Briefing note

Environmental water requirements of wetlands and their importance for river basin management in the Mediterranean, including the effects of climate change on natural water flow

2020

The Mediterranean Wetlands Initiative (MedWet)

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MedWet

Environmental water requirements of wetlands and their importance for river basin management in the Mediterranean, including the effects of climate change on natural water flow

This Briefing note was prepared by the Specialist Group on water (Water-SG) of the Scientific and Technical Network of MedWet (MedWet/STN).

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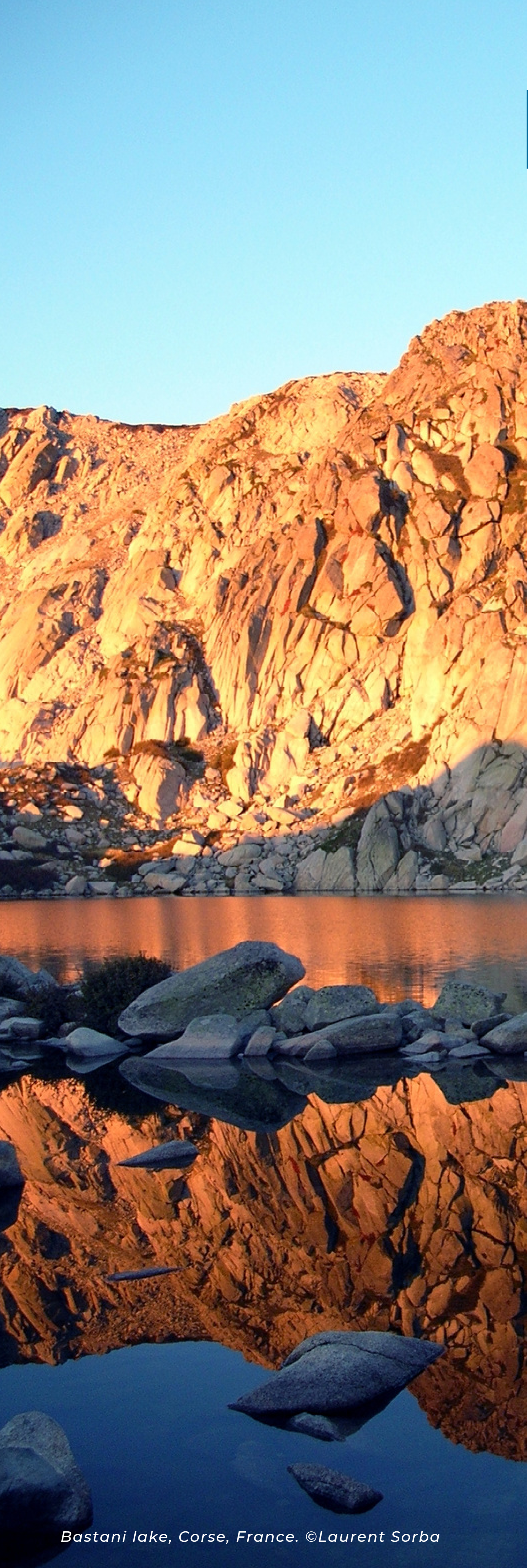
Skadar Lake, ©Alexey Komarov



Bastani lake, Corse, France. ©Laurent Sorba

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MESSAGE

Wetlands are vital for human survival. As one of the world's most productive environments, wetlands are indispensable for countless benefits or ecosystem services. These benefits range from freshwater supply, food, building materials and biodiversity, to flood control, groundwater recharge and climate change mitigation. The long-term success of wetland conservation depends on persons owning, living in and depending on wetland resources to make informed decisions that result in sustainable management and lasting economic viability.

To achieve long-term conservation goals and objectives, investment in the knowledge and capacitiy of wetland managers is as critical as investment in direct conservation measures. Without this investment in people at all levels (from government staff to local wetland managers), there will be little chance of securing the wise use of wetlands. In essence, long-term sustainable wetland use and management depend on building essential human and social capital.

This Briefing note, developed by the Specialist Group on Water (Water-SG) of the Scientific and Technical Network of MedWet (MedWet/STN), introduces a cognitive framework for the quantity, quality and timing of water flows required to sustain wetlands in the Mediterranean region.

The aim of this note is to support the conservation and the sustainable wise use of Mediterranean wetlands, in accordance with the implementation of the Ramsar Convention. This document includes both theoretical and practical information, reporting on specific case studies from the Mediterranean region, and provides tailor-made management recommendations to support and serve both site managers and policy makers to assist them in developing and implementing adaptation strategies in the face of climate change.

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Ter River. ©Almayael/Wikimedia Commons

BACKGROUND

The Water-SG is one of the five Specialist Groups that make up the MedWet/STN. The SG comprises 10 experts from seven countries in complementary disciplines and practices, who advise on water resource management in a wetland context.

The Water-SG is contributing to knowledge on environmental flows, namely the volumes, the timing, and the quality of surface and groundwater needed to sustain the different types wetlands in the Mediterranean.

The working group also reviews examples of Mediterranean wetlands performing the functions of natural water service infrastructure in the provision of storage, supply and purification.

Know more about the MedWet/STN and its Specialist Groups:

https://medwet.org/the-scientific-and-technical-network/

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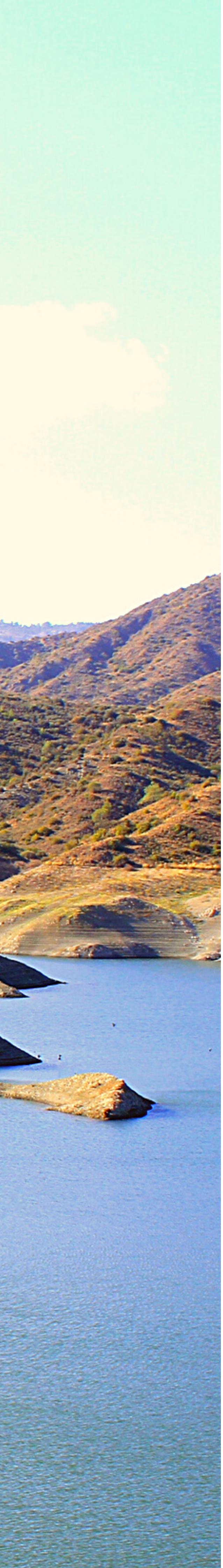


1. INTRODUCTION

Wetlands, big and small, play a key role for Mediterranean society, not only because of the immense biodiversity they hold (1), but also because of the services they provide. Not least the adaptation and mitigation of climate change, which is severely affecting the region with extreme temperatures, droughts, floods and sea level rise. In order to maintain the natural functions of wetlands, an adequate definition and allocation of environmental water to cover their needs is essential.

