

# The opaque lagoon. Water management and governance in l'Albufera de València wetland (Spain)

Anne Jégou<sup>1,\*</sup> and Carles Sanchis-Ibor<sup>2</sup>

<sup>1</sup> Laboratoire ThéMA, Département de Géographie, Université de Bourgogne, 2 boulevard Gabriel, 21 000 Dijon, France.

<sup>2</sup> Centro Valenciano de Estudios del Riego, Universitat Politècnica de València, Camí de Vera s/n, 46022 València, Spain.

\* Corresponding author: anne.jegou@u-bourgogne.fr

Received: 03/05/18

Accepted: 05/11/18

## ABSTRACT

### The opaque lagoon. Water management and governance in l'Albufera de València wetland (Spain)

The Albufera de Valencia is a complex anthropogenic waterscape, constructed by different social groups over centuries. Today water management in the protected wetland remains opaque, much like the water in the eutrophic lagoon. Four major organizations manage this natural heritage, which remains torn between nature conservation and rice growing, in a jigsaw of overlapping jurisdictions and crisscrossed visions. Water management in this socioecological-system is complex and contested, and takes place within a changing scenario due to recent variations in the water quality and quantity budgets. This paper analyses this changing socio-ecological system based on interviews with stakeholders, and advocates for a new model of management based on shared governance, mediation and transparent data.

**Key words:** water management, governance, protected area, sustainability, Albufera de València, ecological flows

## RESUMEN

### La laguna opaca. Gestión y gobernanza del agua en l'Albufera de València (España)

La Albufera de València es un humedal sometido, desde hace varios siglos, a una acusada influencia antrópica. Hoy día se halla en un estadio eutrófico, y la falta de transparencia de sus aguas es comparable a la opacidad en determinados ámbitos de su gestión, en la que chocan los intereses contrapuestos del conservacionismo y el productivismo, en un entramado de jurisdicciones solapadas y visiones contrastadas. La gestión del agua en este sistema socio-ecológico es compleja y conflictiva, y tiene lugar en un escenario cambiante debido a las variaciones en el balance de recursos hídricos y la calidad de las aguas. Este artículo analiza este sistema socio-ecológico a partir de entrevistas con diversos usuarios y agentes, y propone un nuevo modelo de gestión basado en una gobernanza compartida, la mediación y la transparencia informativa.

**Palabras clave:** gestión del agua, gobernanza, espacios protegidos, sostenibilidad, Albufera de València, caudal ecológico

## INTRODUCTION

The Albufera is a coastal freshwater hypereutrophic lagoon 10 km south of Valencia (Spain). The lagoon (2320 ha) is surrounded by an arch of marshlands where rice is grown (16 000 ha), and separated from the Mediterranean Sea by a forested sand barrier. The case of the Albufera illustrates the complexity of water management in some Mediterranean wetlands where the connection between irrigation systems and palustrine ecosystems creates an amalgam of contrasted visions, goals, functions and values, generating enormous difficulties to define shared strategies for sustainability.

This work pays tribute to Professor Maria Rosa Miracle. She made the Albufera a preeminent subject of research, developing seminal works on its hydrobiology and guiding the action of numerous younger researchers (Serra *et al.*, 1984; Garcia *et al.*, 1984; Soria *et al.*, 1987; Miracle *et al.*, 1987; Vicente & Miracle, 1988; Alfonso & Miracle, 1990; Vicente & Miracle, 1992; Miracle & Vicente, 1993; Romo & Miracle, 1993, 1994, 1994a; Soria *et al.*, 2001, 2002, 2005; Ultra *et al.*, 2001; Miracle & Sahuquillo, 2002; Romo *et al.*, 2008; Miracle, 2012; Marco-Barba *et al.*, 2013; Onandia *et al.*, 2014, 2015). Beyond this outstanding scientific contribution, she was also a passionate and vocal advocate for the protection and recovery of the Albufera.

Throughout the last two decades, on several occasions, Professor Miracle told the authors that the human-induced hypereutrophic stage of the Albufera could be reversed in the space of a few years. It “just” depended on how water management was handled: *“It’s only a problem of water flow regulation, with clean water. I think we have technology also to clean water. Aquatic ecosystems are very grateful: it just took one day or two for reproduction of seaweed. If we give clean water, good seaweeds, then macrophytes come out”* (Interview 2014-8 see supplementary information at <http://www.limnetica.net/en/limnetica>)<sup>1</sup>. The Albufera waters, unfortunately, are still not transparent. The lagoon got dark during the 1970s, as a result of the uncontrolled industrialization and urbanization of the surrounding areas, and from then on, only sporadic short

winter clear phases have taken place. Water management is also opaque. Information loopholes, overlapped institutions and contested visions are, among others, responsible for this murkiness, which dramatically hinders ecosystem recovery.

This opacity is investigated in this paper. How is water managed in the Albufera Natural Park? How can the management be made transparent and consistent? This paper addresses environmental geography through an empirical approach based on numerous interviews and on the review of local documentation and events. It begins with the historical construction of a complex water system and the way it operates today. The purpose is to understand a territory that is “on hold”, where water management is a jigsaw made up of multiple stakeholders. The final part of the paper suggests some changes for the future, in order to work towards the good management that professor Miracle claimed for.

