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ESR 5: Microbial metabolism of terrestrial resources in river corridors under variable flow regimes: match-mismatch scenarios between resources and consumers

3 year fixed- term PhD position.

Host institute: Leibniz-Institute of Freshwater Ecology and Inland Fisheries, DE

Supervisors: Drs Gabriel Singer, Jörg Lewandowski (IGB, Berlin, Germany), Chris Robinson (EAWAG, Zürich, Switzerland), José Barquin (University of Cantabria, Spain)

Project Description:

The aim of this PhD project is to understand how water level fluctuations, i.e. natural and anthropogenically-impacted flow regimes, are linked to the metabolism of terrestrially derived dissolved organic matter (DOM) via affecting the match/mismatch between chemical traits of DOM resources and functional capabilities of microbial consumers.

Flow dynamics directly translate to the transport of organic matter along river corridors and thus control its availability as a resource for (primarily microbial) consumers. By different processes, flow dynamics also shape the composition and diversity of microbial consumer communities, e.g. locally by disturbance effects and regionally by mediating dispersal. With the exception of pelagic bacteria, riverine consumers of organic matter are benthic and immobile in comparison to their resources delivered by flow. Metabolism of the chemically highly diverse DOM is a function of match between resource traits and consumer traits. On both sides, functional diversity is likely important for the efficiency at which resources are locally metabolized vs. left over for further downstream transport. The flow regime and alterations thereof thus likely control match/mismatch scenarios between resources and consumers developing along the river corridor, with implications for the organization of food webs and for the metabolism of organic matter, specifically the dissipation of terrestrially derived organic matter to a climatically relevant CO2 flux outgassing to the atmosphere.

Depending on a research expose to be developed by the candidate the project may be conducted at different study sites with different flow regimes and/or by field- and lab-based experiments as well as modelling approaches. Empirical research could include measurements of DOM decomposition in gradients of resource-consumer match/mismatch at micro- and fieldscale. For this, state-of-the-art optical, chromatographical and mass-spectrometric methods are available to characterize DOM, and molecular-biological tools may be used to characterize microbial communities taxonomically and functionally.

Objectives:

(1) Investigate the compositional variability of DOM under various flow regimes.

(2) Identify composition and typical functional capabilities of benthic microbial communities as shaped by intermittent submergence/exposure, hydrodynamic erosion and successional recovery.

(3) Explore the potential for match/mismatch scenarios to develop between DOM resources and consumers due to flow regime variability and management.

Expected outcomes:

(1) Knowledge on how flow regime controls compositional variability of DOM resources, composition and key functional properties of microbial consumer communities.

(2) A first understanding of match/mismatch development between traits of resources and consumers under various flow regimes.

(3) An upscaling- or model-based assessment of flow variability/management effects on river C cycling on the regional (river corridor/network) scale.

Secondments:

3-month stay at EAWAG in Zürich (Switzerland, host: Chris Robinson) in year 1 or 2 with the purpose of planning experiments and fieldwork.

3-month stay at the University of Cantabria (Spain, host: Jose Barquin) in year 1 or 2 with the purpose of fieldwork.