The environmental water requirements of a wetland, using the broad definition of the Ramsar Convention are the adequate amount and quality of water at the right time to sustain its biodiversity and provide water-related services and benefits to people. The formal definition of these "environmental flows" or needs, together with stakeholders, can help reduce uncertainties around water allocation, and contribute to reconciling the different demands for water. In the face of climate change, an environmental flow assessment process can also provide a more complete knowledge base of the changing nature of water availability and allocation needs within the hydrological context of the basin where the wetland is found.

This Briefing Note supports policy makers by facilitating an understanding of the linkages between the water needs of wetlands and of people, as well as the different levels of decision making needed to implement environmental flows (for example, at the local wetland scale, at the basin level, across river basins, or in national and regional sectoral plans e.g. EU-wide). It stems from Ramsar Policy Brief #4 (2) and highlights the complexity of the trade-offs between

(1) E.g. at least 2,983 species assessed in the region [1], 176 freshwater Key Biodiversity Areas (KBAs) covering an area of 302,557 km2 [2], 61% endemic freshwater mollusks, 45% endemic freshwater fishes, and 50% endemic amphibians [3], and 30% of water-dependent vertebrate species for 2-3% of the terrestrial surface area of the Mediterranean region, one of Earth's 34 biodiversity hotspots. [4]
(2) Ramsar Policy Brief #4 "Implementing environmental flows with benefits for society and different wetland ecosystems in river systems" was developed as task 4.1 by STRP 2016-2018. The Ramsar STRP (Scientific & Technical Review Panel) is the global-level model for MedWet STN (Scientific & Technical Network). [5]

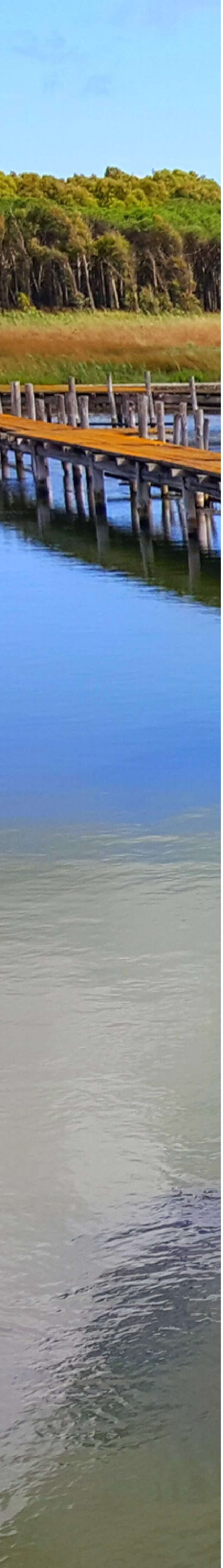
stakeholders required to sustainably meet those competing water needs in the particular context of the Mediterranean region - a region where use of water is already intense and climate change challenges are intensifying.

The high temporal variability in meteorology of the Mediterranean region, which combines strong droughts with short periods of heavy rainfall linked to flooding events, is expected to worsen with climate change. This strengthened trend to more extreme conditions, in addition to increasing temperatures and sea level rise, could lead to even more difficult situations regarding water management and environmental flows. Increased frequencies of flooding from the sea will put mounting pressure on the existence of coastal wetlands and, together with lack of connectivity in heavily regulated basins, to the spatial migration of suitable wetland habitats or species, and therefore their biodiversity.

This is all bound to compromise the ecological health of Mediterranean wetlands in a region where water stress is already high and demands have steadily increased in the last decades. [4]

The science of environmental flow assessment, its principles, and methodologies have been evolving to integrate shifting precipitation patterns. These shifts can limit the ecological outcomes of purely hydrologic restoration or other less flow-related environmental factors e.g. sediment regime alteration, that are critically important for maintaining hydrological connectivity. [6]

This Briefing Note provides a set of actionable recommendations to assist with successful implementation of environmental flows - starting from an adaptation perspective in the face of non-static hydrologic and ecological conditions as well as of the remaining uncertainty.



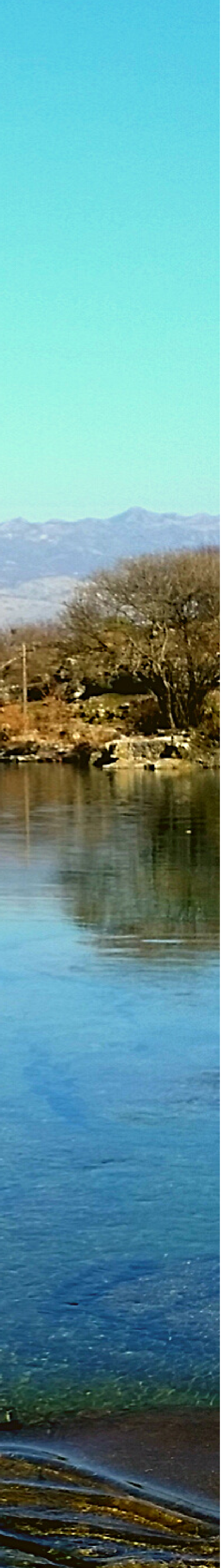
2. The Mediterranean context – wetland types and main ecological features related to the flow or flooding regime

The Ramsar Convention has adopted a very inclusive definition; "…wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres." When adopting the Ramsar definition of wetlands, practically all places in the Mediterranean where there is water, permanently or temporary, be it fresh, brackish or salt water, including all the coastal lines up to six meters of depth at low tide, can be considered a 'Mediterranean wetland' (3).

