

DRYvER is a research & innovation project funded by Horizon 2020 focusing on drying rivers and the impact of climate change. The 4-years project started in September 2020 and brings together 25 partners from 16 countries in Europe and South America as well as from China and the USA. Its main goals are to collect, analyze and model data from 9 drying river networks (DRN) in Europe and South America to create a novel global meta-system approach that incorporates hydrology, socio-economics, ecology and biogeochemistry in order to craft strategies, tools and recommendations for adaptive management of river networks.

ARTICLE N°0 Short news

The Freshwater Biological Association will be hosting [SEFS13](#) from 18th - 23rd June 2023 in Newcastle Upon Tyne, England. DRYvER will be organizing the **Special Session** (SS14) titled "Drying rivers in a time of global change"

The upcoming **3rd General Assembly** (GA) of DRYvER will be held between 26-27 September in Pécs, Hungary.

Following the GA, in the framework of DRYvER's **Training School** (TS), young researchers will have the opportunity to get an insight into the scientific know-how of each Work Package of DRYvER. The TS will be organized between 28 September and 02 October, also in Pécs, Hungary.

The DRYvER citizen science application won an **Honorary Mention** at the [European Union's new Citizen Science Prize](#).

ARTICLE N°1 Communication updates

Factsheets: key challenges of DRYvER summarized in 1 page

Interested to understand key challenges addressed by the DRYvER team at a glance? Have a look at the factsheets prepared by the consortium for a non-expert public:

- [Factsheet 1: What is an intermittent river?](#)
- [Factsheet 2: Do drying rivers have any functions?](#)
- **Factsheet 3:** What are the strategies for adapting biodiversity to intermittent rivers? (available soon)
- **Factsheet 4:** What are the key ecosystem services? (available soon)
- **Factsheet 5:** How to have an adaptive management of DRNs? (available soon)
- **Factsheet 6:** What policy recommendations for DRNs? (available soon)



WHAT IS A DRYING RIVER NETWORK?

A river network is composed of a collection of tributaries, streams, or creeks, converging into one mainstem and forming a drainage basin. For decades, it was assumed that most river networks are perennial, implying they have flowing waters continuously.

The majority of the global river network is prone naturally to drying

A global map showing the probability of drying of the global river network. From M. L. Meade et al. (2013).

More than half of the global river network length is naturally prone to drying. This is due to meteorological, geological, and hydrogeological causes. Drying can lead to the presence of disconnected pools, with standing waters, or to the complete disappearance of surface water, with or without an underlying subsurface flow. Hence, drying is the norm rather than the exception. This recent finding calls for a shift in paradigm in the science and management of rivers and streams. For example, conceptual models available for river science does not well integrate drying, which is the master variable determining the biodiversity and ecological integrity of drying river networks. Similarly, most management tools used to assess the ecological status or define environmental flows in river networks do not account for drying.

Drying is an expanding hydrological phenomenon due to global change

Global change is altering the drying regimes of river networks and in many areas, is increasing the prevalence of drying. This can be caused by surface and groundwater abstraction, the construction of reservoirs to store and regulate the flow for irrigation, hydropower and recreational activities, the changes in land use, and climate change. Each of these non-natural drivers of drying has some specific hydrological signature and ecological consequences which are poorly explored but presumably more dramatic than for naturally drying river network. This is due to the lack of adaptation of species inhabiting perennial rivers. Consequently, management strategies should be different between natural and non-natural drying river networks.

Left and right: naturally intermittent streams in dry condition in the Mecsek Mountain, southeast Hungary (Photo: B. Penecker). Middle: non-naturally dry riverbed of the Hármas-kőrös below the dam at Békéscsaba, southwest Hungary (Photo: G. Jakab)

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Webinars

Hydrological trajectories of DRNs under climate change

October 18 from 11 to 12

Predicting biodiversity changes in DRNs

November 15 from 11 to 12

Predicting changes in ecosystem functions in DRNs

December 13 from 11 to 12

Ecosystem services of DRNs and their values

January 17 from 11 to 12

Adaptive management of DRNs

February 14 from 11 to 12

Share them with your colleagues and peers, and follow us on [Twitter](#) and [LinkedIn](#) to be informed when the next factsheets are released!

