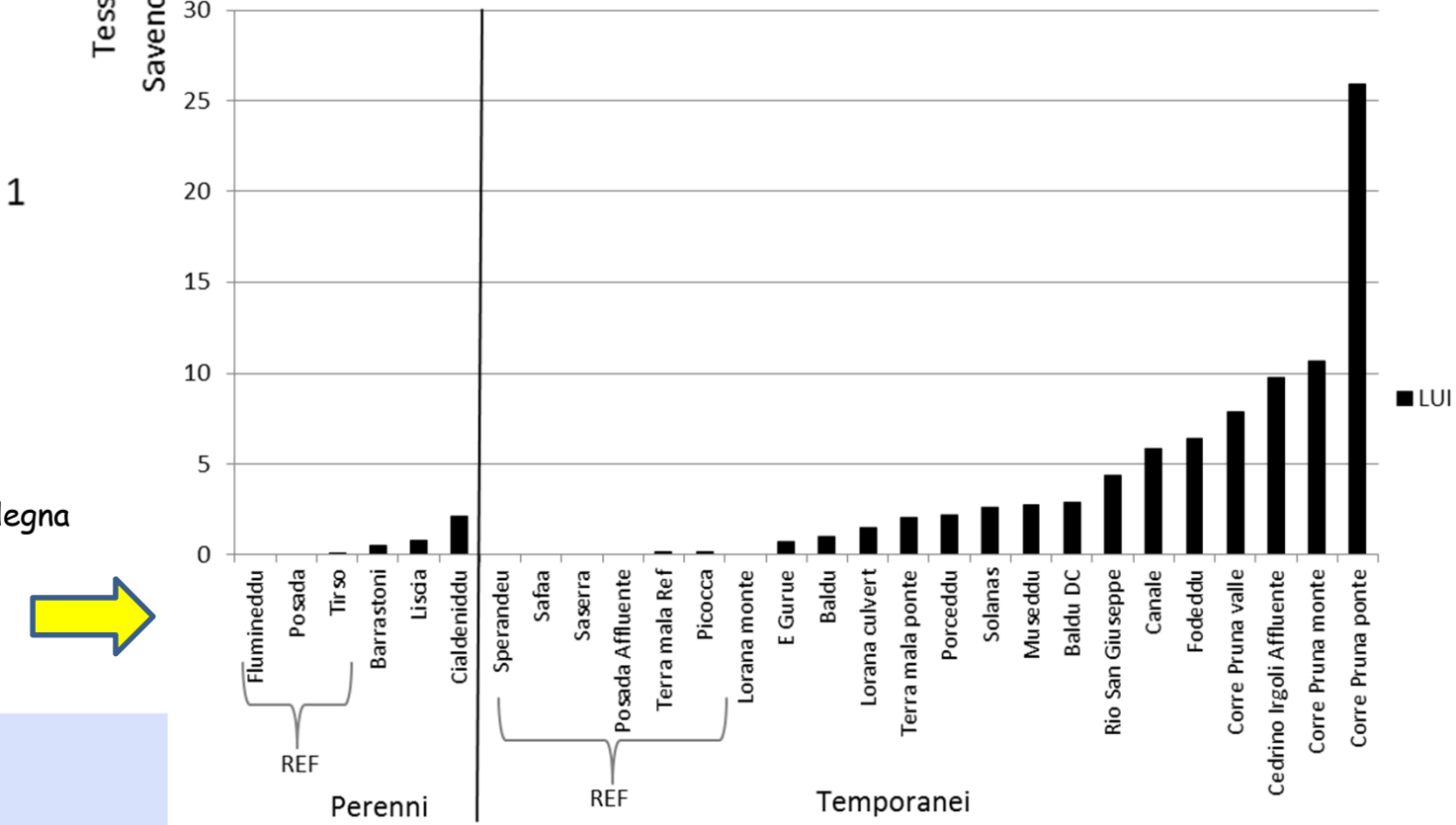
	Score			
Land Use (Artificial)	Spot-checks and Sweep-up	Only for Sweep-Up, when different from spot-checks (sec. I)		
		P	E	W
IN, UR, WT, QU	5			
SU	3			
MS, RA	3	0.3	0.45	0.6
PG, AW	1			
RO	1	0.1	0.15	0.2
WR	0			