Using such a wide definition of wetlands calls for a more detailed characterisation of the **main ecological features** related to the hydrological functioning of each wetland type and, consequently, the natural patterns in time and space that need to be considered when addressing environmental flows in these ecosystems:

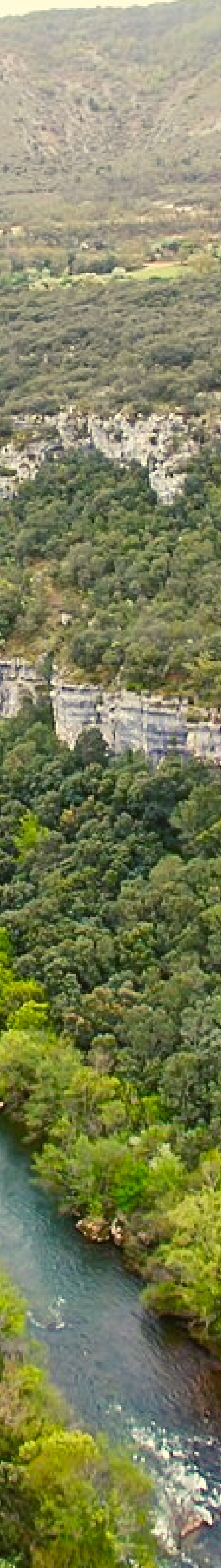
- **Seasonality and inter-annual variability of the Mediterranean climate**. Important drivers for wetland features derive from the Mediterranean climate, which is characterised by an irregular balance of the precipitation and evapotranspiration regime, as well as the irregular distribution of precipitation both within the year and within years. These temporal contrasts result in a hydrological regime with a strong seasonal component, and a water balance that can be very different in different years. This means that seasonal meteorology is the main requirement by which environmental flows need to be managed, i.e. by mimicking the natural patterns.

(3) https://medwet.org/aboutwetlands/ramsarconvention



- **Vulnerability and resilience to climate change**. The on-going process of climate change is expected to increase in seasonal and inter-annual variability, and therefore even more uncertainty for management. In the Mediterranean coast of Spain for example, the storms occurring in 2019 and early 2020 broke many records in terms of wave height, flash rainfall, and even snowfall amounts. Whereas extremely long periods without any rainfall also occurred. These extreme situations, including temperature records broken almost every year in the hottest months, means even more evapotranspiration from vegetation - clearly demonstrating how the effects of shifts associated with climate change point to a greater water stress affecting both ecosystems and human use. At the same time, scarce coastal lagoons are key to providing storm protection in the Mediterranean. Where wetlands are healthily maintained by an appropriate flooding regime as described below, they can also play a key role in climate change adaptation and mitigation through sequestration of carbon. [4]

- **Water circulation regimes**. Additional to the natural patterns imposed by the climatic features of the Mediterranean, many other ecological features are intrinsic of each wetland type. A main feature is the water circulation regime, which according to Ramsar wetlands types is divided into lotic (i.e. running waters), lentic (i.e. standing waters), and transitional (e.g. estuaries), and coastal marine environments. These key features blend for each of these wetland types in relation to the environmental flows. In lotic systems, the flow regime strongly influences, even determines, the biota and ecosystem processes. The maintenance or recovery of the natural regime is therefore essential for the structural and functional health of the river ecosystem. [7] In lentic ecosystems, the flooding regime, i.e. when, where, and how much the wetland is inundated, is the key ecological feature, and influences other ecological variables (e.g. salinity). These in turn co-determine the composition of the biological communities and the ecosystem functioning. [8]

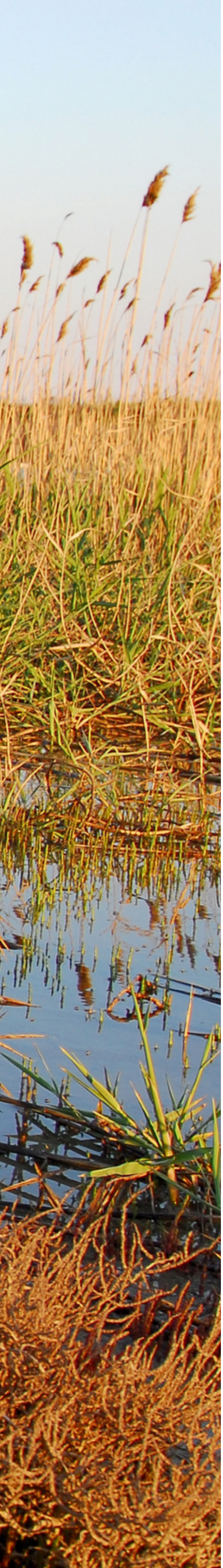


Similarly, transitional waters such as estuaries are influenced in their ecological features by the flow regime, since, for example, the freshwater flows interact with marine waters and determine the physical and chemical structure of the estuary, which, as in the abovementioned ecosystem types, is quite relevant for the biota and the functional processes. [9]

- **Combinations of temporary and permanent wetlands as local variability**. Temporary lakes and ponds, ephemeral rivers and estuaries, intertidal flats, etc. coexist in the Mediterranean with permanent systems showing more stable (though still variable) ecological features. Given such variability, the management of environmental flows should follow the natural patterns of wetlands as a general rule. In the Mediterranean region natural patterns are determined by the seasonality providing distinct temporal profiles inherent to each Mediterranean wetland type within the geographical context it develops. Latitudinal and longitudinal gradients, combined with the influence of local factors, modulate the intrinsic seasonality of environmental flows and flooding patterns - thus determining the natural hydrological regime that is to be imitated when designing and managing environmental flows allocations. As an example of a highly variable local factor, hydrological connectivity may control the intermittent flow between isolated wetlands and the more permanent stream network.

The relevance of defining flow or flooding regimes from an ecological perspective

Considering the special characteristics of Mediterranean wetlands, as both annual and seasonally variable, defining flow or flooding regimes that mimic this natural variability is of extraordinary relevance. During the last two decades, pioneering initiatives for the discharge of experimental floods have been carried out in some river basins, typically through participative processes involving water managers, water users and scientists.



Many of these early examples from South Africa [10] [11], Switzerland [12], the USA (New Mexico [13] and Arizona [14] [15]), Australia [16] and Spain [17] have one lesson in common that researchers and managers have been reaffirming since the introduction of environmental flows in the ecohydrology science discourse worldwide: **a regime of minimum flows (even when they partially mimic natural flow patterns) did not ensure, in the medium and long term, the ecological integrity of river ecosystems**.

Minimum environmental flows (even when they incorporate intra- and inter-annual variability) will contribute to maintaining certain processes and biological communities, but will also progressively contribute to ecologically impoverished and physically dwarfed ecosystems.

Natural systems require natural disturbances which, along high flows or even average but timely flows, can favour their regeneration and the reoccurrence of habitats and processes that are typically linked to early stages of ecological succession. As a result, rates of ecosystem processes rather than single species states should be measured as variables. These rates better represent ecological responses to flow variability and therefore scheduled environmental water allocations. [6] [7]

These considerations admittedly pose considerable technical challenges of not just adequately defining the water needs of wetlands but also designing management plans that can mimic the natural patterns as recommended - while still meeting most if not all of the other managerial objectives for the body of water.

Below is a case study of a cluster of successful experiences for the lentic type of Mediterranean wetlands that have paved the way towards overcoming these hurdles.

