

# Visions for water management

MIRAGE

Members of the **MIRAGE** project – Dr Jochen Froebrich (Coordinator), Professor Nikos Nikolaidis, Professor Narcís Prat, and Dr Eduardo García-Roger – provide an illuminating overview of the water management issues that the project is tackling in the Mediterranean, and why it is vital to address them



**Could you explain the founding principles and overall aims of the MIRAGE project? What prompted the development of your approach, and what characteristics of your chosen test sites made them particularly suitable for your research?**

MIRAGE seeks to improve the application of the EU Water Framework Directive (WFD) and the development of river basin management plans (RBMP) in the circum-Mediterranean region.

Research was prompted by the fact that temporary streams form the major types of water bodies in Mediterranean river basins. The project aims to support more appropriate environmental management in the spirit of the WFD.

The project will attempt to understand the behaviour of temporary rivers – with respect to hydrologic, biogeochemical and sediment transport processes – at three scales, namely the region (Mediterranean area), the basin, and the sub-catchment. This will allow us to scale-up and scale-down hydrological, biogeochemical and ecological processes.

**Of all the elements affecting water quality and management – floods, waste, pollution, and erosion to name just a few – which is likely to be the most damaging, and how far are we on the road to mitigating such occurrences in the future?**

The complexity, pressures and problems depend largely on the stream order and

climatic constraints. For instance, large rivers, despite exhibiting huge discharges, may be primarily affected by waste waters, as human populations have historically developed at waterfronts. Streams in rural areas could be more directly affected by water abstractions. Indeed, in arid countries, the most important factor is water abstraction, as this dries out many streams. Also, pollution from a number of point sources can have a major impact on the remaining water quality in pools when the stream flow is going to be interrupted. The only way to mitigate this problem is to encourage wise use of water with water saving programmes, and in the south of Europe to mobilise increased control-irrigated areas. Also there is an urgent need to integrate drought management issues more effectively in the implementation of river basin management plans, as demanded by the WFD. If this is not brought about, many river-dependent wetlands – like the Coto Doñana and the La Mancha lagoons – will eventually dry up.

**Can you outline the collaborative nature of the project, and the importance of this shared expertise in terms of gathering and analysing data at your test sites? Have you received input and advice from local governments on the ground?**

The collaborative nature in MIRAGE is highly stimulating. The cooperation within the mirror basins – together with the surrounding specific study sites – had demonstrated that this could prove to be an exemplary model for future projects. It helps to bring researchers together, while at the same time enabling the continuation of work in individual experimental basins.

The focus on mirror basins helps to maintain links with regional authorities. Here, close interaction between researchers and local authorities has been set up. In Greece, it is expected that our monitoring infrastructure will be used by the local prefecture beyond the duration of the project.

**Have you benefited from any innovation in terms of your data capture techniques? How much of your work is comprised of field study at your chosen locations?**

Much of our work is field work and some groups have innovated existing systems in taking samples (for example how to sample macroinvertebrate and how to measure the functional characteristics of temporary streams). This innovation has been transferred to all members of the consortium and will be communicated to the scientific community, as well as managers, over the next few years. After first year analyses, we have proved that temporary streams clearly differ from perennial, and so they need different approaches.

**Finally, what are the main criteria by which you evaluate the success of your work? Is it your aim to influence policy makers on a strategic level?**

In regard to the science, our means of evaluation will hinge on whether we have compiled a consistent set of information. Following on from this, for the applied part, we seek to develop a consistent guidance document on how to improve the second versions of the river basin management plans. This will be deemed successful if basin agencies and European institutions – other than those already involved in the project – benefit from the plans in the long-term.

**DRY STREAM:** The protection of natural pools and disconnected flows are key challenges in management of temporary streams



# Changing the course of river management

Temporary rivers have often received insufficient attention in water management plans. Now, the **MIRAGE** project is dedicated to developing and integrating strategies across seven Mediterranean river basins

**SOME 10 YEARS** ago, the EU adopted the heavily anticipated Water Framework directive (WFD) – the most substantial piece of water legislation ever produced by the European Commission. The directive has proven to be a key driver in mobilising sustainable approaches to the management of rivers and waterways within the EU. However, its implementation in areas with temporary streams has presented, until recently, a substantial challenge to water management operators.