Webinars: get in depth understanding of the activities and results of DRYVER

From October 2023 to February 2024, DRYVER partners will propose a cycle of webinars to present the work done in the different work-packages, the most interesting results, and the utility and relevance of these results.

These webinars will target a scientific audience, not necessarily specialists in the topics addressed, but having an interest in challenges related to drying rivers. Researchers, students, participants in other European projects etc. are welcome!

The programs will be detailed later on [Twitter](#) & [LinkedIn](#). Thank you for sharing the information!

LinkedIn

DRYVER now has its own LinkedIn account. If you haven't already, follow us to receive some updates on our activities and share our page:

<https://www.linkedin.com/company/dryver-h2020/>

ARTICLE N°2 Co-creation efforts are ongoing in DRYVER to ensure uptake of the project findings by local stakeholders

Co-creation of management solutions to mitigate the negative impact of drying on river networks is vital for stakeholder uptake, as well as acquiring the necessary holistic understanding of the study systems. In DRYVER, we have adopted the Nature Futures Framework (NFF) of the Intergovernmental Panel for Biodiversity and Ecosystem Services.

The NFF recognizes three perspectives people may have on nature, i.e (1) nature for nature, emphasizing the intrinsic values of nature; (2) nature for people, emphasizing the instrumental values of nature, and (3) nature as culture, emphasizing the relational values of nature (Fig. 1). Using the three horizons approach of [Sharpe et al. \(2016\)](#) **We want to instigate the necessary transformative change needed to protect intermittent rivers in a drying climate.**

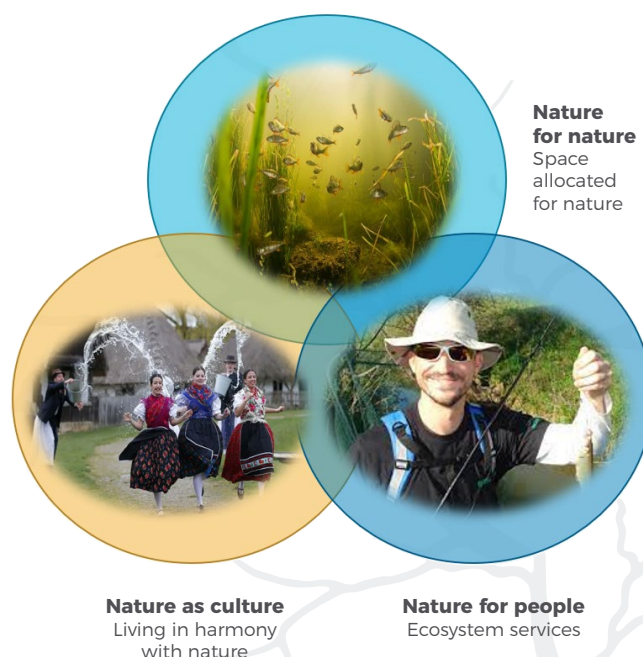


Fig. 1: The three perspectives Nature Futures Framework (NFF)





To this end, we ask the stakeholders in the DRYVER DRNs three questions, i.e. what are the changes you have seen in recent times in your DRN, what is your desired future based on the 3 NFF perspectives, and what interventions are needed to achieve this desired future.

We have carried out 4 co-creation workshops so far, i.e. the CELAC DRNs, the Spanish DRN, the Finnish DRN, as well as most recently the Hungarian DRN (Fig. 2). Using the same approach across the different DRNs allows us to assess the variability in barriers to achieving the desired state for DRNs, including conflicting governance structures, stakeholder conflicts, management locked-ins, local land use practices, under perception of climate change impacts as well as lack of understanding and uptake of Nature-Based Solutions.

