BRAIN-be
Belgian Research Action through Interdisciplinary Networks

ORCA

A comparative analysis of **OR**ganic and **C**onventional **A**griculture's impact on Aquatic systems

DURATION
15/01/2017 - 15/04/2021

BUDGET
665 484 €

PROJECT DESCRIPTION

There is an ongoing debate on the choice of agricultural practices in terms of their impact on food security, ecosystem functioning and biodiversity. The impact of organic farming is expected to differ from that of conventional farming, and organic farming is promoted under the current EU Common Agricultural Policy. To date, most comparative studies of organic and conventional agriculture focus on the agricultural land itself, on terrestrial ecosystems, or on rivers, while the numerous small ponds and shallow lakes in agricultural settings are largely ignored. Yet, they harbor the majority of regional aquatic biodiversity and are key providers of ecosystem services.

The ORCA project aims to investigate the effects of both agriculture type (organic *versus* conventional) and land use intensity (cropland *versus* grassland) on biodiversity in ponds and shallow lakes. More specifically, we will (1) assess biodiversity of different organism groups in ponds along strong land use gradients of both organic and conventional agriculture; (2) test the hypothesis that aquatic biodiversity in ponds is higher in (a) areas of organic compared to conventional agriculture, and (b) in areas of extensive compared to intensive land use; (3) test the hypothesis that zooplankton populations are genetically differentiated between ponds in areas with organic *versus* conventional agriculture; (4) test the hypothesis that the size of the buffer zone around standing waters impacts local biodiversity; (5) estimate the effects on aquatic diversity of scenarios of increasing levels of organic farming at the regional scale; and (6) develop a map on priority areas where a transition to organic agriculture can have the largest impact on biodiversity and ecosystem services.

Our overall research strategy involves combining existing datasets with the collection of new data. Using GIS analyses, we will identify areas dominated by organic *versus* conventional farming and stratify them according to land use type (land use dominated by grassland *versus* cropland). We will select 60 ponds, stratified by agricultural practice and land use type. In addition to a detailed environmental characterization, we will quantify community characteristics of five different aquatic organism groups in all selected ponds. We will conduct landscape genomic analyses of genetic variation at neutral markers using next generation sequencing of all *Daphnia pulex* and *D. magna* populations we will sample. Common garden experiments will focus on *D. magna*, and will involve isolating multiple lineages from each population and testing them for their sensitivity to chemicals commonly used in conventional or organic agriculture. Our analyses will thus go beyond morphological and functional diversity and will also address genetic diversity for a focal taxon. The newly collected survey data will be integrated in the existing SAFRED database to increase our power and geographic cover. This integration of data will provide a crucial context in terms of evaluating the differential impact of organic *versus* conventional farming on aquatic systems against the broader gradient from relatively pristine ponds in natural areas to ponds in highly urbanized landscapes. In addition to the analyses at the level of single ponds, we will use our results to estimate the expected effects on aquatic biodiversity of scenarios with increasing levels of organic farming at the regional scale. We will do so by creating virtual landscapes with different relative frequencies of pond types and by simulating alpha, beta and gamma diversity in these virtual landscapes using a resampling procedure on pond diversity data.

ORCA

Targeting the overall objective of ORCA demands an interdisciplinary approach (GIS analysis, field surveys, standardized laboratory experiment, genetic analyses, and advanced statistical methods) for which the complementary expertise and infrastructures of all project partners is needed.

Our results will yield major scientific insights on the importance of agricultural practice and intensity on pond water quality, biodiversity and functioning. Testing for a differential genetic impact of organic *versus* conventional farming practices can represent a breakthrough in the assessment of the impact of agricultural production methods at different levels of biological organisation. ORCA will provide data and insights that are of direct relevance to policy makers and that can easily be translated into management and intervention plans. By providing solid scientific data on the environmental impact of organic *versus* conventional farming on pond ecosystems, ORCA will be of direct relevance in developing overarching policy views on sustainable agriculture.

ORCA will develop scenarios to optimize pond biodiversity at the landscape scale and will draw priority maps on where policy interventions may have the highest impact. ORCA will also contribute in developing pond ecology, biodiversity and functioning as endpoints of environmental research on sustainability of land use. Another generic result of ORCA will be an extended database containing detailed information on land use in the neighbourhood of >350 ponds across Belgium. Next to peer-reviewed papers in scientific journals, we will also produce publications that will appeal to a broader audience, and regularly engage in meetings with stakeholders to co-develop the project. The overall findings relevant to policy will be translated into a policy brief.

CONTACT INFORMATION

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LINKS

https://bio.kuleuven.be/eeb/ldm/ORCA/Home

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