Piemonte

HER 1

Sardegna



HMS, HQA and LUI are actually included in DM 260/2010 (Italian law indicating technical criteria for classifying water bodies) for the definition of High/Good boundary

Ecological Quality Ratio: HMS & LUI

90th percentile (MHS=6) → High/Good boundary

EQR_{HMS} = 100-HMS observed /100-0 [where 0 is HMS median value at reference sites]

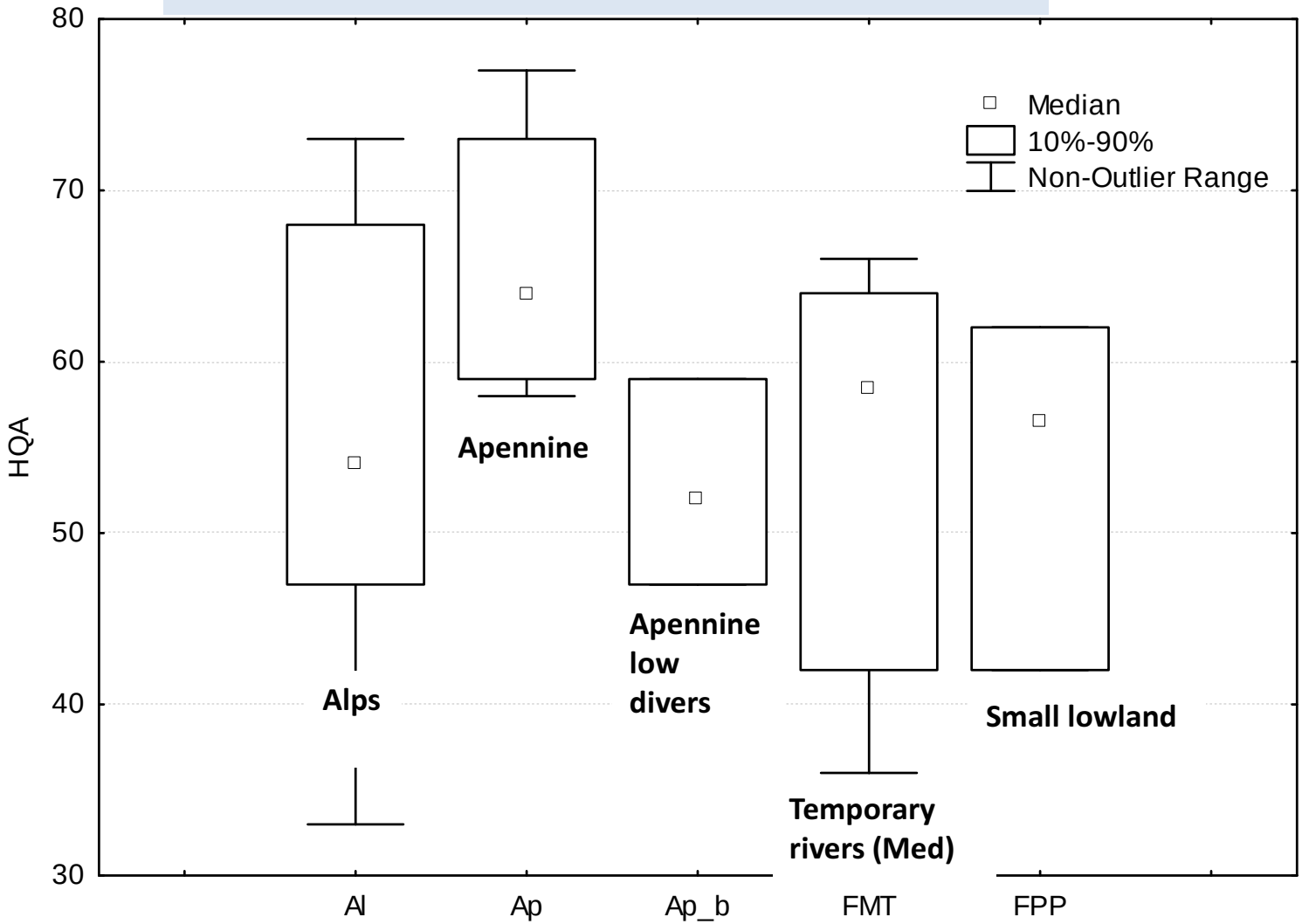
90th percentile (LUI) → High/Good boundary