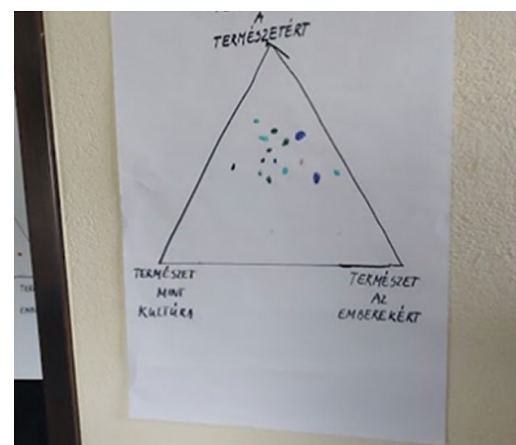
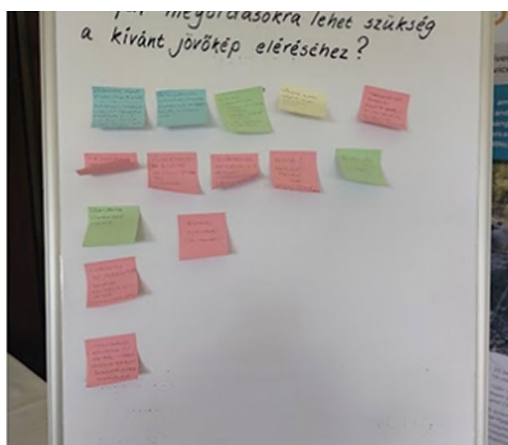


Fig. 2: Moments from the Hungarian co-creation workshop

ARTICLE N°3 From local to European level: how DRYvER is trying to upscale its results.

In December 2022 and March 2023, two e-workshops were dedicated on upscaling efforts in DRYVER project. Upscaling in DRYvER means modelling values of different variables first for all river reaches in case study catchments and then for all river reaches in Europe based on values measured for sampling points in case study sites. Upscaling to European scale in DRYVER is performed for flow intermittence, biodiversity scenarios, carbon related ecosystem functions, and ecosystem services provision.

The first workshop was dedicated to methods, strategies, goals, and timing for upscaling efforts. The second workshop focused more on challenges

encountered during the upscaling process. Both times, open discussions were successful and inspiring. For example, during the last workshop we discussed about trimming the European river network before upscaling and there was a consensus to leave out rivers downstream large lakes and reservoirs from our analysis. We also decided together to use statistical models for upscaling instead of process-based models.

Big projects like DRYVER require tight collaboration between partners and workshops are a good way for discussing different issues with all teams at the same time.



ARTICLE N°4 Naiara López-Rojo interview about her research results: how does drying influence Drying Rivers Networks?

Could you introduce yourself?

My name is Naiara López-Rojo. I am currently a post-doctoral researcher at INRAE (French National Institute for Agriculture, Food, and Environment) Lyon, since April this year. I did my PhD in Spain, and afterwards I moved to Grenoble, France two years ago to join the Laboratory of Alpine Ecology (LECA, Grenoble) as a postdoc within the DRYVER project. My research has always been focused on the effect of global change in freshwater ecosystems. During my PhD I analysed, mainly through laboratory experiments, the effect of riparian biodiversity loss (due to changes in land use) in stream ecosystem functioning, focused on decomposition and nutrient cycling. Then, during my first post-doc, through a field approach at European scale, I analysed the effect of drying on river ecosystem functioning, namely on greenhouse gas (GHG) emissions.

What is your role in DRYVER?

I am mainly involved in WP3 (ecosystem functioning). I have participated in the WP3 field campaigns in France and Finland. We measured in situ GHG emissions, river metabolism and organic matter standing stocks and leaf litter decomposition, together with associated environmental variables. I was responsible of analysing the patterns and drivers of CO₂ and CH₄ emissions in the 6 European drying river networks (DRNs) of DRYVER (France, Finland, Spain, Czech Republic, Croatia and Hungary). I have also contributed to WP2 tasks (biodiversity), performing the eDNA extractions of more than 1400 sediment and biofilm samples, with the DNA group at LECA. Since June, I have co-animated the DRYVER Forum of Young Researchers with Amélie Truchy.