CASE STUDY

Controlled floods in Mediterranean Spanish rivers: from design to release

Fernando Magdaleno – Water Directorate, Ministry for the Ecological Transition (Spain)

Ebro Canyon. © David Martin

Water legislation and management in Spain are beginning to face the complex challenge of releasing cost-efficient controlled floods, contributing to the combined commitment of the Water Framework Directive (2000/60/EC) and the Habitats Directive (92/43/EEC).

In Spain, water legislative initiatives recently named controlled floods as a compulsory component of environmental flow regimes in strategic water bodies. The national Regulations for Hydrologic Planning (2007, 2008) developed a mandate for releasing managed floods in heavily regulated rivers, with the aims of:

- (i) controlling the presence and abundance of river species;
- (ii) maintaining the physical-chemical conditions of water and sediments;
- (iii) improving the status and availability of river habitats by means of the geomorphic dynamics; and
- (iv) favouring flow processes that control the connections among rivers, associated aquifers, transitional waters, and the sea.

Controlled floods must contribute to the reactivation of eco-geomorphic processes in the channel, be similar to ordinary (bankfull) floods, and be designed according to the hydraulic, hydrologic and ecologic modelling of the river or water body. The main features of the controlled flood (i.e. peak magnitude, event duration, frequency and seasonality, and speed of increase and decrease of the flood profile) would respond to the trade-off between ecological requirements and managerial objectives of the river.

There has been an array of experiences since the afore-mentioned legislation was enacted (Figure 1). Controlled floods have proven entirely satisfactory in eco-geomorphic terms, with no significant incidence on social-economical uses of water in the basin.

Still, many lessons have been learned which should be considered in future controlled releases in order to optimise their functionality.

The examples developed are from the Duero/Douro basin (e.g. Pisuerga, Luna and Esla rivers), the Ebro basin (e.g., in the Ebro mainstem) and in the Catalan basins (e.g. Cardener, Llobregat and Ter rivers). New case studies are expected to give continuity to the initiative in the same and other Spanish basins such as the Tagus (central Spain).

All of these are basins and rivers of Mediterranean dynamics. As such, they represent a true challenge from the combined perspective of reservoir exploitation - in such variable climatic condition and considering the large water demands for urban and specially agricultural uses-and conservation/restoration of the fragile and valuable river habitats sustained by Mediterranean rivers, which are adapted to the specific rainfall-runoff processes dictated by the geographical and climatic context (Figure 2).

Some of these river systems where floods were released are small or medium-sized, but in other cases large river sections were involved. This is the case of the Ebro River, where biannual controlled floods are reaching a peak flow which reaches 1,300 m3/s. [17]

The Ebro River in Miravet (Catalunya). Photo: © Makinal~commonswiki

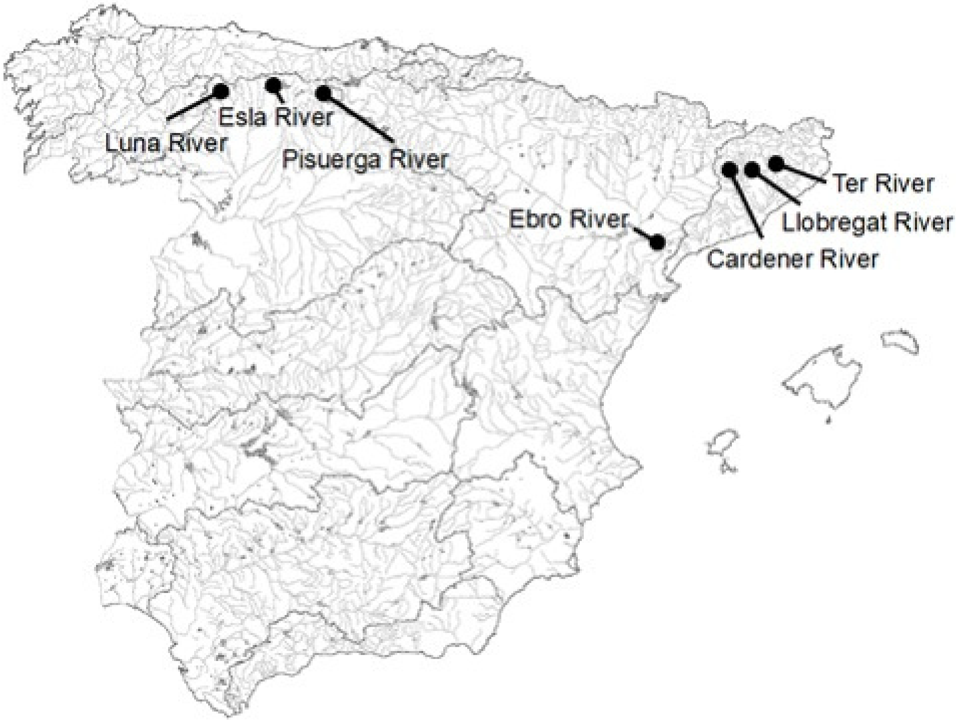


Fig. 1 – Distribution of up-to-date controlled floods experiences in the Spanish basins.