## METHODOLOGICAL AND CONCEPTUAL FRAMEWORK

This paper deals with environmental geography through a territorial approach linking stakeholders and ecosystems. Environmental geography aims at all-round thinking involving both political and natural dynamics. This approach is based on the ethical values of ecological centrism: humans surrounded by their biosphere and belonging to it (Larrère, 2010), and managing ecosystems holistically. Two concepts are related to this integrated vision. First, the notion of “*médiance*”, a French neologism created by Augustin Berque in 1990, an orientalist geographer and philosopher, to understand the intricate and inseparable relation between a society and its “*milieu*”, its natural environment (Berque, 1990). In continuation of this concept appeared the “*mésologie*” as a science for the analysis of the humans’ “*milieux*” (Berque, 1996). This link between social and ecological environments has also been explored by Berkes and Folke (1998, 2006), who coined the concept socio-ecological system (SES) to provide a holistic framework to understand and strengthen ecosystems management. This has opened a field of research for the analysis of ecosystems resilience and robustness (Folke, 2006; Anderies *et al.*, 2004;

2013; Janssen *et al.*, 2007). Both eco-social perspectives provide the appropriate conceptual framework to analyse complex interactions in ecosystems such as the Albufera wetland.

The main source of information of this research consisted of semi-structured interviews conducted as part of a comprehensive approach (Kaufmann, 1996), during two periods of fieldwork in 2004 (10 weeks and 49 interviews) and 2014 (11 days and 18 interviews), held in Spanish with stakeholders from 25 different organizations. Some of the interviewees were contacted in both periods, providing perspective on how the Albufera had changed over 10 years. For each survey, participants were asked about the current state of the wetland, management practices and expected evolution. For confidentiality reasons, we have not used their name when quoting them but we use their number in classification for the excerpts translated for this paper: interviews 2014-1 to 6 are political institutions, 2014-7 is a local councillor, 2014-8 to 10 are scientists,












2014-11 is a farmer, 2014-12 and 13 are companies, 2014-14 to 17 are NGOs and finally 2014-18 is a media.

We also used information from another 30 interviews with key agents of the recent history of the Albufera that were recently published by the *Assut Foundation* (Llorens & Dies, 2017), and the unpublished documentation and video files of the Symposium “*L’Albufera Ara*” that took place in Valencia in December 2016, featuring experts, managers and researchers working in the Albufera throughout the last decades. Other information sources consulted include legal or educational documents and the daily local press.

### STATES AND CHANGES IN THE CONSTRUCTION OF THE ANTHROPOGENIC SYSTEM

The Albufera can be thought of as a complex anthropogenic system (Fig. 1), an artefact of

#### Institutions and infrastructures for water management

-  Natural Park Authority (Regional government)
-  Sewage Treatment Plants (EPSAR)
-  Valencia City Council
-  Other city councils
-  Inlets' sluices (Drainage Board, JDA)
-  Rivers (Jucar Basin Authority)
-  Irrigation channels (WUAs)
-  Artificial wetlands
-  Urban areas
-  Devesa
-  Rice paddies



**Figure 1.** The Albufera complex jigsaw of jurisdictions and infrastructures. *El complejo entramado de jurisdicciones y de infraestructuras en la Albufera.*

nature and culture that has resulted from a long material and immaterial mutual interaction. The different waterscapes over the centuries have reflected the identities, ideas and technologies of the dominant stakeholders, and can be conceptualized as different “*médiances*”, each of them attached to a particular water management system and to different forms of governance (Sanchis-Ibor *et al.*, 2008). From Antiquity until the 17<sup>th</sup> century, the Albufera was a large brackish lagoon (Rodrigo *et al.*, 2009; Marco-Barba, 2009), connected to the sea through a regulated 200 m wide inlet. The spectrum of fluctuations of the water table was controlled by the local fishing community, closing and opening the inlet and artificially introducing water from the Xúquer and Túria rivers when it was necessary to raise the water level (Sanchis-Ibor, 2001).

In 1760 rice farmers took the control of the inlet. With the support of the Crown, they drained the marshes and irrigated the new lands (García Monerris, 1983). In the following decades, farmers stopped using the natural inlet, which had become disconnected and far from the lagoon due to the reduction in the wetland's size. They opened three new canals to drain the lagoon, installing sluices to close the flow from the sea. The lagoon came to be supplied exclusively with abundant fresh water through irrigation channels from the rivers, primarily from the *Acequia Real del Júcar*. Salinity decreased, and the wetland became an oligotrophic freshwater lagoon (Sanchis-Ibor 2001; Rodrigo *et al.*, 2009; Marco-Barba, 2009). 102 Small polders (the so-called *tancats*) were built to drain the lands located below the lagoon water level (5 200 hectares).

During the second half of the 20th century, the lagoon was transformed into a third waterscape as the area came to be dominated by residential and manufacturing developments. This unplanned urban sprawl spread from València city, mostly affecting the west and northern shores. Abundant wastewater was discharged into the Albufera via the network of irrigation channels, and farmers used increasing amounts of fertilizers and pesticides. This transformation peaked from 1970 to 1980. The Albufera became heavily polluted, receiving enormous quantities of phosphorus and nitrogen (and even heavy metals) and in the end

became highly eutrophied, reducing the number and variety of macrophytes and fish species (Carrasco *et al.*, 1972; Blanco, 1984; Blanco *et al.*, 2003; Soria, 1987; Vicente & Miracle, 1992; Miracle & Vicente, 1993). In this transitional period, the coastal sand barrier (the Devesa) was also partially urbanized (1967–1974) with a touristic development project launched during the Francoist dictatorship, that threatened the conservation of the ecosystem.

During the 1970s and 1980s, the degradation of the ecological conditions of the lagoon took place simultaneously to important institutional and social changes. The Albufera (its coastal lagoon, its Devesa and its rice crops) came to be seen as natural heritage. The “*Tot el Saler per al poble*” social movement claimed the public ownership of the Devesa. Both the lagoon and the sand barrier were under the jurisdiction of the Valencia City, so the City Council stopped the development project, started controlling the access to the coastal forest, and in 1980 created a technical service (OTDA) to restore the sand dunes and the pine forest the condition they were in prior to the urbanization project. A few years later, the new Autonomous Community of Valencian Country created the Natural Park of the Albufera of Valencia (1986) to give a legal identity, ensure conservation, and provide autonomous legal standing to the area.

