Supplementary material

Macroinvertebrate responses to flow intermittence: when mesohabitat matters

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Table S1. Experiment schedule

Phase	Date	Activity	Description
Pre-treatment (colonization)	May 03, 2021	Beginning of the passive colonization phase	We started pumping water from the River Queich through the RSM system, keeping 1 L/s discharge in all the flumes.
	May 18, 2021	Active seeding of the flumes	All the flumes were supplied with macroinvertebrates collected from the River Queich (next to the RSM mesocosm system) with both leaf bags and kick-sampling.
	June 7, 2021	Macroinvertebrate sampling	Pre-treatment sampling of benthic macroinvertebrates. Two Surber samples were collected from each flume, one next to the water inlet (riffle mesohabitat) and one next to the water outlet (pool habitat).
Treatment	June 15, 2021	Beginning of the treatment phase	ID and PD treatments started in specific flumes (see Figure 1), reducing the discharge to 0.4 L/s resulting in only a few cm of stagnant water left in the flumes. Mesh cover placed on all metal frames, isolating each unit from both external influences and the other units.
	July 7, 2021	ID back to the normal flow	Discharge in ID flumes reset to 1 L/s.
	July 21, 2021	ID back to drought conditions	Discharge in ID flumes reset to 0.4 L/s.
	August 4, 2021	ID back to normal flow	Discharge in ID flumes reset to 1 L/s.
	August 17, 2021	Macroinvertebrate sampling	During-treatment sampling of benthic macroinvertebrates. Two Surber samples were collected from each flume, one next to the water inlet (riffle mesohabitat) and one next to the water outlet (pool habitat).
Post-treatment (recovery)	September 24, 2021	All flumes back to normal flow	Discharge in both ID and PD flumes reset to 1 L/s.
	October 20, 2021	Macroinvertebrate sampling	Post-treatment sampling of benthic macroinvertebrates. Two Surber samples were collected from each flume, one next to the water inlet (riffle mesohabitat) and one next to the water outlet (pool habitat).

RSM: Riparian Stream Mesocosm, ID: Intermittent Drying, PD: Prolonged Drying.

Table S2. List of resistance and resilience traits selected for this study (Bozóki et al., 2024; Stubbington et al., 2022; Viza et al., 2023).

Selected traits	Selected modalities	Rationale
Transversal distribution	ponds, pools, disconnected side-arms	Organisms adapted to lentic and temporary waters, hence able to survive during the ponded phase of the drying process.
	temporary waters	
Current preference	null	Preferences for lentic environments can select organisms able to resist the first steps of the drying process (i.e., the ponded phase).
	slow	
Temperature	thermophilic	Organisms adapted to warmer waters or with a wide tolerance for water temperature can resist the increased water temperature during the drying process.
	eurythermic	
Locomotion	full water swimmer	Swimmer organisms can actuate avoiding strategies during the disturbance or recolonize faster after the rewetting. Burrowers and interstitial organisms can resist using the sediment as a refuge area.
	burrower	
	interstitial	
Respiration	spiracle	Organisms can obtain oxygen directly from the air.
	hydrostatic vesicle	
Maximal potential size	max potential size ≤ 0.25 cm	Small body sizes allow organisms to reduce their metabolic demand and easily access refuge areas.
	max potential size 0.25-0.5 cm	
Resistance form	eggs, statoblasts	Desiccation-tolerant life forms (which are often dormant) can persist during dry phases.
	cocoons	
	housing against desiccation	
	diapause or dormancy	
Dispersal strategy	aquatic active	Active dispersal facilitates post-disturbance recovery of communities.
Life cycle duration	≤ 1 year	Shorter life cycles enable faster recovery after rewetting.
Potential number of cycles per year	> 1	Multiple generations per year promote fast post-disturbance.
Reproduction	ovoviviparity	Ovoviviparity and egg groups laid in vegetation can resist drying. Asexual reproduction can enable population recovery from single organisms after rewetting.
	terrestrial clutches	
	asexual reproduction	
Drift propensity	occasional	Higher drift propensity facilitates recolonization from unimpacted upstream habitats.
	frequent	

Table S3. Full taxa list of macroinvertebrates sampled at the Riparian Stream Mesocosm (RSM) system throughout the experiment, including their relative frequency and abundance in the dataset.