EQR_{LUI} = 39.2-LUIobserved /39.2-0 [where 0 is HMS median value at reference sites]

EQR HMS	HMS Score range	Range 100-HMS	Quality status
≥ 0.94	0 - 6	94-100	High status
≥ 0.82	7-18	82-93	Good status
≥ 0.58	19-42	58-81	Moderate status
≥ 0.28	43-72	28-57	Poor status
< 0.28	≥ 73	≤ 27	Bad status

$EQR_{LUIcara}$	LUIcara range	Range Max-LUIcara	Quality status
≥ 0.95	0 - 2	37.2- 39.2	High status
≥ 0.72	2.01-11	28.2-37.19	Good status
≥ 0.49	11.01-20	19.2-28.19	Moderate status
≥ 0.26	20.01-29	10.2-19.19	Poor status
< 0.26	> 29	<10.2	Bad status

HQA variability



Ecological Quality Ratio: HQA

10th percentile (HQA) → High/Good boundary

EQR_{HQA} = HQAobserved -11 /reference median value-11
[where 11 is HQA minimum value, if HQA is < 11 (very rare) → = 0]

EQR_{HQA} (median REF 58)	Score HQA – Mediterranean temporary	Quality status
≥ 0.66	≥ 42	High status
≥ 0.49	34-41	Good status
≥ 0.32	26-33	Moderate status
≥ 0.15	18-25	Poor status
< 0.15	≤ 17	Bad status

EQR_{HQA} (median REF 56)	Score HQA – small lowland	Quality status
≥ 0.69	≥ 42	High status
≥ 0.51	34-41	Good status
≥ 0.33	26-33	Moderate status
≥ 0.16	18-25	Poor status
< 0.16	≤ 17	Bad status

EQR_{HQA} (median REF 57)	Score HQA – other	Quality status
≥0.78	≥ 47	High status
≥ 0.59	38-46	Good status
≥0.39	29-37	Moderate status
≥0.20	20-28	Poor status
<0.20	≤ 19	Bad status

EQR_{HQA} (median REF 54)	Score HQA – Alps	Quality status
≥ 0.84	≥ 47	High status
≥ 0.63	38-46	Good status
≥ 0.42	29-37	Moderate status
≥ 0.21	20-28	Poor status
< 0.21	≤ 19	Bad status

EQR_{HQA} (median REF 64)	Score HQA – Appennino	Quality status
≥ 0.91	≥ 59	High status
≥ 0.68	47-58	Good status
≥ 0.45	35-46	Moderate status
≥ 0.23	23-34	Poor status
< 0.23	≤ 22	Bad status

EQR_{HQA} (median REF 52)	Score HQA – Appennino (low divrsification)	Quality status
≥ 0.88	≥ 47	High status
≥ 0.66	38-46	Good status
≥ 0.44	29-37	Moderate status
≥ 0.22	20-28	Poor status
< 0.22	≤ 19	Bad status

Lentic-lotic River Descriptor

Negative scores associated to lotic features

Positive values associated to lentic features

It is possible to separate scores associated to artificial features to scores linked with natural features