Since the creation of the Natural Park, the management of the area has been clearly tugged in two directions: between agricultural and economic exploitation on one side and ecological conservation on the other, creating two different “frames” according to Mieke Hulshof's structural approach (Hulshof, 2012; Husholf & Vos, 2016). Too frequently, the two directions come into opposition. For example, just after the park was created, farmers' organizations and other businessmen created an association to fight against the legal restrictions imposed by the conservation institution. They took the case to court, and in 1992, the decree creating the Natural Park was annulled (however, it was reapproved in 1993). At other times, the two directions coincide with negotiations or empirical solutions, such as the use of pheromones to fight against plagues.

These two directions correspond not only to

two different social groups but, most of all, to different outlooks and relationships with nature. Nature conservation is perceived as a severe restriction by numerous farmers, whereas the ecologist organizations blame some farming practices for some detrimental changes to the wetland ecosystem (shorted flooding periods, low water levels, concrete lining of canals, etc). However, when they are interviewed, both groups share the mutual understanding of a common necessity to protect the wetland. Ecologists defend the critical role of rice paddies in the conservation of wetland fauna, whereas farmers acknowledge the added value that the wetland bestows to their rice production.

The lack or insufficiency of economic compensation for the ecosystem services provided by rice farmers hinders this convergence of interests. The recent reforms to the Common Agricultural Policy (CAP) specifically addressed these agro-environmental systems, have given specific economic support to sustainable farming practices developed within the Nature 2000 network. However, the Albufera farmers have publically threatened the administration with protests against the CAP agro-environmental subsidies if this aid involves forbidding certain practices, such as burning the straw after the rice harvest (Llorens & Dies, 2017). The economic compensation is not enough to abandon unsustainable practices.

### **INSTITUTIONAL FRAMEWORK WITH CRISS-CROSSED TOOLS AND JURISDICTIONS: WHAT ARE THE GOALS FOR WATER MANAGEMENT?**

The Albufera of the 1960s is unanimously considered by all the interviewees as the best state of the waterscape, while that of the 1980s saw the worst years, with dark water and massive fish death episodes in the irrigation channels and lagoon shores. One of the most important points to debate is the benchmark for ecological quality. Most stakeholders refer to the Albufera of 1960s as a model to restore. Hulshof and Vos (2016) called it the “idyllic landscape frame”. This opinion is shared not only by environmentalists but also by farmers and fishermen. The period is associated with bucolic collective memories,

such as swimming in the lagoon, eating fresh prawn cones, and the availability of drinkable spring water in the middle of the lagoon.

To return to the pristine conditions of the 1960s is also the management goal settled by the Júcar Basin Authority (*Confederacion Hidrografica del Júcar*), acknowledged after a participatory process that took place in 2004 (CHJ, 2004; 2016), which was also the basis for an ambitious research program (*Albufera Sostenible*) and for the planning of restoration projects in the hydraulic system. The *Albufera Sostenible* program established an exhaustive list of waterworks. This mission included the interception and treatment of the sewage systems surrounding the Albufera (mainly through the new *Colector Oeste* pipe), the construction of several storm tanks to capture polluted rainfall, and the creation of several artificial wetlands to act as green filters to renaturalize the treated wastewater (Martín, 2008; Mondría, 2010).

Unfortunately, the overlapping structure of administrative jurisdictions and responsibilities in the Albufera does not contribute positively to the facilitation of ecosystem management. Four main institutions act as decision makers, and share in the jigsaw of jurisdictions to create a “disorganized” (Interview 2014-4, see supplementary information at <http://www.limnetica.net/en/limnetica>)<sup>2</sup> system of water management. These are: the Autonomous Community Authority (*Generalitat Valenciana*), the Devesa-Albufera technical department of the Valencia City Council (the *Oficina Técnica Devesa-Albufera*), the Júcar Basin Authority (*Confederacion Hidrográfica del Júcar - CHJ*), and the Drainage Board (*Junta de Desagüe, JDA*).

Two of these bodies are more publicly visible, concerned mainly with ecosystem conservation. Some of their powers overlap, as do the locations that they manage:

- the Autonomous Community Authority (*Generalitat Valenciana*), through two institutions: one for natural areas management (Albufera Natural Park Authority) and one managing water treatment plants (EPSAR).
- Valencia City Council, the owner of the Devesa and the lagoon through its technical department: the *Oficina Técnica Devesa-Albufera*

The other two institutions are less visible but ultimately more powerful, and both are specifically concerned with water management.

- The Júcar Basin Authority (*Confederación Hidrográfica del Júcar - CHJ*), belonging to the Ministry of the Environment, is responsible for water management in all of the Albufera hydrographic basin.

- The “Drainage Board” (*Junta de Desagüe, JDA*) is a government board elected by all the farmers of the *tancats* area (polders), where all the municipalities sharing the *tancats* are represented, but the presidency is permanently held by the Valencia City Council. It was created at the beginning of the 19<sup>th</sup> century to control the water level of the lagoon and to facilitate drainage works (Sanchis, 2001). It controls the water level in the lagoon and rice paddies by means of sluice control in the three outlets (*goles*) and a pumping station at the Pujol outlet. The Spanish Water Law does not acknowledge this private management of a public water body, but the JDA argues that the Albufera is a private water body owned by the Valencia City Council.

The coastal lagoon, within its medieval boundaries corresponding to the rice fields, has been protected since 1986 by the Autonomous Community Authority. It was the subject of two protection plans before the current Pilot Plan for Use and Management was approved in 2008, after eight years of negotiations. But a part of that plan is not yet in action under a legal ruling. This part concerns different areas of protection, as construction threats are pressing on the coast. Moreover, the plan currently in force does not really deal with rules about water management. A new plan was outlined in 2013, including recommendations for water management, but it is also on hold. So, the park still waits for legal documentation to define water uses and protection levels.

