

# Understanding effects of global change on water quantity and quality in river basins- The SCARCE Project

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The increasing anthropogenic manipulation of the hydrological cycle, as well as the exacerbation of climate change forcing, result in resource pressures that translate in even larger uncertainties in sensitive geographical areas. In particular, the Mediterranean region is undergoing severe alterations in water availability because of a decrease in the number of precipitation days but also in an increase of heavy rain events. An imbalance between water availability and its use is obvious in these water-thirsty regions, and clearly impacts the sustainability of water resources. The consequences are multiple, and include direct impacts on

economic sectors that use and depend upon water availability, such as agriculture, tourism or industry. Ultimately, however, these consequences are the basis for a conflict between natural ecosystems and human needs, where ecosystems are those most challenged and their services remain at risk.

The effects of water scarcity on river basins extend from its associated hydrological irregularity to the chemical quality of available water systems. Higher nutrient and pollutant concentrations are expected under lower water flows, both as an effect of direct human inflows as well as a simple effect of lower water dilution. This is especially relevant in many arid and semi-arid river systems, where flowing waters under scarcity mostly consists of treated sewage effluents. Wastewaters are being reused for drinking purposes and agriculture; some chemical compounds may eventually be transported from the waste water treatment plants (WWTPs) to river waters, and affect the chemical and biological quality of those waters. In these situations, potential water quality problems extend to the higher concentration of emerging pollutants, presence of pathogenic organisms, and multiple effects on the biota dwelling within the river systems. Biological communities respond to harsher environmental conditions imposed by scarcity with lower diversity, arrival of invasive species, as well as with lower efficiency of biological processes, some involving water quality as a return. The increased pressure on water resources will cause additional effects on aquatic ecosystems, in which the stress being produced by scarcity may sum up others physical or chemical stressors. Groundwater quality may be also affected by farming, or after leakage of industrial and domestic pollutants, making the use of these resources much more tenuous.

This special issue is a collection of key articles presented at the 1st Annual Conference of the SCARCE-CONSOLIDER

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project that was held in Girona, Spain, in early December 2010. The SCARCE project is a multipurpose project whose aims are to describe and predict the relevance of global change impacts on water availability, water quality and ecosystem services in Mediterranean river basins of the Iberian Peninsula, as well as their impacts on the associated human society and economy. The project provides a multidisciplinary approach through the study of hydrology, geomorphology, chemistry, ecology, ecotoxicology, economy, engineering and modelling. The SCARCE-CONSOLIDER project includes the active involvement of Water Authorities and other relevant agencies as stakeholders. During the first SCARCE Congress, different aspects of water scarcity were debated, including water quality, hydrological and geomorphological implications of water scarcity, climate change as a driver of variations in water scarcity for the ecosystems and human beings, ecosystem conservation and water scarcity, tools approaching implications of water scarcity and societal implications of water demands and shortages.

In total, ten papers were accepted and included in this special issue. One of the papers outlines the general structure of the SCARCE project and the activities conducted within their ten Work Packages (Navarro-Ortega et al.). Three papers deal with surface water and sediment quality issues, including different groups of emerging organic contaminants, e.g., perfluorinated compounds, illicit drugs and pharmaceuticals. Perfluorinated compounds were studied in water and sediment samples from l'Albufera Natural Park (Picó et al.), whereas illicit drugs were studied in surface waters from the Pego-Oliva marsh (Valencia, Spain) (Picó et al.). Pharmaceuticals were investigated in a typical Mediterranean River (Llobregat, NE Spain) relating their presence and fate with the hydrological conditions of the river

(Osorio et al.) and their removal from wastewater was studied through reverse osmosis and nanofiltration (Dolar et al.). Two other papers deal with the results obtained from an experiment with treated sewage water in a Mediterranean river (the Llobregat River). The papers provide overviews of the possible impacts resulting from discharging reclaimed waters in a receiving river system under drought, and therefore with low dilution capability, and later using river water as a source for drinking water purposes under drought emergencies. The papers respectively cover microbiological (Rubiano et al.) and chemical impacts (López-Serna et al.).

There is an obvious necessity to disentangle the effects caused by chemicals from other stressors in the ecosystem. The paper by Brix et al. analyses the links between levels of alkylphenolic compounds and benthic community descriptors (biofilm and macroinvertebrates) in the highly polluted Llobregat river. Finally, two papers deal with indexes and models aimed to help on the design of monitoring studies and in the understanding and application of the obtained results. Ginebreda et al. analyse the application of new indexes in compound prioritization, therefore helping to define the key compounds for the scenario under study. Ocampo et al. present a conceptual model to assess water quality in river basins based on ecological risk assessment principles, and incorporates a novel ranking and scoring system based on an artificial neural network.

Overall, this special issue exemplifies the need for multidisciplinary approaches which are essential to producing reliable assessments and predictions on the relevance of global change on water resources and quality, which can later be translated into policy issues and implemented by water resource managers.



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She earned her PhD in Analytical Chemistry (2009) from the University of Barcelona. She was involved in the EU project AquaTerra on the analysis of persistent organic pollutants. She has 11 papers published in international refereed journals and 1 book chapter. Her preferred lines of research are monitoring, and the fate of priority, new, and emerging pollutants combined with degradation and sorption studies.



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in the applications of LC–MS to environmental analysis, with the first publication in 1987 and a book in 1996. Since then he has published over 642 scientific papers in journals of SCI, 120 book chapters, he is co-author of 1 book on Pesticides analysis in the environment and editor of 20 books on Environmental analysis and fate of pollutants. He is co-editor-in-Chief of Science of the Total Environment (Elsevier, NL), editor-in-chief of the Wilson + Wilson Comprehensive Analytical Chemistry, book series (Elsevier, NL) and co-editor-in-chief of the Handbook of Environmental Chemistry book series (Springer-Verlag). In 2007, he received the Prize King Jaime I on the Protection of Nature 2007. His scientific focus is on water quality assessment and management, fate and behaviour of emerging contaminants in surface waters, wastewaters and groundwater and analysis, fate and risk of nanomaterials in the environment.



**Sergi Sabater** is Professor of Ecology at the University of Girona and Deputy Director of the Catalan Institute for Water Research (ICRA) since 2008. He earned his PhD in Biology (1987) from the University of Barcelona. He has published more than 120 papers on ecology in international scientific journals and about 70 other contributions. He has co-edited the books *Hydrology and nitrogen buffering capacity of riparian zones* (2010), IAHS Benchmark Papers

in Hydrology, *Water Scarcity in the Mediterranean: Perspectives Under Global Change* (2010) Springer-Verlag Berlin and *Global Change and River Ecosystems – Implications for Structure, Function and Ecosystem Services*, Developments in Hydrobiology 15 (2011). His lines of research include the relevance of global change on river ecology, the metabolism and functioning of fluvial systems, the response of river algae and biofilms, and the ecotoxicology of biofilms. Recently has specifically analyzed the relevance of water scarcity and the associated effects of higher nutrient content, hydrological alterations and toxicant effects on river ecosystems.