

Project BR/175/A1/ORCA- A comparative analysis of ORganic and Conventional Agriculture's impact on aquatic biodiversity

Agriculture is a dominant human activity that impacts key natural resources, including biodiversity. Efficient agriculture is, however, important to meet human demands. The impact of organic farming is expected to differ from that of conventional farming. Organic farming has therefore been highly promoted under the current EU Common Agricultural Policy. To date, most comparative studies on the impact of organic and conventional agriculture focus on the agricultural land itself, on terrestrial ecosystems, or on rivers. Yet, small farmland ponds harbour much of the regional aquatic biodiversity and are key providers of vital ecosystem services.

The ORCA project combined existing datasets with newly collected data to (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 areas of organic compared to conventional agriculture, (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 different scenarios of land use change. We use data on amphibians and fish, as well as from macro-invertebrates, macrophytes and zooplankton.

Our results show that differences between organic and conventional agriculture in terms of taxonomic diversity in aquatic organism groups such as macrophytes and zooplankton are modest, but relevant for some organism groups, especially at the regional spatial scale. The diversity of shoreline vegetation and zooplankton seems to benefit most from organic agriculture. The analysis of the integrated database (old and newly collected data) reveals that even a small amount of agriculture, irrespective of whether it is organic or conventional, affects the characteristics of aquatic communities. Agriculture also promotes pond eutrophication. The creation of relatively small buffer strips around the pond might be an effective tool to mitigate the detrimental effect of agriculture on pond biodiversity. In addition to differences at the ecosystem and community level, our results show striking differential genetic adaptation of zooplankton to both conventional and organic pesticides. Organic pesticides in general seem to be equally toxic to non-target taxa as conventional pesticides, suggesting the need to be careful in their use. Furthermore, our results indicate that changing pesticide use may harm non-target species because their populations continuously need to adapt to novel pesticides.

Keywords: farmland ponds, organic agriculture, land use, aquatic biodiversity, pesticides, genetic adaptation.