Since the beginning of the last financial crisis the Park Authority has encountered great barriers to the mobilization of economic and human resources. In contrast, the technical department of Valencia City has maintained its resources with the support of European funds. During the last decade, this delineation has created a contrast between the areas managed by the Park Authority and the areas managed by the City Council

(Jégou, 2015), which partially explains the difference in ecosystem recovery rates between the Devesa and the lagoon and rice paddies, much more favourable to the dune barrier landscape.

As the Spanish central government owns all the water bodies (according to the 1986 Water Law), the CHJ allots water quantities to users, particularly to irrigator’s communities. The central government is also in charge of the construction of the main infrastructures of the sewer system.

Although water levels in the lake are controlled exclusively by farmers, other stakeholders have an interest in water management: fishing communities, hunters, touristic residents, ecology associations and foundations. Two associations are particularly active: *Acció Ecologista-Agró*, which has defended an interest in the park for years and is able to bring legal action; and the Community of Fishermen of El Palmar. Both groups are significantly affected by the fact that agriculture is the only criteria to control the water levels and the communication with the sea.

Information has not been publicly available about how water is managed within the lagoon, that is to say, how the water level is adjusted depending on the times of year, except that it is adapted for rice farming. The Drainage Board (JDA) does not reveal its timetable and has acted arbitrarily during the last decades. This has been tolerated by Valencia City Council until recently, and has generated conflicts with the other administrative bodies. In 2016, a professional fisherman sued the JDA for drying the drainage canals. In 2017 the attorney’s office ordered that control should lie with the Autonomous Community Authority, but it is not yet clear how this is going to be implemented. Therefore, on paper, it is now possible to ask for information about how the lagoon is regulated from the JDA.

This complicated situation for water management led Mieke Husholf (2012) to conclude that the Albufera is “stuck in fragmentation”. Water management in the lagoon is disconnected from protected area management: all the parameters are handled for rice growing, such as the water level in the lagoon and the water allotted to the area. From an institutional perspective, this is the most evident dysfunction of this socio-ecological

system. According to common-pool resources theory (Ostrom, 1990) collective management of shared natural resources requires following a reduced number of basic rules that are not respected in the Albufera. These rules include participation of all the users in decision-making processes affecting the collective wealth, which is also intrinsic to democratic societies. The current situation fails to conform to the Spanish legal framework, which considers all the surface water bodies as public wealth. It is also far from the spirit of the European Water Framework Directive, which advocates for the representation of all users in the management of water. In the Albufera, despite the collective societal interest, the water levels are managed as a private water body. This could be considered inertia or the remainder of a former “*médiance*”, in which rice production was the dominant activity that configured and defined the wetland system. This “*médiance*” does not exist anymore.

### MANAGING WATER QUALITY: PURSUING TRANSPARENCY

National and regional administrations made important investments in water treatment in the 1980s and 1990s to improve water quality in the ecosystem. Chlorophyll-*a* levels significantly decreased during the 1990s, and are still slowly decreasing, since 2016 even below the hypereutrophic levels.

However, the water quality has not improved sufficiently to meet sound ecological standards and this progress is not enough for conservationists. “*The improvement is stagnant. [...] For a decade, we have been in a period of improvement but we are stagnant [...]: the process is slower in an ecosystem so altered*” (Interview 2014-4, see supplementary information at <http://www.limnetica.net/en/limnetica>)<sup>3</sup>. If wastewater treatment plants and sewage pipelines were built around the park, with some having tertiary processing capable of removing some of the phosphorus and nitrogen, it would be possible to absorb all the urban water of the system.

However, the sewer transportation system remains inadequate: it is incomplete on the west shore of the Albufera and it cannot process storm-

water during downpours. The tertiary treatment is not fully efficient, even not in operation or existent in some places, and the treated water contains an excess of phosphorus that feeds chlorophyll production. Moreover, there are still some irrigation channels in the northern area receiving sewage from some urban areas, and directly discharging pollutants into the lagoon.

Green filters have been used in the lagoon since 2008 through three artificial wetlands (*la Pipa*, *Milia* and *l’Illa*) in place of rice field *tancats*. *La Pipa* was designed to restore part of the wetland which was going to be affected by a failed project of ravine channelization. It has produced significant educational and scientific results. *Milia* and *l’Illa* were designed to clean and renaturalize the water after initial processing in a treatment plant, as a part of the *Albufera Sostenible* project. They have never been connected to the sewage treatment plants and only filter water from the drainage channels of the irrigation system.

Clear phases were frequent at the beginning of the 21<sup>st</sup> century but they have been rare during the last decade. Fortunately, during the last two years a limited but significant bloom of macrophytes (*Potamogeton pectinatus*, *Najas marina*, *Ceratophyllum demersum*, *Myriophyllum spicatum*, *Potamogeton crispus*) has taken place in Spring and Autumn, interrupted by massive mortalities in Winter and Summer. These changes evince the lagoon’s capacity of self-regeneration, which was postulated on several occasions by professor Miracle. However, the lagoon mat-sediments trap significant levels of toxic heavy metals, and other researchers fear that an improvement of water quality and a decrease in pH could activate all the heavy metals accumulated at the bottom of the lagoon (Martín-Monerris, 1998). This has been defined by some experts as a Damocles’ sword over the wetland (Llorens & Dies, 2017).

Flushing operations during clear phases may provide a tool for water renovation. According to some interviewees, this requires a sound and coordinated management, integrating all the system users: “*We don’t think it could be resolved with less water, but the management is lacking consultation between authorities: for example,*

*there are two crucial periods for the lagoon, which are well known. If the Albufera would have enough good water during those crucial periods, we could achieve recovery of part of the submerged meadows. For that, it's necessary to involve the rice farmers and environmental stakeholders of the area*" (Interview 2014-5, see supplementary information at <http://www.limnetica.net/en/limnetica>)<sup>4</sup>.

