



Improving the management of large protected wetlands: Learning the lessons from the Doñana nature reserves.

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Abstract

The Doñana National Park (Guadalquivir estuary, SW Spain) enjoys international credit as a major wintering and stopover area for a wide array of migratory birds. However, the Park suffers from ever-increasing degradation caused by its position in a heavily used area and the concurrent inadequacy of the Park's management practices. In this paper, we analyse the water use structure and its associated decision-making network for the Guadalquivir watershed. Current fragmentation in both the praxis and the conceptualisation of water use and management is found to underlay the above-described degradation process. We then elucidate the origins and consequences of this fragmentation by:

- (a) describing the historical process behind the construction of socio-nature in the Guadalquivir watershed;
- (b) mapping the institutional and socio-technical organisation of the Doñana nature reserves management (National Park, Natural Park and Biological Reserve), and situating it in the framework of Spanish territorial and environmental management.

Finally, we use an Ecological Water Management methodological framework to identify directions for improving the Park's management: integrating Doñana in its watershed, establishing a global framework for nature conservation and creating an institutional framework for strategic management.



1 Introduction

'Science consist not in the accumulation of knowledge, but in the creation of fresh modes of perception.' (D. Bohm, 1993)

The world faces a wide range of economic and human health crises related to inadequate access to, or inappropriate management of, clean fresh water. Inefficient technologies and applications, the inequitable allocation of limited water supplies and the continuous increase in pollutant inputs have resulted in depleted water resources, widespread water quality degradation and a wide range of unanticipated ecological and economic impacts (Gleick⁴). This has resulted in increased regional conflicts over water, ecological degradation and unhindered spread of water-related diseases.

The need for innovative approaches in the preservation and wise management of the remaining water resources has been broadly acknowledged. Incorporating sustainability and equity in the use of water resources has become a major policy objective. This requires placing a high value on maintaining the integrity of water resources and the flora, fauna and human societies that have developed around them⁴.

However, the definition and implementation of sustainable water use policies is proving increasingly difficult. A recent report by the Ecological Society of America¹ acknowledges that 'in practice, management approaches have often focussed on maximising short-term yield and economic gain rather than long-term sustainability'. They attributed this disparity to 'several obstacles', which can be mapped into three categories: insufficient knowledge and information, lack of public awareness and inadequate institutional frameworks (which do not fit the openness and interconnectedness of ecosystems).

An additional limitation stems from the insistence on the use of 'hard' approaches to manage socio-natural resources. They are based on the assumption that technology is value-free and, if scientists could feed 'perfect' information on the 'external reality' to managers and policy makers, and keep the public informed, management goals will be naturally met. This 'linear model of the role of science in society' has tended to result in naive schemes for technology implementation and transfer (Röling⁶). Instead, we believe that a major change in the use of water resources can only be achieved by continuous re-negotiation among a 'soft' platform of stakeholders (*sensu* Röling⁶). Indeed, other authors have already shown that the management of water resources in the Mediterranean region has always been the arena for continuous re-negotiation between actors pursuing their own interests (e.g. Swyngedouw⁹).

The question is: how to dissolve the dualism between the hard (natural) and soft (social) sciences and create integrated platforms for resources management? Röling⁶ defends the use of 'coupled systems, comprising a 'hard' ecosystem and a 'soft' platform for decision making', to overcome their 'totally different epistemologies.' Alternatively, 'hard' scientists could accept the constructivist nature of human knowledge and move to a post-Newtonian perspective to resource management⁶. The latter approach involves the



dissolution of the dualism between nature and society/culture, an issue largely debated by human geographers (Gerber³). New, integrated views have been advanced from the deconstruction of the concept of 'nature', proposing the (social) construction of an integrated socio-natural system⁹.