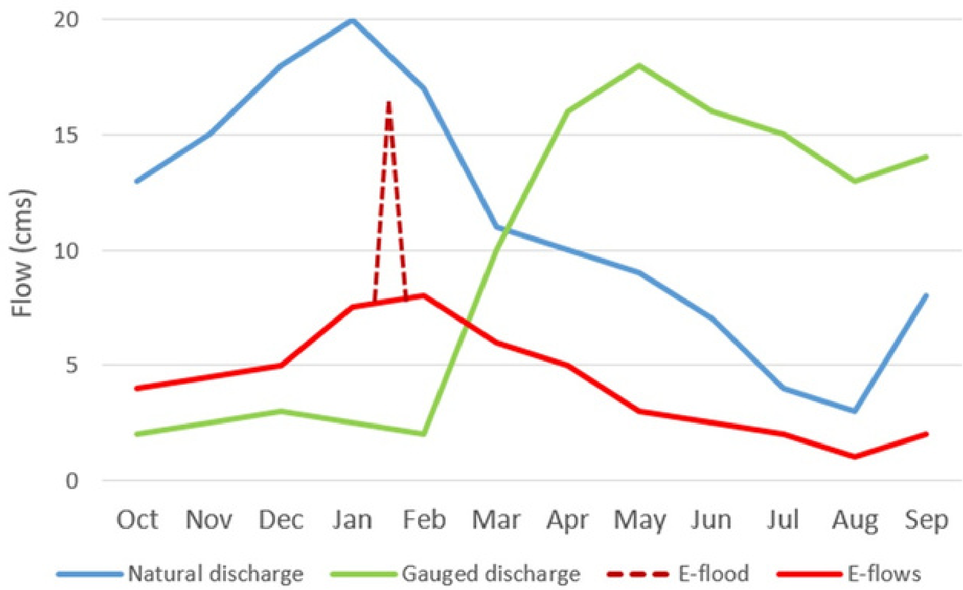
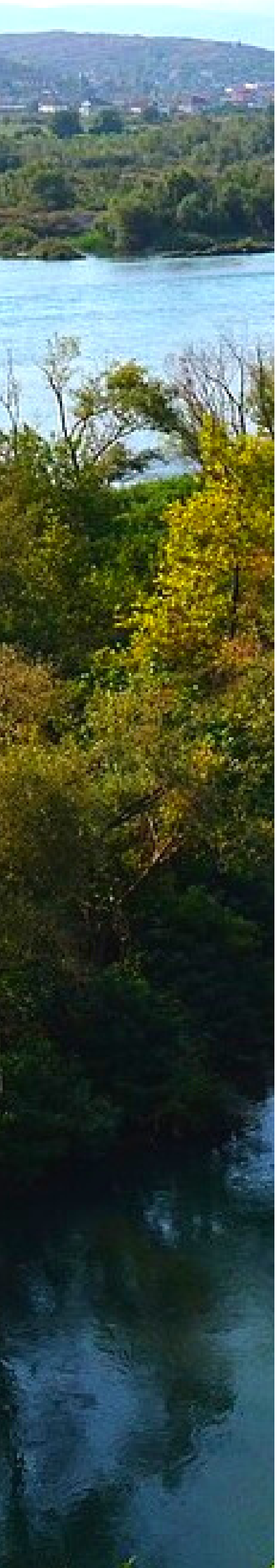


Fig. 2 – Conceptual comparison of pre- and post-regulated flow regimes (natural vs. real discharge), environmental flow regime and periodical release of controlled flood.

3. The Mediterranean context – regulatory and socio-economic aspects related to the flow or flooding regime



From a legal perspective, certain types of standing waters may be more challenging than water courses to protect. Water legislation may not complement sustainable water resources management with the conservation of important aquatic habitats and species. Rules for rivers have often been linked directly to human uses such as abstractions or navigation. However, the nexus of the physical and ecological with the hydrological (river) network can be harder to demonstrate; or with a pond or a marsh when this is disconnected, however temporarily, or variably dependent on an aquifer.

Appropriately, the European Union's Birds and Habitats Directives (BHD) and Water Framework Directive (WFD) safeguard any water-dependent site designated because of Natura 2000 listed habitat or species. The establishment of hydro-morphological elements (i.e. environmental flows and connections to groundwater) that support both the requirements of the qualifying habitat or species of Natura 2000 sites and those of good ecological status under the WFD is a desirable yet elective assessment programme that Spain for example has undertaken.

The WFD, for its part, aims at reaching the good status of all water bodies in the European Union, and not to further deteriorate them. This implies the protection and the adequate water allocation for wetlands. However, not all countries make that obvious link explicit in their legislation, and not all wetlands have been designated by Member States as water bodies, typically leaving out of the River Basin Management Plans (RBMPs) those that are smallest and temporary.

It is otherwise difficult to expect a good level of protection for wetlands especially if isolated and in the absence of at least a designation under an international treaty such as the Ramsar Convention.

This is not the case for the Laguna de Gallocanta in Spain (see below) where the persistence of high-diversity saline wet environments is affected by the variability in rainfall and its effect on fluctuations in the water level of the lake. This makes it vulnerable to climate change despite its level of national, regional and international protection.

CASE STUDY

Relating habitat distribution to hydrological conditions to establish a reference surface for Habitats of Community Interest in the temporary saline Lake Gallocanta, Spain

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- *Maria José Viñals – Department of Cartographic Engineering Geodesy and Photogrammetry, Polytechnic University of Valencia, (Spain)*
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Laguna de Gallocanta. ©M. M. Farriols

Laguna de Gallocanta is an endorheic (isolated) saline lake that occupies an area of 14.4 km² on a large endorheic-steppe depression on the Ebro river basin, Spain.

In addition to its proven conservation values as a scarce type of ecosystem, as well as for the halophylic flora and fauna, which are characteristic of these environments, it is a very unique system of high scientific interest due to the diversity of plankton species (up to 70% of the characteristic species of Mediterranean temporary saline lakes have been cited there).

Laguna de Gallocanta is the largest saline lake in Western Europe presenting a good conservation status. Figure 3 shows the zonation of the main Habitats of Community Interest (HCI) protected under the Annex 1 of the Habitats Directive and some of the catalogued plant species. [18]

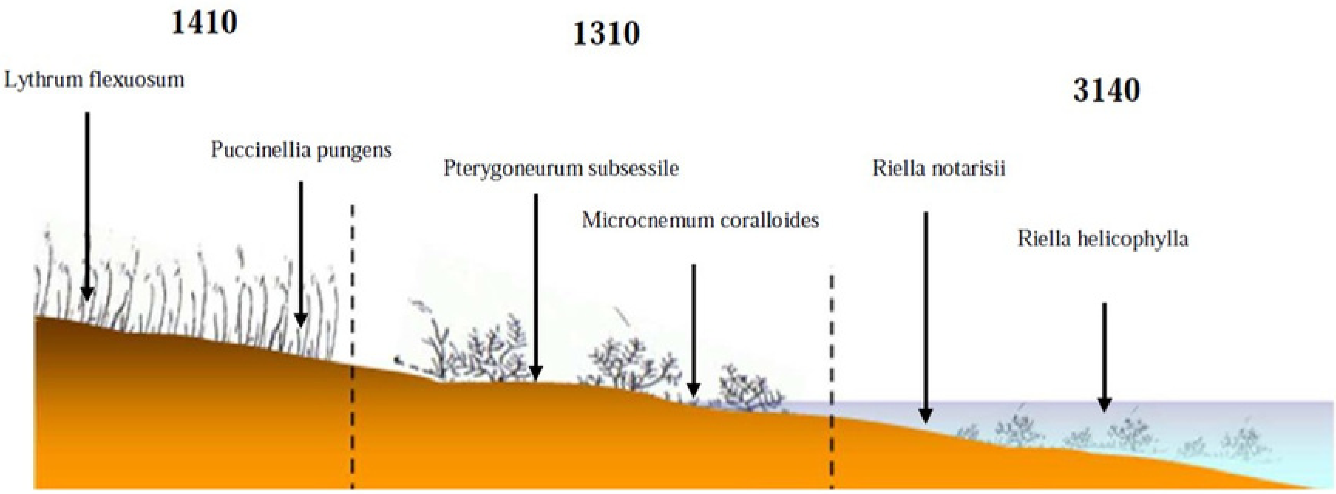


Fig. 3. – Habitats of Community Interest (HCI) from the Annex 1 of the European Habitats Directive associated to the hydrological dynamics of Lake Gallocanta. HCIs: 1310 - Salicornia and other annuals colonising mud and sand; 1410 - Mediterranean salt meadows; 1510* - Mediterranean salt steppes; 3140 Hard oligo-mesotrophic waters with benthic vegetation of Chara spp.