The relationship between water quality and quantity is an important issue. Pollution concentrates when water quantities are low. Lagoon water was renovated 21 times per year between 1971 and 1981, but only 10 times per year between 1999 and 2009 (Mondriá, 2010). This change is, together with the temporary suspension of the construction of the sewage transportation networks, the major factor explaining the very limited progress in water quality during the last years. This connection between quantity and quality tends to be regularly mentioned by environmental associations and researchers (Husholf & Vos, 2016).

## WATER QUANTITY DILEMA

During the decade prior to the creation of the Natural Park, the lagoon annually received 300 hm<sup>3</sup> from the Júcar River, and 200 hm<sup>3</sup> from the Turia River, wastewater and other sources: a total of 500 hm<sup>3</sup>. 20 years later, between 2000 and 2009, the Júcar River only provided more than 100 hm<sup>3</sup> during the wet years and despite the increase in treated wastewater, the total water input has never reached 300 hm<sup>3</sup> (Mondriá, 2010). The wetland has lost the 40 % of its water input in 30 years, and treated wastewater has increased significantly, whereas "natural sources" proportionally decrease. Is this the start of a new *médiance*?

Water quantity has decreased because the lagoon is the last water body in the Júcar Basin, in geographical order, following the river flow, before the waters reach the sea. The wetland is affected by recurrent drought periods, but beyond this temporary scarcity, the Albufera is threatened by the structural deficit of the Júcar basin, estimated to be 195 hm<sup>3</sup> per year in the current Basin Water Plan (2015-2020). The Júcar River

district is, in fact, a well-known case of basin closure (Molle *et al.*, 2010; Avellà *et al.*, 2014) with a substantial imbalance between "paper water" (official allocations) and real water, due to the recent disproportioned expansion of uses and the overestimation of basin resources in the water planning cycle of 1998 (CHJ, 1998). This quantitative perception of water is not accepted for some stakeholders: "*They consider the river as water. It's the same to say the forest is only timber, but the river is obviously not only water*" (Interview 2014-8, see supplementary information at <http://www.limnetica.net/en/limnetica>)<sup>5</sup>.

According to the recent official water basin plans, the water allocated to the lagoon has increased in the last two decades. The 1998 Basin Plan estimated 100 hm<sup>3</sup> as water necessities for the Albufera. Ten years later, the Basin Plan of 2008 allocated 167 hm<sup>3</sup>, the percentile 95 % of the historical series estimated in the study for sustainable development of the Albufera (CHJ-TYPSA, 2004). The current Water Basin Plan (2015-2020) has allocated 210 hm<sup>3</sup>, adding some winter flows from Júcar and Turia basin to the historical surface and groundwater inputs, and to the irrigation return flows.

Does this mean that the Albufera has been receiving an increasing volume of water during the last two decades? Unfortunately, not. Or at least this is the perception of most of the agents involved in the management of the Albufera. Most of them express the opposite opinion. "*During one of the last meetings, there was a consensus: the Albufera gets less water and needs quality water from the Júcar. This is established by the law*" "*All is regulated on the paper but is not achieved*" (Interview 2014-5, see supplementary information at <http://www.limnetica.net/en/limnetica>)<sup>6</sup>. And the gauging stations installed since 2014 by the regional government in the main 15 irrigation channels never have measured more than 100 hm<sup>3</sup> per year.

In any case, there is no way to easily check the water budget, because the Natural Park does not have a complete gauging network. The Basin Júcar Authority only can estimate indirect sources analyzed through management models and the Drainage Board JDA does not make available information on water levels and water pumped to



the sea. Moreover, these allocations are below the estimations of the necessities of the lagoon, which have been calculated to be 265 hm<sup>3</sup> per year (Soria & Vicente, 2002). The lack institutional engagement for an ecological flow is regularly discussed in interviews: “*Who decides how much water is allocated for the Albufera? The basin plan does not specify that. Someone needs to issue a mandate for that. We need to do it*” (Interview 2014-6, see supplementary information at <http://www.limnetica.net/en/limnetica>)<sup>7</sup>.

According to the Water Framework Directive, the Albufera is an obligatory restriction for the whole Júcar system, but in practice, it is still the last in the queue, and the agricultural demands are given priority. The environmental water quality objectives established by the WFD for the Albufera do not have to be fulfilled until 2027. Postponing these objectives could be realistic, but it also bestows certain flexibility to the administration to manage the system, and to preserve the priority of the farming sector of the whole Júcar basin, which suffers from enormous political pressure.

The current deficit of the Júcar basin could increase in the next decades due to climate change processes. The Júcar Basin Authority has estimated a 12 % decrease in water resource availability in the whole Júcar basin, whereas other possible scenarios (Marcos-García *et al.*, 2017) have calculated higher decreases in rainfall and water resource availability for 2030. In this possible context, how could the necessities of the Albufera be guaranteed? Will it be possible to maintain the freshwater stage? Some authors have detected significant soil salinity at the rice paddies, and have identified a subsurface flow from the Mediterranean Sea that varies depending on the irrigation practices. This flow produces a salinization of soil horizons in depth, and it is weaker in the southern area, because of the river Júcar water (Moreno-Ramón, 2013; Moreno-Ramón *et al.*, 2015). Moreover, some conservationists link the recent increase of flamingo populations as a possible sign of rising salinity. Are the *Albufera Sostenible* (2004) objectives really possible or even desirable under these dramatically different conditions? Or should ecosystem management start a process of adapta-

tion to a new scenario of salinity in a few years? And finally, as Moreno-Ramón (2013) suggested: Are the *tancats* still sustainable or will renaturalization be required to control the increasing salinity?