Here, we will use the low Guadalquivir area to exemplify the limitations of building policy scenarios that do not pay attention to human decision-making. First, we will review the creation of the socio-natural hybrid in the Guadalquivir watershed, and the conflicting worldviews it involves. We will make the case that the current hybrid is rooted in a fragmented view of resources management, in which separate stakeholders develop hard management approaches that fail to accommodate the necessities of other stakeholders. As a way to overcome the current situation, we propose the creation of a coupled-system platform (*sensu* Røling⁶). The role of this platform will be to facilitate the re-negotiation among the different institutions and actors, activating a process of generation of the scientific and technological aids for the emerging management goals.

2 The Guadalquivir estuary and its Nature reserves.

The Doñana National Park (Guadalquivir estuary, SW Spain) enjoys international credit as a major wintering and stopover area for a wide array of migratory birds. In addition, it is one of the last strongholds of many endangered species, included the world's most threatened cat (the Iberian Lynx) and the rare Imperial eagle. It is the largest Spanish National Park, and for many it represents one of the last natural European ecosystems, unspoiled by man and left to the wise hand of Nature.

However, the Park suffers from ever-increasing degradation caused by its position in a heavily used area and the concurrent inadequacy of the Park's management practices. Outside of the Park, large pyrite mines pollute the inflowing waters and threaten to pollute the groundwater. The estuary supports rich, active fisheries, but most urban and industrial sewage upstream is not treated. Tourist development has degraded large areas, affecting the groundwater supplies and polluting the coastal waters. In addition, stakeholders promoting tourism continuously demand expansions of the road system, which threatens the Park's fauna and profoundly damages the vegetation cover. Agricultural development resulted in the conversion of two thirds of the marsh to irrigated crops and rice fields. These are important sources of diffuse water pollution, and the pesticides utilised are bio-accumulated by the aquatic fauna (including species consumed by humans) and the waterfowl (which often feed outside the Park). Most of the watershed water is used for agriculture, and the powerful agricultural and water-engineering lobby resents the Park's demands for a sufficient (and clean) water supply. Over-hunting and poaching is frequent inside and outside the Park, and difficult to control since the surrounding landowners consider the Park to be a threat to their interests. Eucalyptus plantations take another share of the groundwater, and create unsuitable habitats for the wildlife. Free-ranging cattle roam the Park, overgrazing its vegetation and spreading bovine tuberculosis to the wild game. However, owners refuse to give up their



traditional rights to graze cattle in communal land. Inside the Park, there is heated discussion between those who want to optimise its natural values and those who want to maximise the number of visitors, part of the Park's mandate.

The conflict of interests among the different stakeholders and nature conservation officials has created considerable friction. Despite increasing investments in conservation, the Guadalquivir estuary suffers recurrent environmental hazards that are a manifestation of continued ecosystem health deterioration. The situation seems deadlocked in mutual distrust and crossed accusations, including lawsuits following every publicised environmental hazard.

In 1992, it was recognised that the National Park could not be considered an isolated management unit. The Andalusian Government appointed a commission of experts, who produced a set of policy recommendations for the region's sustainable development. These recommendations were used to attract EU funding. Six years later, most of these funds have been spent in old-fashioned development activities (such as infrastructures for water supply, irrigation, roads/highways and tourism, respectively comprising 31%, 21%, 25% and 2% of the total budget), including the small percentage dedicated to 'environment' (9% of the budget, of which 14% will be used to build a waste-treatment plant in Huelva, 24% to forest management and 60% to 'ecosystem restoration' outside the reserves). A platform for decision-making was also created (the 'Patronato'), which would take into account the various interests and provide opportunity for conflict resolution, negotiation, consensus-building and concerted action. However, the platform quickly became driven by political interests, chaired by politicians and controlled by the Central Government. Soon the Patronato was blocked by the very same conflicts of interests among institutions and stakeholders that motivated its creation.