The potential surface area of habitats in Lake Gallocanta is mainly determined by the edaphic salinity characteristics and the flood pattern. The altimetric location of the plant communities in the lagoon allowed to study their flood frequencies based on historical data on the level of water sheet. Figure 4 shows the potential surface area of each type of HCI in the period 1926/2001 for a maximum surface area of the 1,500 ha lagoon.

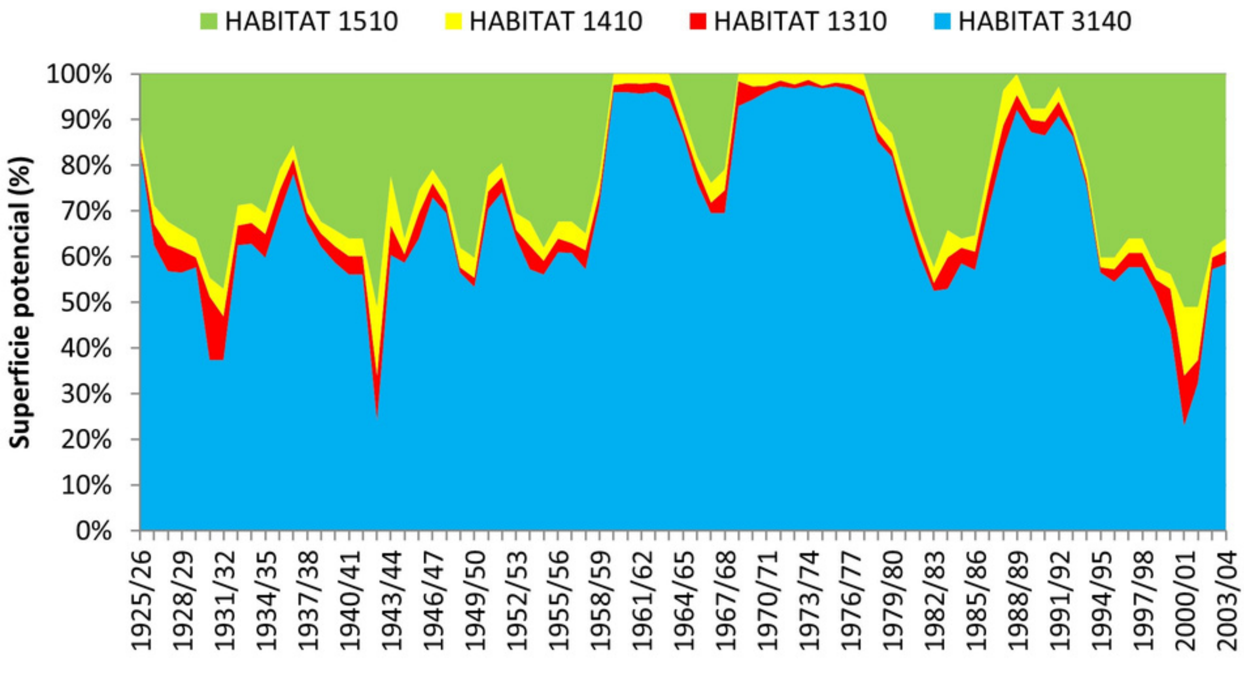


Fig. 4 – Estimated time course of potential areas of HCI in the temporary saline Lake Gallocanta.

The historical evolution of these surfaces under natural conditions allowed to obtain surface reference values for each of the types of HCI. In accordance to the concept of favourable conservation status, the potential reference surfaces for dry, semi-humid, and wet years have been determined by applying the 12.5, 50 and 87.5 percentiles on the series of annual values obtained (Table 1).

Habitat reference surface (ha)	Dry years	Semi-humid years	Wet years
3140	647,9	763,5	1198,5
1310	17,1	35,4	65,0
1410	27,5	40,3	58,2
1510	480,1	303,5	0,0

Table 1. Reference surfaces for the main HCI in Lake Gallocanta

According to the 2nd Mediterranean Wetlands Outlook, the **socio-economic context** of the region is one where a steady drop in the flow of rivers has been coupling with a massive increase in dam storage capacity to a level 1.5 times the annual volume of freshwater discharged into the Mediterranean Sea. [4]

Water is used mainly for agriculture in North African and Middle Eastern countries, as well as in Greece and Spain, while other countries like the Balkans and France that have more abundant water resources use it especially for domestic, industrial, and energy purposes. Overall, irrigated agriculture consumed the greatest amount of water in the region, with 66% of the total consumption in 2014. [4] Although it contributes to education, valorisation and local livelihoods, tourism can also take a toll on scarce water resources in line with other demographic pressures. The increasing population, economic development, and poor efficiency due to losses in water supply networks are the main drivers of excessive withdrawals from river, wetland, and underground aquifer ecosystems. These drivers need to be tackled by an adequate definition and allocation of environmental water.

The relevance of defining flow or flooding regimes from a management perspective

The seasonal character of many wetlands in the Mediterranean as a consequence of the characteristic negative water balance poses additional challenges to management such as flash floods, as in the first case above, or vulnerability to salinization due to the greater evaporative context. Climate projections suggest that water deficit will further increase, affecting the availability of water resources for wetlands and other socio-ecosystems, including agricultural. Only 27% of 229 Mediterranean locations modelled are expected to retain the hydrological conditions needed for these wetlands to persist in good status by 2100 under current carbon emissions. [19] However, not only can wetlands be affected by climate change, but they can also influence it by their carbon exchanges with the atmosphere. [20] [21]

They therefore can be an ally or a hinderance - depending on scale and their functioning - in the fight against climate change and its catastrophic impacts as defined by the UNFCCC Paris Agreement and the Sendai Framework on Disaster Risk Reduction. Mediterranean governments are generally not on track to meet their international commitments for the conservation and wise use of wetlands. (4)