## BUILDING CONFIDENCE FOR SHARED GOVERNANCE

Since the creation of the Natural Park, social consensus about protection has significantly increased. Protection and natural heritage are now linked: the people of Valencia cherish the wetland, its Devesa and its lagoon, as a protected area. Citizens appear to be more involved, with an increasing number of visitors and local participation in cultural and educational activities. There are new organizations and companies working in environmental tourism (especially birdwatching), foundations such as *Assut* (since 2010) developing awareness of the wetland values through dissemination programs and NGOs such as SEO-Birdlife, or Global Nature and *Acció Ecologista-Agró*, both taking care of the artificial wetlands of *Milia* and *La Pipa* respectively. Other new associations such as *Xuquer Viu* (created in 2003) are committed to solving water quantity problems, promoting a living Júcar river at the basin scale for ecosystems and humans, with fresh flowing water. Two Life programs, fully or partly dedicated to environmental education, have been very successful in recent years –“Environmental Seduction” and “Life Albufera”– facilitating mass visits to the Devesa and to the *La Pipa* green filter.

During the last decade, a number of areas of debate have arisen, drawing attention to the valuable social capital of the Albufera. A citizens’ association “*Fira de l’Albufera*” was created in 2011 in order to organize an annual meeting for associations, institutions and inhabitants of the Albufera. This association was configured as a tool for social and cultural dynamization and also as a forum for informal discussion among stakeholders. Six *Fira de l’Albufera de Valencia* events were organized between 2011 and 2016, but unfortunately none in 2017.

Despite this growing social interest and involvement, the park’s management lacks of

social and political debate across many aspects of decision-making. There is an assembly with a consultative role only, the *Junta Rectora*, but its meetings are scarce. In order to break this isolation, the *Junta Rectora*, in cooperation with the Universitat de València organized an open Symposium in 2016, “*L’Albufera, Ara*”, followed by a public exhibition on the history of the civil fight to recover the Devesa.

During this symposium, water management was the most controversial issue. It became evident during the meeting that there was complete lack of a common route sheet for water management, neither for future needs nor for day-by-day practices. Currently, the main stakeholders (River Basin Authority, Autonomous Community with the three authorities concerned, Valencia City Council, researchers from Life Albufera) are working on a new Special Plan, centered on water management. They have begun to meet regularly but there are no concrete results for the moment, and no public dissemination of the debates and progress.

## CONCLUSIONS

The most exceptional value of the Albufera is not the internationally recognized birdlife, but its unique water system with its complex mechanisms and its specific set of agro-ecosystems, which is worth conserving and making sustainable. This heritage dimension, thanks to the attachment of the people of Valencia to their Albufera, is the most significant lever for achieving greater sustainability, but also a demanding challenge for managers.

The Natural Park was created to increase sustainability and conservation of the ecosystem. However, management has been marred by unsustainable dynamics and most of all political, institutional and financial inertias (Jégou, 2015). The resulting jigsaw of jurisdictions and stakeholders has dramatically hindered transparency and decision sharing. The key goals of water management and governance principles are unclear and not common to all stakeholders. One of the most evident examples of this lack of transparency and decision sharing is the determinant role still played by the Drainage Board.

Despite this inconsistent institutional context, the lagoon and its Devesa have undergone significant improvements during the last decades. The socio-ecological system should achieve higher sustainability through the implementation of transparency, conciliation and shared actions of water management. Transparency can describe the governance as well as the water quality, as if water quality reflects governance quality. If the governance remains murky, so does the water. This interpretation stems from the “corps médial” of Augustin Berque, the ecosystem being a representation of society, its mesological body (Berque, 1996).

Transparency, conciliation and shared governance require the reformulation of the institutional architecture of the wetland. The recent experience shows that the formula of the Natural Park has been useful to improve wetland conservation and increase environmental awareness, but is insufficient to manage the whole SES, in which other institutions are involved. The integration of all the institutions managing the Albufera through a transversal coordination office is recommended, to move beyond the current fragmentation.

Moreover, mediation is absolutely necessary. Any mediation has remained informal until now. The creation of a permanent observatory, based on the emerging social capital of the wetland, could be the basis with which to strengthen the approach between the two frames –conservationist and productivist - traditionally opposed in the wetland.

This is particularly significant in the current and uncertain environmental context, defined by highly demanding scenarios of climate change and lack of fluvial resources. The threat of increasing salinity could bring into question the mentioned goal of bringing back the Albufera to the idyllic 1960 stage. Most likely, according to the current water resource availability, the challenge is to find the best way to adapt the ecosystem (with the highest water quality levels) to a new hydro-social scenario, instead forcing the system back in time to a past *médiance*.

## ACKNOWLEDGEMENTS

First of all, we address special thanks to Maria Rosa Miracle for her greeting support and insight.

Many thanks to Eduardo Vicente for his support and for inviting us in this tribute for Professor Miracle. We thank also all the stakeholders we met, for sharing their knowledge of Albufera and for their support in this research. Last but not least, we thank María Sahuquillo and the two anonymous reviewers.