## TEMPORARY VS PERENNIAL

Temporary streams differ from perennial rivers in humid regions in their hydrological and ecological processes. Therefore, research in developing management strategies for temporary waterways demands a different set of considerations; indeed, blanket and homogenised strategies of water management in perennial and temporary streams have proved ineffective and, in certain cases, inoperable. It has long since been established that hydrology in particular has a central role in accounting for the distinction between temporary and perennial rivers. However, an understanding of how hydrology affects water quality dynamics, ecology and related management options has only recently been gained. In this regard, the spatial variability in water flow and dry parts of stream courses is of particular importance and relevance to researchers.

## RESEARCH REQUIRED

Concerted research into the behaviour and characteristics of temporary streams is therefore

crucial in the development of effective and tailored strategies for sustainable water management. This is amplified somewhat where the Mediterranean region is concerned, as many Mediterranean water bodies are already dominated by temporary streams. According to projected figures released by the European Environment Agency in the LREM-E scenario for 2030, the Mediterranean region is to be exposed to an increase in the occurrence of hydrological extremes. As a consequence, temporary streams will become increasingly relevant as means of preventing droughts and mitigating the impact of floods. This can be seen to underline the growing demand not only for adequate management strategies for temporary streams, but also for national drought management plans to be tailored in accordance with the specific vulnerability of temporary streams.

With great foresight, the European Commission has provided funding for the MIRAGE project. A seminal and comprehensive investigation into the viability of specific management options for temporary streams has already been initiated under the project's banner. The studies are focused around seven Mediterranean river basins, each acting as a framework for the broader management of the many Mediterranean water bodies dominated by temporary streams. The basins are: the Evrotas (Greece); Candelaro (Italy); Sebou (Morocco); Vene (France); Vallcebre and Taibilla (Spain); and Enxoe (Portugal).

## INTEGRATING SCIENCES

In addressing the pertinent issues surrounding the management of temporary streams, MIRAGE has adopted a multidisciplinary approach. From this, it is anticipated that the project will successfully cultivate healthy and sustainable water management systems, taking due account of environmental, economic and social considerations.



**FIGURE 1.** Displaying the spatial distribution of the main phases: an appreciation of river flow, disconnected flow, pools and dry sections for critical moments during the year is recommended in order to obtain an understanding of the actual water availability and to provide a basis for better planning. **Source:** HCMR

## INTELLIGENCE

# MIRAGE

## MEDITERRANEAN INTERMITTENT RIVER MANAGEMENT

### OBJECTIVES

Mirage aims to provide key knowledge and guidance for a better management of temporary streams in the Mediterranean region

### CONTRIBUTING EXPERTS

**Dr Jochen Froebrich** (Alterra, Netherlands)  
**Professor Nikos Nikolaidis** (Technical University of Crete, Greece)  
**Professor Narcís Prat and Dr Eduardo García-Roger** (University of Barcelona, Spain)

### PARTNERS

**Alterra – Wageningen UR**, Netherlands (coordinator) • **Technical University of Crete (TUC)**, Greece • **Joint Research Centre (JRC-IES)**, Italy • **Istituto di Ricerca Sulle Acque (CNR-IRSA)**, Italy • **Consejo Superior de Investigaciones Científicas (CSIC)**, Spain • **Universitat de Barcelona (UB)**, Spain • **Universidad de Murcia (UMU)**, Spain • **Universités Montpellier (UM2)**, France • **University of Leeds (UNIVLEEDS)**, UK • **Centre for Ecology and Hydrology (CEH)**, UK • **Forschungsverbund Berlin e. V. (FVB)**, Germany • **Institute of Marine Research (IMAR)**, Portugal • **Hellenic Centre for Marine Research (HCMR)**, Greece • **Université Sidi Mohamed Ben Abdellah de Fes (FST-Fes)**, Morocco • **Autorità di Bacino della Puglia (ABP)**, Italy • **Land Reclamation Survey (PL-LRS)**, Sparta, Greece • **Leibniz Universität Hannover (LUH)**, Germany

### CONTACT

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**JOCHEN FROEBRICH** is leading the Alterra IWRM research team, which integrates experience in irrigation and drainage with new challenges for increasing water productivity under water stress. The focus is on Sub-Saharan Africa and the Circum-Mediterranean region. Since 1993 he has specialised in managing water quantity and quality in semi-arid river basins.

