



Conference Abstract

The ecology of ponds in the context of human activity and geography - environmental DNA and beyond

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Abstract

Pond ecosystems are hotspots of freshwater biodiversity, often containing many rare and protected species that are not commonly found elsewhere (Harper et al. 2018; Harper et al. 2019). However, even if they constitute c.a. 30% of freshwaters by area, still not enough effort has been put into pond monitoring and management and pond ecosystems are hence relatively poorly understood. Results of ECOPOND project will lead to add valuable knowledge upon pond diversity in geographic gradient taking for consideration human impact by comparing rural and urban areas.

The sample design in ECOPOND includes six geographic regions, spanning from the south of Poland to the middle of Norway, where we will sample five replicates of urban and rural ponds in close geographic proximity, making it possible to test the impact of urbanization on biodiversity and biotic homogenization across latitude. We will sample all

ponds at spring and late summer, making it possible to assess also seasonality in biodiversity.

ECOPOND will utilize environmental DNA and RNA to perform biodiversity screening. The extracted eDNA and eRNA fragments will be amplified with the use of several selected markers for vertebrates, invertebrates, fungi and bacteria. Comparisons between eDNA and eRNA metabarcoding are hypothesized to allow inference between present and past diversity, as eRNA is thought to be only available from live organisms in the community. Moreover, ECOPOND aims at testing the effects of selected invasives species that can have on whole ecosystems. By sampling a range of biotic and abiotic parameters describing studied ponds, we will incorporate the available data for the ponds and employ occupancy modelling methods to assess the habitat preferences of selected invasive alien species. Then we will develop a method that can contribute towards an earlywarning system of evaluating threats to ecosystem status.

One of the focus species will be the parasitic fungus *Batrachochytrium dendrobatidis* (Bd), an infectious fungal pathogen that has caused a number of amphibian declines and extinctions. The European amphibians seem less affected by the parasite at present. However, the fungi could be a direct driver of reduced genetic variation due to selection, or directly reduce the infected amphibian's overall fitness by reducing the microbiotic diversity on their skin, which in many cases acts as a second immune system. ECOPOND will therefore provide data on genomic variation (using RADseq) for two amphibian species: the smooth newt (*Lissotriton vulgaris*) and the common toad (*Bufo bufo*). We will investigate populations of these species inhabiting ponds that are infected and not infected by Bd as well as collect data on their skin microbes (identified using metabarcoding). We will also contrast the genomic diversity between the replicated urban/rural setup and look for repeatable genomic changes.

This setup will also be compared for the genomic variation for a potential native prey, the blue-tailed dragonfly, as will ponds with and without fish and/or amphibians (possibly also comparing between native and IAS top-predators) in order to look for predatory selective sweeps in the genome and transcriptome (experimental setup). All ponds will also be analyzed for over 20 water quality parameters and include data on a range of site characteristics that will be used as explanatory variables in all models. ECOPOND will compare large datasets across large geographic regions and will provide detailed knowledge of biodiversity patterns in vertebrates, invertebrates, fungal and microbial species, as well as genomic composition and skin biodiversity for animals inhabiting the same ponds set in an urban context.

As a total, ECOPOND will obtain data on the location and status of biodiversity interests, gather data that can help in preventing the establishment of invasive alien species, and eradicating or controlling species that have already become established. And finally, ECOPOND will work closely with stakeholders and develop statistical techniques that can be used for monitoring, detection and protection of biodiversity.

Keywords

ponds, urbanization, DNA metabarcoding, landscape genomics, biodiversity, invasive species

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