Whereas EU Directives are a sub-regional instrument, regional frameworks applicable to all countries in the Mediterranean Basin are the Barcelona Convention and its most relevant protocols as well as the Mediterranean Strategy for Sustainable Development. [22]

It has been advocated that the emphasis of the Sustainable Development Goals (SDGs) on protecting freshwater and coastal ecosystems could build further momentum for environmental flows and the repositioning of wetlands as nature-based solutions and a central element of sustainable water resources management. [4] [5] [23] A key principle of the SDGs as a cross-cutting policy agenda is the integration of different sectoral priorities. An additional tool in recognising interdependencies between e.g. water, energy and food securities, overcoming 'silo' mind-sets and practices, and explicitly addressing trade-offs that inevitably result from specific development paths and investments is the Water-Energy-Food-Ecosystems (WEFE) Nexus approach. [24]

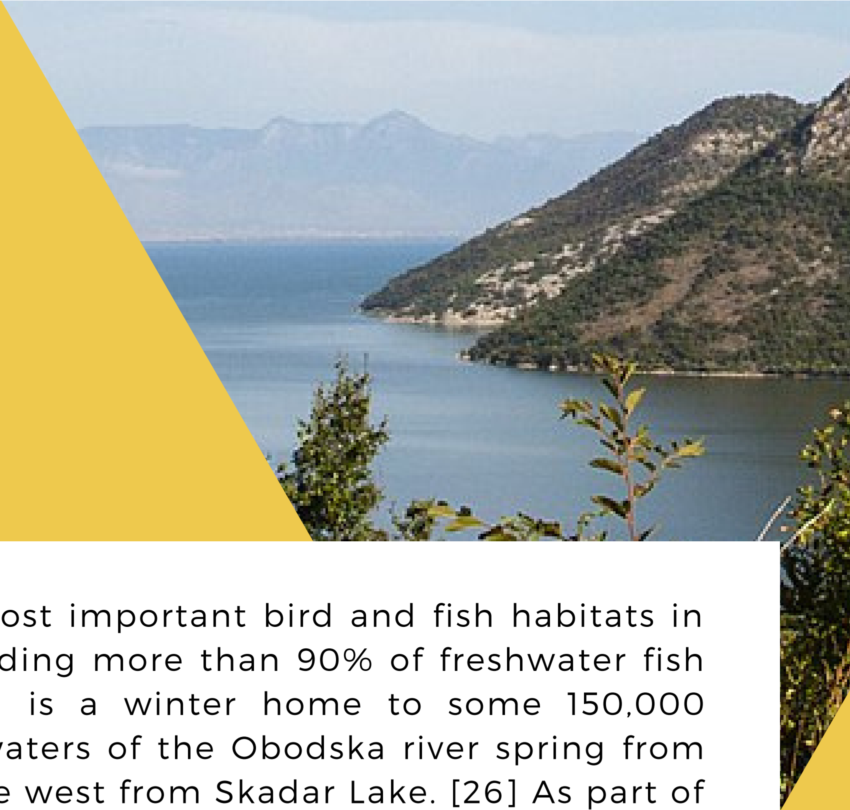
(4) See pages 7 and 10 of the 2nd Mediterranean Wetlands Outlook for details on specific targets of goals and plans under these international agreements. [4]

Such an approach allows the assessment of the potential for interdisciplinary solutions incorporating environmental flow methodologies that improve resource efficiency and account for the contribution of ecosystems, along with their resulting health. Management questions that could be answered with this approach are: a) is a wetland a net contributor of storage or water released to the river network when considering the changes in season? b) Would the costs of degradation be too high or irreversible if environmental water is not allocated across all ecological needs over time and space? Or, c) conversely, would the costs of retrofitting a water infrastructure project be affordable (like in the case study from Montenegro below)?

CASE STUDY

Environmental flows as an indicator of trade-off between hydropower and the environment in the Dinaric Arc region of the Balkans

Zoran Mateljak – WWF Adria / Dinarica



Skadar Lake hosts one of the most important bird and fish habitats in the Mediterranean region, providing more than 90% of freshwater fish consumed in Montenegro, and is a winter home to some 150,000 migratory birds. [25] The headwaters of the Obodska river spring from the Crnojević cave located to the west from Skadar Lake. [26] As part of the Dinaric Arc Sustainable Hydropower Initiative, the World Wide Fund for Nature (WWF) led the development of a study in this river basin for a small hydropower plant on Treskavacki Potok.

The aim was to demonstrate that environmental flow implementation can make hydropower generation better account for ecosystem needs. More specifically, the study determined the impact of implementing an environmental flow regime on electricity generation compared to current practice, which consisted of maintaining only 10% of average annual flow in the river at all times. In contrast to this "biological minimum", ecological experts reviewed five different environmental flow assessment methodologies to recommend a flow regime respectful of natural flow and existing aquatic and riparian ecosystems on the basis of available hydrological data and samples collected in the field.

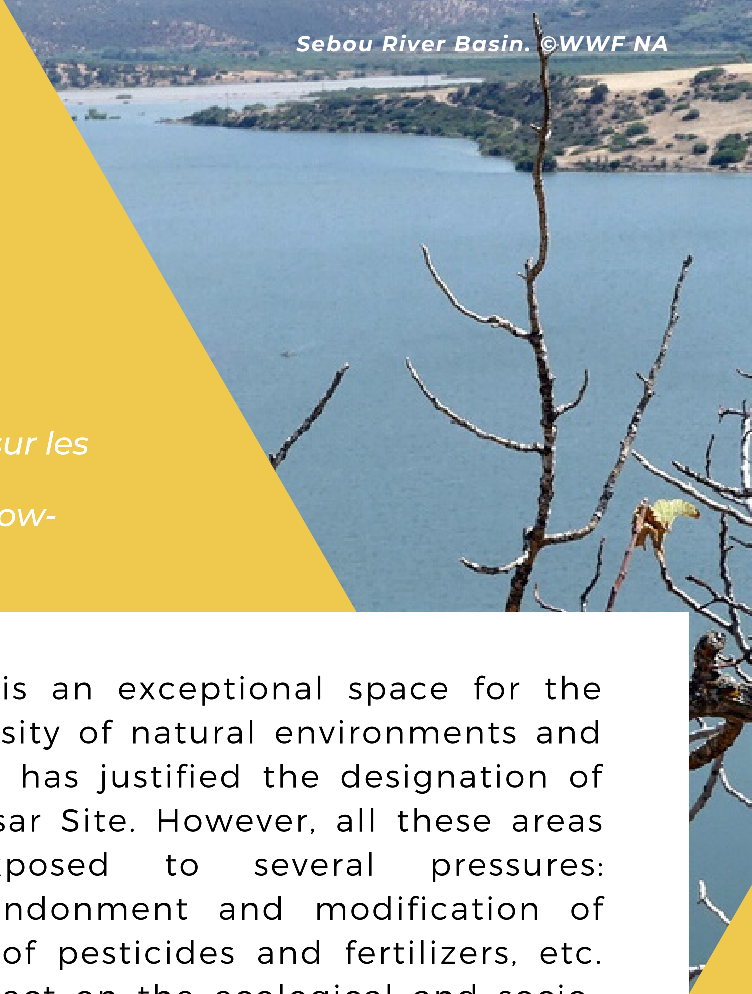
The water allocation for hydropower use was determined by comparing biological minimum and this environmental flow regime. The outcome shows that a small hydropower plant operating on an environmental flow regime would produce 2.4% electricity per annum less than if operating on a biological minimum.

