Do drying rivers have any function?

As big, living organisms, rivers need to obtain energy and nutrients through various biological processes called **ecosystem functions**; for example, the production of organic matter through photosynthesis, or the recycling of nutrients through the decomposition of dead organic matter. Water is essential for these processes, but more than half of the global river length is naturally prone to drying. **How alive can drying rivers remain then?**

This is one of the questions the DRYvER project is investigating. We found **dry rivers can emit as much CO_2 as when they are flowing** (Figure 1). CO_2 emissions are associated with the respiration of microbial communities living in riverbed sediments. Despite the absence of surface water, **dry rivers can be as active as flowing ones**, calling for a shift of paradigm in river science.

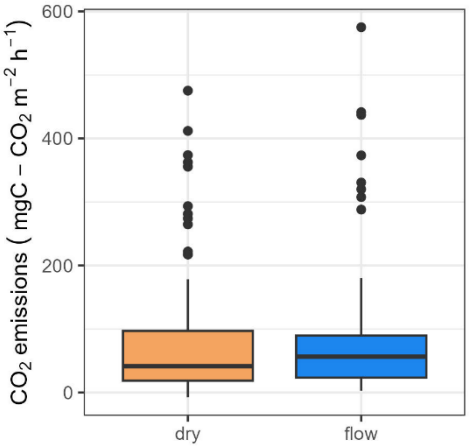

Figure 1. CO_2 emissions from dry and flowing conditions measured in non-perennial streams distributed across 6 river networks.

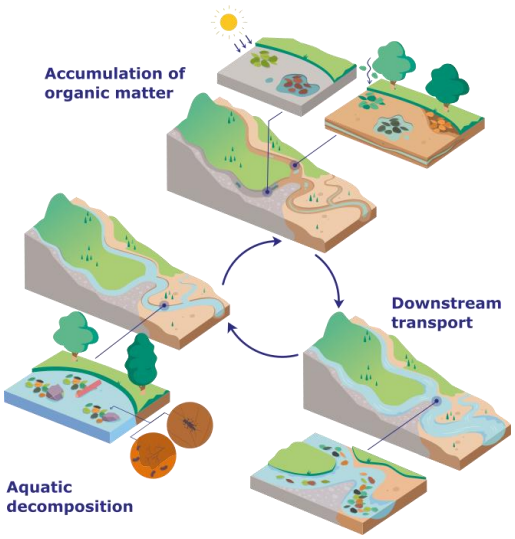

Figure 2. Representation of hydrological changes in naturally drying rivers from del Campo et al. (2021)

Flow variations control ecosystem functioning in drying river networks

Naturally drying rivers are highly dynamic ecosystems, which can change between flowing, non-flowing and dry conditions along the year. The succession of dry and flowing phases controls ecosystem functions.

Large amounts of organic matter such as terrestrial leaf litter and dead algae can accumulate on dry riverbeds (Figure 2). Upon flow resumption, massive amounts of this organic material can be transported downstream, boosting microbial respiration and **resulting in pulsed emissions of CO_2** to the atmosphere.

Biodiversity can compensate negative effects of drying on river networks

The diversity of organisms (one aspect of biodiversity) is key to maintain healthy ecosystems. Drying can have a negative effect on some organisms who are responsible for certain ecosystems functions (Figure 3). However, when **diverse communities** are present in the ecosystem, other species can take over the function when environmental conditions change. Biodiversity can thus **compensate for the negative effect of drying.**

In our research within DRYvER, we found that the diversity of invertebrate communities has a positive effect on the function of leaf litter decomposition in drying rivers, but not in perennial rivers that always have water. This result illustrates how **biodiversity can become even more important for drying river networks.**

Figure 3. Caddisflies and river shrimps are invertebrates which a very important role in the process of leaf litter decomposition. Pictures from Jan Martini and Roland Corti.

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