## REFERENCES

- ALFONSO, M. T. & M. R. MIRACLE. 1990. Distribucion espacial de las comunidades zooplanctónicas de la Albufera de Valencia. *Scientia Gerundensis*, 16(2): 11-25.
- ANDERIES, J. M., JANSSEN, M. & OSTROM, E. 2004. A Framework to Analyze the Robustness of Social-ecological Systems from an Institutional Perspective. *Ecology and Society* 9(1): 18.
- ANDERIES, J. M.; FOLKE, C.; WALKER, B; OSTROM, E. 2013. Aligning Key Concepts for Global Change Policy: Robustness, Resilience, and Sustainability. *Ecology and Society* 18 (2): 8.
- AVELLÀ, L.; M. GARCÍA-MOLLÀ & C. SANCHIS-IBOR. 2014. *Problemática del sistema de explotación del Júcar en el contexto de los planes hidrológicos de cuenca (1998-2008)*, Congreso Nacional del Medio Ambiente, Madrid.
- BERKES, F., & C. FOLKE (eds). 1998. *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*. Cambridge University Press, New York.
- BERKES, F.; COLDING, J.; FOLKE, C. 2003. *Navigating Social-ecological Systems: Building Resilience for Complexity and Change*. Cambridge, UK: Cambridge University Press.
- BERQUE, A. 1990. *Médiance. De milieux en paysages*, Montpellier, Reclus Belin.
- BERQUE, A. 1996. *Être humains sur la terre. Principes d'éthique de l'écoumène*, Paris, Gallimard.
- BLANCO, C. 1984. *Estudio de la contaminación de la Albufera de Valencia y los efectos de dicha contaminación sobre la fauna y flora del lago*, PhD Thesis, Universitat de València.
- BLANCO, S., S. ROMO, M. J. VILLENA & S. MARTÍNEZ. 2003. Fish communities and food web interactions in some shallow Mediterranean lakes. *Hydrobiologia*, 506-509: 473-480
- CARRASCO, J. M., P. CUÑAT, M. MARTÍNEZ, R. M. MARTÍNEZ E. & PRIMO. 1972. Contaminación de la Albufera de Valencia. I. Niveles de contaminación por insecticidas, *Revista de Agroquímica y Tecnología de los Alimentos*, 12 (4): 583-596.
- CHJ. 2016. *Plan Hidrológico de Cuenca*, Confederación Hidrográfica del Júcar, <https://www.chj.es/es-es/medioambiente/planificacionhidrologica/Paginas/PHC-2015-2021-Plan-Hidrologico-cuenca.aspx>.
- CHJ-TYPSA. 2004. *Estudio para el desarrollo sostenible de l'Albufera de Valencia*, Confederación hidrográfica del Júcar-TYPSA, <http://www.albufera.com.es>.
- FOLKE, C. 2006. Resilience: The emergence of a perspective for social-ecological systems analyses, *Global Environmental Change*, 16 (3) 253-267
- GARCIA, M. P.; E. VICENTE & M. R. MIRACLE. 1984. Sucesión estacional del fitoplancton de La Albufera de Valencia. *Anales de Biología*, 2 (2): 91-100.
- GARCIA MONERRIS, C. 1983. *Rey y Señor. Estudio de un realengo del País Valenciano (La Albufera, 1761-1836)*, Valencia, Ayuntamiento de Valencia
- HULSHOF, M. 2012. *Stuck in fragmentation. The Albufera de Valencia: A case study on regime formation*. Wageningen University and Research Center, Universitat Politècnica de València.
- HULSHOF, M. & J. VOS. 2016. Diverging realities: how framing, values and water management are interwoven in the Albufera de Valencia wetland in Spain, *Water International*, 41 (1): 107-124. DOI: 10.1080/02508060.2016.1136454
- KAUFMANN, J. C. 1996. *L'entretien compréhensif*, Paris, Armand Colin.
- JANSSEN, M. A.; ANDERIES, J. M; OSTROM, E. 2007. Robustness of Social-Ecological Systems to Spatial and Temporal Variability, *Society & Natural Resources*, 20 (4) 307-322.
- LARRERE, C. 2010. Les éthiques environne-

- mentales. *Nature, Sciences, Sociétés*, 18 (4): 405-413
- LLORENS, V. & B. DIES, 2017. *Trenta anys, trenta mirades*, Edicions 96 - Fundació Assut.
- MARCO BARBA, J., 2009. *Ecología y geoquímica de ostrácodos como indicadores paleoambientales en ambientes marginales marinos: un ejemplo de estudio, la Albufera de Valencia*. PhD Thesis. Universitat de València.
- MARCO-BARBA, J., J. A. HOLMES, F. MESQUITA-JOANES & M. R. MIRACLE. 2013. The influence of climate and sea-level change on the Holocene evolution of a Mediterranean coastal lagoon: evidence from ostracod palaeoecology and geochemistry. *Geobios*, 46 (5): 409-421. DOI: 10.1016/j.geobios.2013.05.003
- MARTIN MONERRIS, M. 1998. *Modelación de la calidad en aguas superficiales. Aplicación al caso de la Albufera de Valencia*. Tesis Doctoral. Universitat de València.
- MARTIN MONERRIS, M. 2008. El sistema de filtros verdes del Tancat de la Pipa. *Ambienta: la revista del Ministerio de Medio Ambiente*, 83: 53-56.
- MIRACLE, M. R. 2012. Les fases clares en l'Albufera: una via per la seua recuperació. In *La universitat de València i els seus entorns naturals: els parcs naturals de l'Albufera, el Túria i la Serra Calderona*, Universitat de Valencia, 96-99
- MIRACLE, M. R., J. M. SORIA, E. VICENTE & S. ROMO. 1987. Relaciones entre la luz, los pigmentos fotosintéticos y el fitoplancton en la Albufera de Valencia, laguna litoral hipertrofica. *Limnetica* 3: 25-34.
- MIRACLE, M. R. & E. VICENTE. 1993. El proceso de contaminación de la Albufera de Valencia: carga de nutrientes y materia orgánica. In A. Rincón de Arellano (dir.) *Medio ambiente y salud*, Real Academia de Medicina de Valencia, Fundación Cañada Blanch, 107-128.
- MIRACLE, M. R. & M. SAHUQUILLO. 2002. Changes of life-history traits and size in *Daphnia magna* during a lear-water phase in a hypertrophic lagoon (Albufera of Valencia, Spain). *Verhandlungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie*, 28: 1203 – 1208. DOI: 10.1080/03680770.2001.11902644
- MONDRÍA, M. 2010. *Infraestructuras y eutrofización en l'Albufera de València*. El modelo CABHAL. PhD Thesis. Universitat Politècnica de València.
- MOLLE, F., P. WESTER & P. HIRSCH. 2010. River basin closure: Processes implications and responses. *Agricultural Water Management*, 97: 569–577. DOI: 10.1016/j.agwat.2009.01.004
- MORENO-RAMÓN, H. 2013. *Evaluación espacio-temporal de las aguas y suelos de la zona colindante al lago de la Albufera de Valencia: Intento de recuperación*, PhD Thesis, Universitat Politècnica de València.
- MORENO-RAMÓN, H., À. MARQUÉS-MATEU, S. IBAÑEZ ASENSIO & J. M. GISBERT BLANQUER. 2015. Wetland soils under rice management and seawater intrusion: Characterization and classification. *Spanish Journal of Soil Science*, 5(2): 111-129. DOI: 10.3232/SJSS.2015.V5.N2.02
- OLTRA, R., M. T. ALFONSO, M. SAHUQUILLO & M. R. MIRACLE. 2001. Increase of rotifer diversity after sewage diversion in the hypertrophic lagoon, Albufera of Valencia, Spain. *Hydrobiologia*, 446/447: 213-220.
- OSTROM, E. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge, UK: Cambridge University Press.
- ONANDIA, G., M. R. MIRACLE & E. VICENTE. 2014. Primary production under hypertrophic conditions and its relationship with bacterial production. *Aquatic Ecology*, 48 (4): 447-463. DOI: 10.1007/s10452-014-9497-9
- ONANDIA, G. A. GUDIMOV, M. R. MIRACLE & G. B. ARHONDITIS. 2015. Towards the development of a biogeochemical model for addressing the eutrophication problems in the shallow hypertrophic lagoon of Albufera de Valencia, Spain. *Ecological Informatics*, 26(3): 70-89. DOI: 10.1016/j.ecoinf.2015.01.004
- RODRIGO, M. A., J. L. ALONSO-GUILLÉN, S. CIRUJANO & I. SOULIÉ-MÄRSCH. 2009. Aproximación a las comunidades de carófitos que existieron en la Albufera de Valencia a partir del estudio de las oósporas del sedimen-