Translated to Montenegrin financial conditions, this equals a loss in revenues of less than 10,000 € per year. While this analysis refers to small hydropower projects and still needs to be scaled up to larger plants, it demonstrates that considering nature as one of the water users in a river basin does not always have to be economically disadvantageous after all the costs incurred are repaid in ecosystem services spared. [27] It also shows that environmental flows are an excellent metric for determining real trade-offs between the various water users and the environment with a view to maximising both human and ecological outcomes. As such, they are also a platform for successful implementation of basin-level planning and transboundary cooperation in a context of many shared basins like the Balkans.

In this context, the WFD and BHD are legal frameworks that drive the integration of multi-sectoral planning. Although EU legislation is not mandatory outside of Member States, EU candidate states such as Turkey may implement parts of the directives as part of their accession agreements; likewise, associated countries such as Switzerland may adopt key features of the WFD water management. Other countries may see the WFD as a well-developed transferable model (see example from Morocco below). Although there is still much scope to further mainstream environmental policy actions into sectors such as agriculture, energy and transport to reduce the driving forces behind aquatic biodiversity loss, the WFD and RBMPs have led to a significant shift in Member States' water management and have increased the availability of information to the public. [28] They are also providing a much better understanding of the linkages between the water needs of wetlands (status) and people (pressures) as well as of the measures to reduce pressures and achieve improvement in status.

In Morocco, the Sebou River basin (case study below) has become the first river basin to adapt and apply the WFD. This speaks to the need, in the definition and negotiation of water allocations, to implement any equivalent legal basis for first conducting dialogues at local, national and regional level and then promoting participatory approaches that lead to the involvement of stakeholders from different sectors (e.g. water agencies, energy utilities, farmers’ associations, NGOs, women’s groups, local communities and businesses). [24]

Sebou River Basin. ©WWF NA



CASE STUDY

Ecological Flow: A Tool for Inclusive Water Resource Management in the Sebou River basin, Morocco

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The Sebou River basin in Morocco is an exceptional space for the coexistence of an extraordinary diversity of natural environments and landscapes. This richness in heritage has justified the designation of certain areas of the basin as a Ramsar Site. However, all these areas represent fragile ecosystems exposed to several pressures: overcrowding of the coastline, abandonment and modification of agricultural practices, excessive use of pesticides and fertilizers, etc. These pressures have a negative impact on the ecological and socio-economic values of the territory.

The new water law of Morocco (36-15) adopted in October 2016 integrates the concept of minimum flow, in particular downstream of water infrastructures (chapt. VIII art. 97). This case study was developed on the basis of the work carried out in the basin that estimated the environmental or ecological flow during different seasons downstream of the Allal El Fassi dam. This unique initiative for Morocco was developed in collaboration with WWF. In all Moroccan river basins, the monitoring of surface water quality is performed using physical-chemical and bacteriological parameters without taking into consideration any ecological criterion.

In the Sebou, ecosystems and aquatic biodiversity needs were also taken into account, using the holistic approach of the Building Block Methodology (BBM) which incrementally assesses water volume requirements for flow, water quality, macro-invertebrates, fish, and vegetation. The assessment resulted in a recommended minimum flow rate of 1 cubic meter per second (Cumecs) to maintain connectivity of the stream and minimum ecological flows between 5 and 6 Cumecs depending on the time of the year to respond to ecosystem needs. The methodology and results have been published [29] to be used by river basin managers at the national, regional and local levels, but the application of this approach now requires additional regulation and decrees for the application of the art. 97 of Law 36-15.

4. Proposed actions and further policy needs

From the above overview of hydrological, ecological, regulatory and socio-economic considerations the following recommendations can be summarised:

- Develop and implement a legal basis for regulating water use that includes an environmental water allocation as well as an assessment methodology to ensure the ecosystems' needs are met and, where already established de facto,
- Develop and implement government programmes or public-private partnerships to protect and restore wetlands that also support the achievement of water, energy, and food security objectives wherever possible along with related SDGs.

This nature-based solution approach to wetland services to people is intended to enable complementary, sustained funding to effectively plan, design, implement, monitor, and adaptively manage negotiated, variability-observing flow regimes for river basins containing different key types of hydrologically connected or isolated wetland resources.

A set of concerted implementation actions is proposed in order to achieve beneficial outcomes for Mediterranean wetlands, beneficial for both people and nature (with a varying degree of policy development depending on the local context):

A. Use the natural hydrological patterns, especially variability for both biodiversity and key ecological processes, as a template for the design, management, and implementation of the environmental flows and water requirements for Mediterranean wetlands.

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B. Establish or operationalize regulation to implement environmental flows during the planning stage of new dams, agricultural irrigation projects and other water infrastructure, including adjustments to the environmental water allocation of aquatic ecosystems impacted by changing flow and other environmental regimes.

C. Position environmental flows as an integral component of water, food, and energy security objectives and related SDGs, as well as National Determined Contributions (NDCs) from for example wetland restoration under the Paris Agreement where appropriate, and the integration of wetland water requirements into river basin plans and/or national policies by sector through available tools and approaches.

D. Develop and implement government programmes or public-private partnerships to support the provision of environmental flows or water to aquatic ecosystems, including groundwater-dependent ecosystems that are of special interest and vulnerability in the Mediterranean.

E. Develop and implement flexible governance and management arrangements that enable the consideration of climatic and other environmental regime change for environmental flows and ecosystems in order to avoid water reallocation from ecosystems to compensate for the impacts of e.g. drought.

Further reading

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Pisuerga River, ©Parque natural montaña palentina

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The Luna River. ©Halconfr/Wikimedia Commons

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