Class/Order	Family	Taxa	Frequency (%)	Abundance (%)
Coleoptera	Chrysomelidae	Chrysomelidae	1	<0.01
Coleoptera	Curculionidae	Curculionidae	1	<0.01
Coleoptera	Elmidae	*Elmis* sp.	59	0.71
Coleoptera	Elmidae	*Limnius* sp.	6	0.02
Coleoptera	Hydraenidae	*Hydraena* sp.	3	0.01
Coleoptera	Hygrobiidae	Hygrobiidae	4	0.01
Crustacea	Gammaridae	*Gammarus* sp.	100	63.77
Diptera	Chironomidae	Chironomidae	97	32.14
Diptera	Chironomidae	Tanypodinae	59	0.54
Diptera	Ephydridae	Ephydridae	1	<0.01
Diptera	Limoniidae	Limoniidae	18	0.10
Diptera	Limoniidae	Pediciidae	3	0.01
Diptera	Psychodidae	Psychodidae	1	<0.01
Diptera	Ptychopteridae	Ptychopteridae	1	<0.01
Diptera	Simuliidae	Simuliidae	21	0.10
Diptera	Tipuliidae	Tipulidae	22	0.25
Ephemeroptera	Baetidae	*Baetis* sp.	76	1.85
Ephemeroptera	Ephemerellidae	*Serratella* sp.	38	0.17
Ephemeroptera	Heptageniidae	*Ecdyonurus* sp.	7	0.02
Trichoptera	Hydropsychidae	Hydropsychidae	22	0.17
Trichoptera	Philopotamidae	Philopotamidae	4	0.01
Trichoptera	Polycentropodidae	Polycentropodidae	1	<0.01
Trichoptera	Rhyacophilidae	Rhyacophilidae	5	0.01
Tricladida	Dugesiidae	*Dugesia* sp.	15	0.10

Figure S1. Pictures of the water inlet (a) and of the water outlet (b) in the Riparian Stream Mesocosm (RSM) system, resembling riffle and pool mesohabitats, respectively. The picture in panel (a) was taken at the beginning of the colonization phase, and the picture in panel (b) was taken during the August (treatment phase) sampling campaign. Photo credits: A. Manfrin (panel a), V.C. Schreiner (panel b).

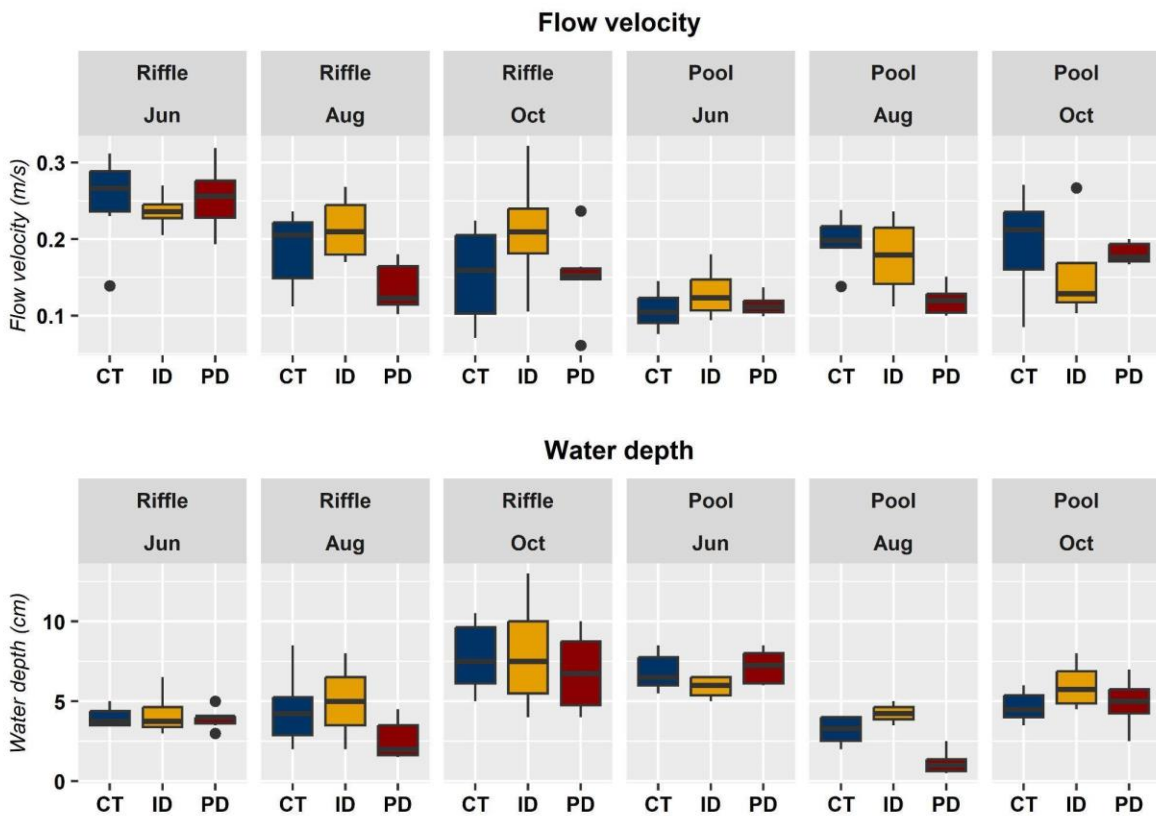

Figure S2. Boxplot summarizing flow velocity and water depth in riffle and pool mesohabitats during each experimental phase (Jun = pre-treatment, Aug = during-treatment, Oct = recovery). CT = control, ID = intermittent drying, PD = prolonged drying. Data were collected during the second normal flow phase of the ID treatment (see Table S1). The pool mesohabitats under PD treatment experienced a water depth reduction due to fine sediment deposition. A removal of the fine sediment was regarded as having too strong an impact on the mesocosm system. The fine sediment deposition in CT and ID was lower, likely related to higher flow velocities able to transport the fine sediment.