- to. *Anales del Jardín Botánico de Madrid*, 66 (2), 195-208
- ROMO, S. & M. R. MIRACLE. 1993. Long-term periodicity of *Planktothrix agardhii*, *Pseudonabaena galeata* and *Geitlerinema* sp. in a shallow hypertrophic lagoon, the Albufera of Valencia (Spain). *Archive Hydrobiologie*, 126: 469-486.
- ROMO, S. & M. R. MIRACLE. 1994a. Long-term phytoplankton changes in a shallow hypertrophic lake, Albufera of Valencia (Spain). *Hydrobiologia*, 275-276: 153-164.
- ROMO, S. & M. R. MIRACLE. 1994b. Population dynamics and ecology of subdominant phytoplankton species in a shallow hypertrophic lake (Albufera of Valencia, Spain). *Hydrobiologia*, 273: 37-56
- ROMO, S., A. GARCIA-MURCIA, M. J. VILLENA, V. SANCHEZ & A. BALLESTER. 2008. Tendencias del fitoplancton en el lago de la Albufera de Valencia e implicaciones para su ecología, gestión y recuperación, *Limnetica*, 27 (1): 11-28
- SANCHIS IBOR, C. 2001. *Regadiu i canvi ambiental a l'Albufera de València*, Publicacions de la Universitat de Valencia.
- SANCHIS IBOR, C., A. JÉGOU & P. PECH. 2008. L'Albufera de Valencia. Une lagune de médiane en médiane, *Géographie et cultures*, 63: 5-22. Online: <http://gc.revues.org/1593>
- SERRA, M., M. R. MIRACLE, & E. VICENTE. 1984. Interrelación entre unos parámetros fisicoquímicos y biológicos de la Albufera de Valencia. *Limnetica* 1: 9-19.
- SORIA, J. M. 2006. Past, present and future and future of la Albufera de Valencia Natural Park. *Limnetica*, 25 (1-2): 135-142
- SORIA, J. M., M. R. MIRACLE y E. VICENTE. 1987. Aporte de nutrientes y eutrofización de la Albufera de Valencia. *Limnetica*, 3: 227-242.
- SORIA, J. M., E. VICENTE & M. R. MIRACLE. 2001. The influence of flash floods on the limnology of the Albufera of Valencia lagoon (Spain). *Verhandlungen der Internationalen Vereinigung für Theoretische und Angewandte Limnologie*, 27: 2232-2235. DOI: 10.1080/03680770.1998.11901635
- SORIA, J. M., M. R. MIRACLE, & E. VICENTE. 2002. Relations between physico-chemical and biological variables in aquatic ecosystems of the Albufera Natural park (Valencia, Spain). *Verhandlungen der Internationalen Vereinigung für Theoretische und Angewandte Limnologie.*, 28: 564-568. DOI: 10.1080/03680770.2001.11901780
- SORIA, J. M. & E. VICENTE. 2002. Estudio de los aportes hídricos al parque natural de la Albufera de Valencia, *Limnetica*, 21 (1-2): 105-115
- SORIA, J. M., M. SAHUQUILLO & M. R. MIRACLE. 2005. Relaciones entre las aportaciones a la zona regable del río Júcar y la conductividad de la Albufera de Valencia. *Limnetica*, 24 (1-2): 155-160.
- VICENTE, E. & M. R. MIRACLE, 1988. Estructura y función de los procariontes en dos ecosistemas lagunares costeros: L'Albufera de Valencia y L'Estany de Cullera, *Biología ambiental: Actas del Congreso de biología ambiental* (II Congreso Mundial Vasco), 79-108
- VICENTE, E. & M. R. MIRACLE. 1992. The coastal lagoon Albufera de Valencia: an ecosystem under stress. *Limnetica*, 8: 87-100.