	Description (page - section)	Category	Feature	Score	
Spot-checks	Flow type (2-F)	Lentic	DR	8	
			NP	2	
		Intermediate	CH, SM, UP	0	
		Lotic	RP	-0.5	
			UW	-1	
			BW, CF, FF	-2	
	Maximum water depth (2-E)	Deep	>75	1	
		Intermediate	25?x?75	0.5	
		Not deep	<25	0	
	Channel substrate (2-F)	Lentic	CL, SI, SA	1	
		Intermediate	GP, BE	0	
		Lotic	CO, BO	-1	
		Artificial	AR	0	
			Extension	P <33%	E ?33%
	Channel vegetation types/ Organic debris (2-H)	Lentic	Emergent reeds/sedges/ rushes/grasses	1	3
			Floating-leaved (rooted)		
			Free-floating		
			Organic matter (CPOM/FPOM)	1	3
		Lotic	Liverworts/mosses/ lichens	-1	-3

Sweep-up		Class		Present	Frequent	Very frequent
		Occurrence (# features)		1-2	3-4-5-6	>7
	Flow type (1-D)	Lentic	DR	16	24	24
			NP	4	6	10
		Intermediate	CH, SM, UP	0	0	0
		Lotic	RP	-1	-1.5	-2.5
			UW	-2	-3	-5
			BW, CF, FF	-4	-6	-10
	Bars (1-C & 1-D)	Every recorded bar scores		-0.5 (maximum total score -5)		
				Major	Intermediate	Minor
	Artificial features (2-G)	Weirs/sluices, Bridges, Culvert		2	1	0
		Deflectors, Fords		1	1	1
	General degradation (4-Q)				Yes <33%	Yes ?33%
		Is water impounded by weirs/sluices?			3	6
			Extension		P <33%	E ?33%
	Features of special interest (4-R)	Natural water falls (>5 m high)			-3	-5
		Natural water falls (>5 m high)			-1	-3
		Debris dam(s)			1	3

LRD varies between -70 (extremely lotic) and 90 (Extremely lentic)

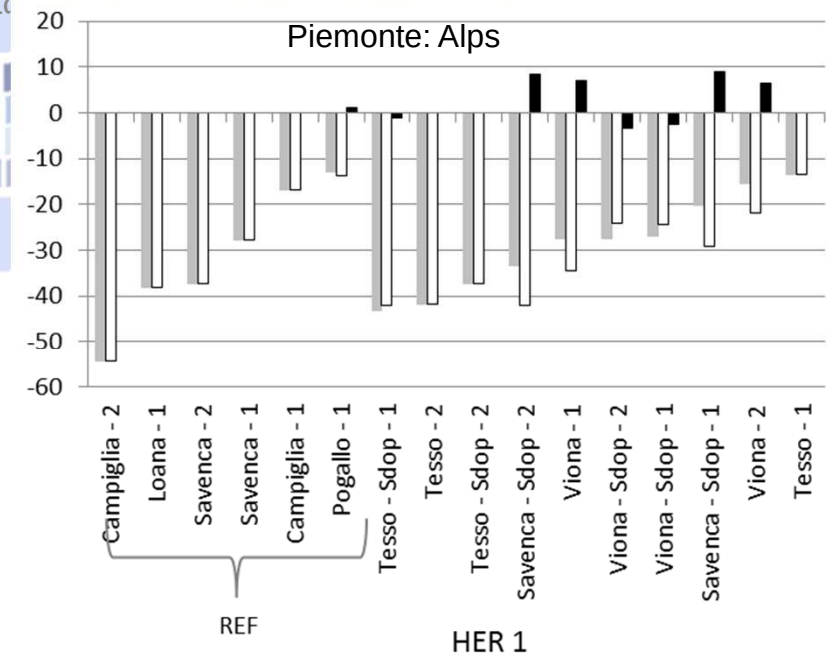
Class	Name	Value		
1+	Extremely lotic		LRD	≤-50
1	Very lotic	-50<	LRD	<-30
2	Lotic	-30≤	LRD	<-10
3	Intermediate	-10≤	LRD	<10
4	Lentic	10≥	LRD	<30
5	Very lentic	30≥	LRD	<50
5+	Extremely lentic		LRD	≥50