It is clear that managing the Guadalquivir estuary and the Doñana nature reserves is by no means a question of technical intervention, but it requires accommodation between human actors who use the same natural environment for different purposes. The 'hard' ecosystem can only be managed by the development of a 'soft' platform for purposive action among diverse stakeholders. European and Spanish regulations will still be necessary to create the drive that will conduce individual actions towards sustainability. However, the attempts to identify a 'best solution' through 'hard' observation and analysis and then impose it linearly to the actors through institutional decision-making has only aggravated the fragmentation and polarisation of the user's views.

3 The socio-natural hybrid

The Coto de Doñana (Guadalquivir marshes) was one of the best hunting resorts used by the land oligarchy, which owned and ruled Spain until this century. Most of the Coto was owned by a handful of aristocrats and used almost exclusively for hunting. This spared the Doñana ecosystems from degradation, and they reached the onset of the 20th century in a fairly pristine state. Between 1940 and 1990, however, two thirds of the Guadalquivir marshes were drained and



transformed into cereal crops and rice fields. Most bushes and woods in the surrounding Coto were also transformed into Eucalyptus plantations.

Following the announcement of the plans to drain the marshes and transform them into arable land (1941-48), national and international pressure mounted to stop their complete destruction. This pressure involved the acquisition or small parcels of the marshland by the WWF (1966). The Spanish Government then decided to spare roughly one third of the marsh and adjacent land. They were included into a new protected area, the Doñana National Park (created in 1969). The land acquired by the WWF constituted the Doñana Biological Reserve (RBD), managed by a research institute integrated in the Spanish National Research Council (CSIC). Though it was placed in the core of the National Park, the RBD kept a separated administration and warden service.

The region around the Doñana National Park was dramatically transformed by the accelerated and disorganised development that characterised the 1950s-1990s period in Spain. The application of conflicting land use strategies by the different authorities and stakeholders caused continuous friction and the area became intensely polarised. What follows is a story of that polarisation, with an emphasis on water management and nature conservation.

3.1 Nature's short-term production

The Administration of the Spanish National Parks was integrated into the Nature Conservation Institute (ICONA), until its transfer to the Ministry of Environment in 1996. The ICONA was a section of the Ministry of Agriculture, set up to manage the production of non-agricultural ('natural') systems through forestry, hunting and fishing. Following the short-term production approach of the time, the ICONA forest engineers transformed natural forests into pine and Eucalyptus plantations for the production of wood and paper pulp. They introduced exotic fish and game species to increase angling and hunting sport activities. They also enforced the shooting and poisoning of raptors and other predators, in an attempt to increase game productivity. This policy resulted in recurrent environmental problems that endure until today, such as the poisoning of protected/endangered species and the yearly onset of provoked forest fires.

Hindered by the engineers' drive for short-term production, the Spanish National Parks Administration never had a chance to modernise their aims and technologies. Most major conservation problems in the Doñana National Park are rooted in the persistence of these outdated management practices:

1. The devastating impact of introduced species, particularly in the aquatic ecosystems (American red-swamp crayfish, black bass, gambusia, pumpkinfish).
2. The overgrazing of the vegetation by a herbivore community that has been released of all its major predators. This is worsened by the abundance of an introduced herbivore (Fawler Deer) and by the presence of free-ranging cattle.
3. The uncontrolled hunting of migratory waterfowl in the agricultural areas that surround the National Park⁵ and the widespread poaching of wild boar and deer inside it. The latter often results in the death of endangered species.²



4. The insistence of the Park's management in maximising 'public use' (i.e. the number of visitors) through major construction works (large visitor's centres) and motorised visits to the protected areas.
5. The excessive focus on 'producing' as many individuals as possible of a handful of protected vertebrate species, in a way that uncouples these species from their ecosystems. The populations of these species are maintained well over the ecosystem's carrying capacity within the Park, while the degradation of the immediate surroundings prevents their expansion to other areas.