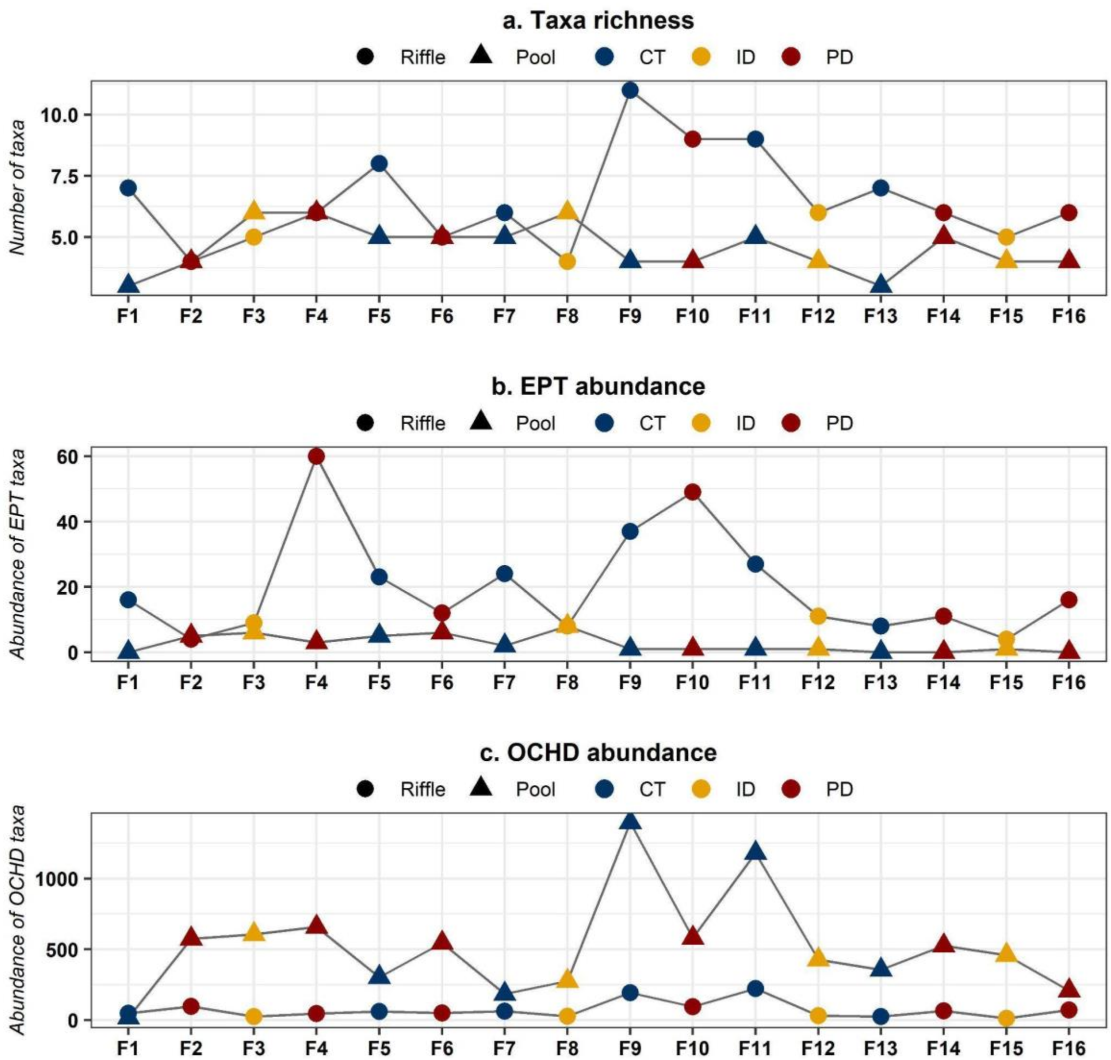

Figure S3. Pre-treatment (June sampling campaign) values of macroinvertebrate metrics measured in riffle (circles) and pool (triangles) mesohabitats across the 16 experimental flumes (F1-16 on the x-axis). Panels show (a) taxa richness, (b) abundance of EPT (Ephemeroptera, Plecoptera, and Trichoptera) taxa, and (c) abundance of OCHD (Odonata, Coleoptera, Heteroptera, and Diptera) taxa. Colors indicate the experimental treatment each flume was later assigned to (CT = control, ID = intermittent drying, PD = prolonged drying); note that treatments had not yet been applied at the time of sampling.

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