On a rudimentary level, temporary streams are frequently unrecognised as extant water bodies; historically speaking, they are poorly monitored and rarely incorporated in regional planning. Consequently, existing literature on individual temporary waterways in the Mediterranean region is lacking. This has stimulated the MIRAGE group to conduct structural assessments of the temporary streams in question by integrating hydrological and ecological characterisation.

Project coordinator, Dr Jochen Froebrich, outlines the importance of ecological considerations in surveying temporary streams. He comments: "As part of the WFD it has been agreed to base assessment on the appearance and quantity of indicator organisms, as they can better reflect time variable deterioration in water quantity and quality". However, it has been demonstrated that without accurate hydrological information it is difficult to interpret ecological data. The intersection between hydrology and ecology is therefore crucial, and the emergence of 'ecohydrology' as a science is particularly important where temporary streams are concerned. Here, scientific discussion should not be restricted to ecological flow conditions; the ecological water availability (for instance, in disconnected pools) during dry periods should also be considered.

### STRIKING A BALANCE

Europe is currently seeking to develop sustainable methods to meet the food demands of a growing population. In relation to this, the disruption of the flow of temporary streams for agricultural purposes is a key issue surrounding water management. Despite mandatory regulations relating to the preservation of the ecological status of natural water bodies in several parts of the Mediterranean region, a number of authorities still intend to manipulate river flows to maximise irrigation areas. In many Mediterranean basins, groundwater resources – and temporary streams in particular – are being overexploited during non-drought periods. Such human activity impacts upon the hydrological conditions of temporary streams, which in turn poses a veritable threat to biodiversity. Through the development of sustainable management strategies, MIRAGE also seeks to mitigate biodiversity loss – an aspect of the project which has notable resonances in the UN's International Year of Biodiversity. In this light, MIRAGE is encouraging improved dialogue between various stakeholders in an effort to sensitise opinion regarding biodiversity loss. Furthermore, the initiative endeavours to inform future policies and legislation with scientific findings.

### INTERFACE

Members of the project have initiated contact with all stakeholders and, in the programmes undertaken in Italy and Greece, a number of knowledge-sharing workshops have been



Blackflies (*Diptera: Simuliidae*) are a biological indicator of water quality in temporary streams

implemented. Furthermore, in gaining relevant information regarding the temporary streams and streams under investigation, the MIRAGE team has organised interviews with farmers and residents within the river basin. To date, community members have proved very receptive to such initiatives, and it is hoped that they will provide a significant amount of pertinent and relevant information which will complement the scientific findings gained from structural assessments. Members of local communities can provide expert knowledge regarding key aspects of temporary streams, such as the rate and frequency at which they dry up, and whether they flow continuously or contain isolated pools.

However, in implementing the WFD and promoting the development of sustainable water management strategies in regard to temporary streams, the Mediterranean region faces a tough test. The farming community is reluctant to ratify proposals which may benefit biodiversity and improve sanitation but impede upon economic and agricultural prosperity. As such, farmers have been found to postpone the implementation of voluntary measures; instead, they opt to rely on governmental programmes for financial support. Relating to this socioeconomic context, Froebrich comments: "The Consortium's past experience indicates that European, national and regional governments have to provide better steering mechanisms and alternatives for income generation". In the meantime, however, the MIRAGE project is committed to empowering the local community to participate in the development of unique water management plans.

### TANGIBLE OUTCOMES

To offer an insight into the final deliverables of the project, it is interesting to consider MIRAGE's work on the Evrotas in Greece. Alongside the development and implementation of watershed managements plans for the area, the project will culminate in the creation of a Local Development Observatory. This will act as the focal water management centre in the region; in addition, funding has been provided by MIRAGE to support the training of staff – a fitting legacy to a much-needed and successfully coordinated initiative.