What is your research topic? How does it relate to DRYVER?

With the unique dataset collected during the DRYVER sampling campaigns, we identified drivers of GHG emissions among local (stream and sediment characteristics) and regional (climate and landscape) scale variables as well as metrics describing local drying patterns and network-scale fragmentation by drying. We have detected an important drying legacy effect: emissions from intermittent rivers are affected by previous drying events, even long after flow resumption.



We also upscaled the CO₂ emissions to the 6 DRNs and have seen that the emissions from dry riverbeds (both during low flow conditions and when the intermittent rivers are totally dry) contribute significantly to the total CO₂ emissions.

What will be your future activities in DRYVER project?

During this second postdoc, I will focus more on the French DRN (Albarine), which will enable me to assess the fine scale patterns of drying and river network fragmentation on river metabolism and carbon cycle. Thanks to the knowledge regarding GHG emissions (measurements in the field, analysis of the data, modelling and temporal and spatial upscaling) during my first post-doc, I will participate as trainer in the next DRYVER Training School (Pécs, October 2023). I will also participate in the upscaling efforts to understand the effect of drying on ecosystem functioning at the European scale in current but also future global change scenarios.



ARTICLE N°5 Focus on the Hungarian DRN

DRYvER studies 9 case studies (DRN) in the EU and South America which cover different climatic and biogeographical zones. This month, we present the Hungarian case study.

Presentation of the DRN

The Hungarian case study network is the Bükkösdi-víz (víz means water in Hungarian), which is a sub-catchment of the Fekete-víz river network. The drainage area of the Bükkösdi-víz is approximately 185 km² and it is located in the Mecsek Mountains, in SW Hungary, about 30 km from the city of Pécs, where the local DRYvER Team of the University of Pécs is settled. The area is in continental climate in the Pannonian ecoregion. Most of the main stem of the

river network is heavily modified, but the tributaries are natural or near-pristine streams flowing mostly in forested areas. The area's population is scattered in smaller towns and villages with a combined number of approximately 11,000 souls. There is a diverse aquatic life in the streams, and some important species listed in the EU Habitat Directive can be found as well (e.g., *Cordulegaster heros*, *Romanogobio uranoscopus*, *Unio crassus*).



From top left to bottom right: The Hungarian DRN's location. A section of the Hungarian DRN in wet and dry phases (Photo: B. Pernecker). The Hungarian team on fieldwork (photos: A. Móra).





Presentation of the Team working in the DRN

The Hungarian Team is working at the Department of Hydrobiology of the University of Pécs, and it is led by WP6 leader Zoltán Csabai. The team did substantial work in WP2 (Biodiversity). Besides sampling the local DRN, they also separated and identified all 639 macroinvertebrate samples from the 6 European case studies and they are now working on digital image analyses based biomass estimation.

The team consists of lead researcher Zoltán Csabai, taxonomic expert Arnold Móra, DEIP manager Bálint Pernecker, lead research assistant Éva Horváthné Tihanyi, local DRYVER coordinator Zsuzsanna Pap, and research assistants Bernadett Boóz, Balázs J. Berta, Dorottya Hárságyi, Anita Szloboda, and Khouloud Sebteoui. Also, several MSc and BSc students participated in WP2 work.

Why is this river network particularly interesting?

The most interesting feature about this DRN is that dryings here have just started to get more and more severe in recent years. While the approximate length of dry sections on the DRN was 40-50% in 2018-2019, this has been constantly rising, and it reached 70-80% last year (2022). Several streams that were thought to be permanent are now drying up every summer. In the past years dryings started in late summer and early autumn. Those dates are now shifted to earlier months and some streams start to dry up in late spring, and the dry periods are getting longer and longer each year.



From left to right: B.J. Berta, B. Boóz, B. Pernecker, É. Horváthné Tihanyi, A. Móra, K. Sebteoui, Z. Csabai, A. Szloboda, Z. Pap, D. Hárságyi.

Impressum

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