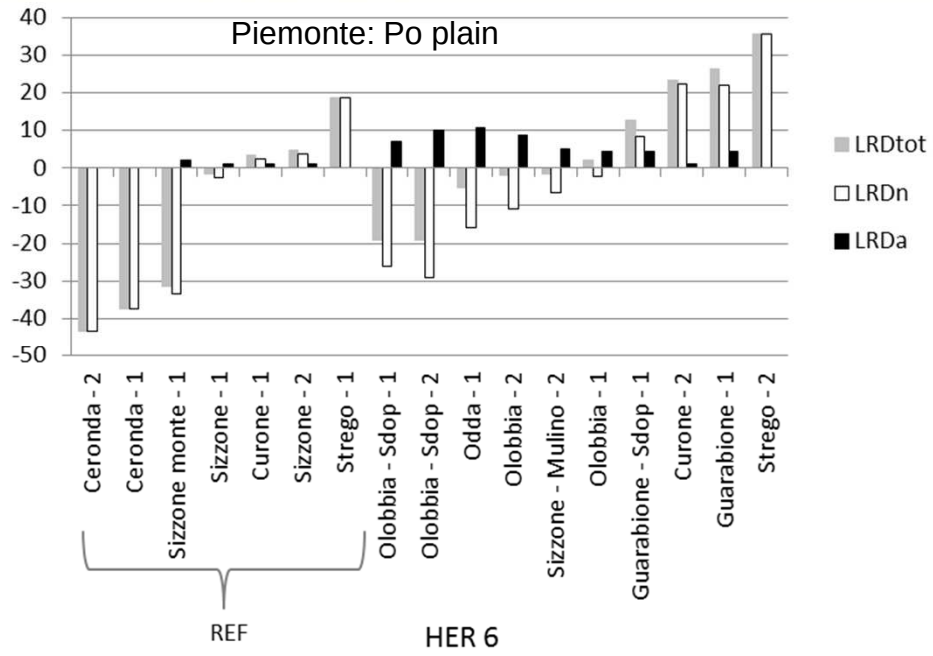

Curone LRD 23

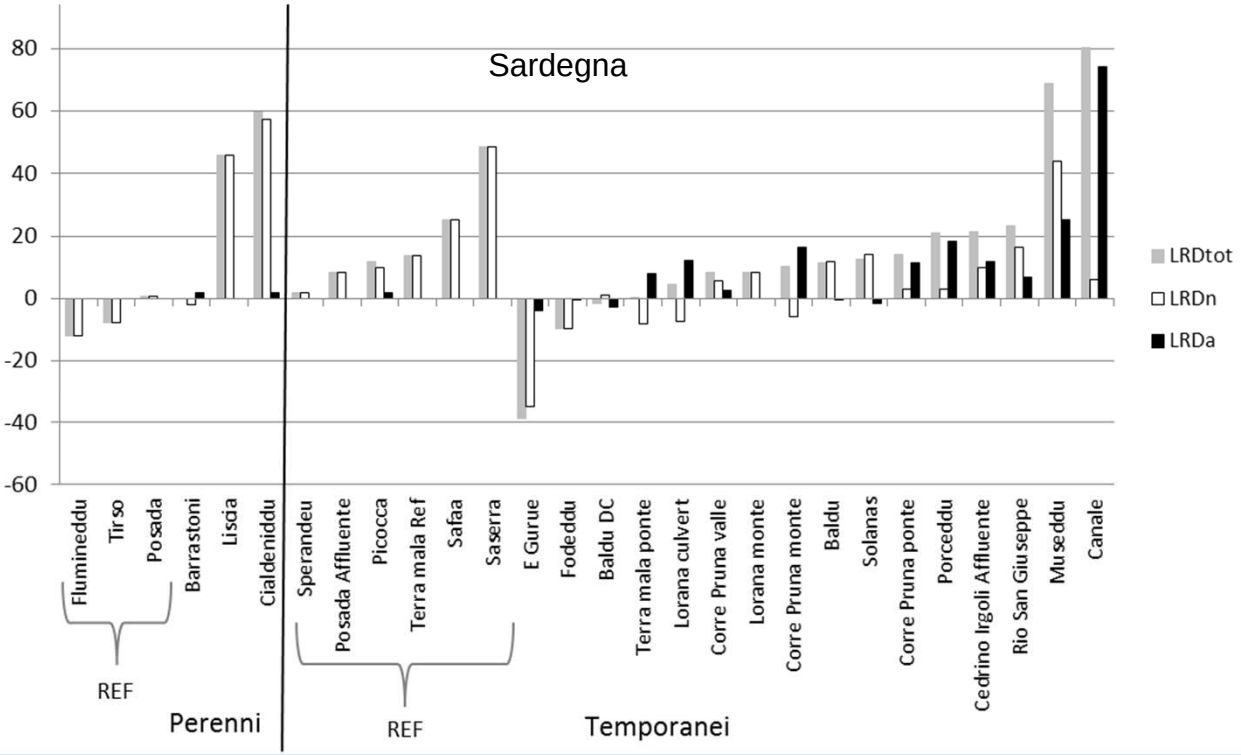

Museddu LRD 69


E Gurue: LRD -38


Campiglia, LRD -54


Piemonte: Alps
20
10
0
-10
-20
-30
-40
-50
-60
Campiglia - 2
Loana - 1
Savenca - 2
Savenca - 1
Campiglia - 1
Pogallo - 1
Tesso - Sdop - 1
Tesso - 2
Tesso - Sdop - 2
Savenca - Sdop - 2
Viona - 1
Viona - Sdop - 2
Viona - Sdop - 1
Savenca - Sdop - 1
Viona - 2
Tesso - 1
REF
HER 1


Piemonte: Po plain
40
30
20
10
0
-10
-20
-30
-40
-50
Ceronda - 2
Ceronda - 1
Sizzone monte - 1
Sizzone - 1
Curone - 1
Sizzone - 2
Strego - 1
Olobbia - Sdop - 1
Olobbia - Sdop - 2
Odda - 1
Olobbia - 2
Sizzone - Mulino - 2
Olobbia - 1
Guarabione - Sdop - 1
Curone - 2
Guarabione - 1
Strego - 2
REF
HER 6
LRDtot
LRDn
LRDa


Sardegna
80
60
40
20
0
-20
-40
-60
Flumineddu
Tirso
Posada
Barrastoni
Lisaia
Cialdeniddu
Sperandeu
Posada Affluente
Picocca
Terra mala Ref
Safaa
Saserra
E Gurue
Fodeddu
Baldu DC
Terra mala ponte
Lorana culvert
Corre Pruna valle
Lorana monte
Corre Pruna monte
Baldu
Solanas
Corre Pruna ponte
Porceddu
Cedrino Irgoli Affluente
Rio San Giuseppe
Museddu
Canale
REF
Perenni
REF
Temporanei
LRDtot
LRDn
LRDa

Lentic-lotic River Descriptor (LRD)

All: Emilia – Toscana – Cilento - Sardegna

All area Samples: 103

Correspondence Analysis					
Axes	**I**	**II**	**III**	**IV**	**Total inertia**
Eigenvalues	**0.34**	**0.23**	**0.22**	**0.20**	**4.24**
	Lentic-lotic character: LRD (R=0.77)	**Environmental quality gradient:** Combined Pressure HMS-HQA-LIM-IFF (R=0.49)	**River type:** Slope (R=0.32)	**Season:** annual rainfall (R=0.46)	

Sardinia Samples: 37

Principal Component Analysis				
Axes	**I**	**II**	**III**	**IV**
Eigenval	**0.248**	**0.121**	**0.082**	**0.069**
	Lentic-lotic character: LRD (R=0.77)	**Upstream/ downstream** site altitude (R=0.74)	**Typology**	**Environmental quality gradient:**

Temporary rivers

- CARAVAGGIO soft → for calculating the different indices


Grazie per l'attenzione!
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