3.2 The Natural Park

The former buffer zone of the Doñana National Park ('Preparque') recently became the Doñana Natural Park, adding up to the high number of organisations managing the Guadalquivir lowlands. Natural Parks are managed by their respective Regional Administration, and land use is regulated through agreements with the owners. Born under the shadow of a worldwide famous National Park and faced with a fairly limited budget, the Natural Park is still striving to justify its existence. Since the Andalusian Government claims the administration of the Doñana National Park, the National Park service fears for its existence (particularly after the disappearance of the ICONA in the 90s). Hence, National and Natural Park soon engaged in continuous frictions. Both institutions have also a difficult relationship with the Doñana Biological Station, which takes considerable conservation and management responsibilities.

3.3 The Spanish puzzle: managing the water resources

The Doñana National Park is also immersed in the mosaic of power and decision making that characterises water resources management in Spain. The Spanish central Administration in Madrid (formerly the Ministry of Public Works, since 1996 the Ministry of Environment) controls general planning and major investments in infrastructures, including the design and implementation of the National Hydrological Plan. River management and the collection of hydraulic and hydrologic data are responsibilities of several River Authorities (Confederaciones Hidrográficas) traditionally manned by the exclusive Engineering Corps. Decisions that affect water quality are mostly taken by Regional Governments and implemented by their Agencies (Andalusian Agencies of Industry, Mines, Agriculture and Environment, for most of the Guadalquivir River). None of the above-mentioned authorities is in charge of producing an integral water management plan for the Guadalquivir watershed.

It is important to note that the water management structure in Spain is the result of a century of power struggle between radically different resource-management ideologies⁹. By struggling to 'naturalise' political territorial organisation (the process that created the River Authorities), the engineering community challenged the regional and central power of traditionalist oligarchs and politicians. Hence, the co-existence of different management institutions and



parallel hierarchies is not an historical accident, but indicates a radical lack of co-ordination and shared goals.

The misunderstanding and lack of co-ordination between the above-mentioned institutions has become evident several times, e.g. during the recent toxic spill of the Los Frailes pyrite mines. The different authorities failed to prevent the spill and to treat it adequately. The Guadalquivir River Authority failed to link water pollution upstream with water uses downstream: risks were not assessed, an emergency plan was never prepared and its officials were repeatedly lenient in their inspections to the dam that contained the toxic residuals. The Directorates of Industry and Mines were more concerned about unemployment than about the potential damage to agriculture, fisheries and public health. Following repeated pollution events that forewarned the 1998 catastrophe, they still granted the mining company with a large (European) subsidy. The National Park seems to act in complete isolation from its surroundings, hence it took several measures to prevent the inflow of polluted water in their 'pristine' ecosystems and never made a public case for proper treatment of the mine residuals.

3.4 Water management in the Doñana National Park

Inside the National Park, the Conservation Office is responsible for water management. The Park's decision making is thus severed from the management of the rest of the watershed. This impairment is worsened by the lack of co-operation shown by the engineers of the River Authority. In addition, the Park's personnel lack training and expertise in water management. As a result, the management of the Doñana marsh cannot help but be compromised, e.g.:

- Three of the four original water entries to the marsh have not been functional for decades. The National Park is substituting them by pumping stations connected through artificial channels.

- Water flow through the marsh is managed through the opening and closing of constructed inflow and outflow gates. Decisions of when to open and close the gates are based only on experience, sometimes with catastrophic results (e.g. devastating autumn floods in 1989 and 1996).

- Due to severe deforestation in the watershed, the streams inflowing to the marsh carry high loads of eroded sediment. Proposed measures to remediate the sedimentation include dredging the shallow river courses inside the marsh, a particularly dangerous approach.

In the outskirts of the Park, water remains a contentious issue. Rice farmers claim ever increasing engineering works to gain water in dry years. The argument is rather demagogic, since no effort has been made to reduce water demand e.g. by introducing more efficient irrigation methods. However, it counts with the support of the powerful construction lobby, benefited by the continuous flow of State-funded engineering works. In addition, the recent expansion of tourism and irrigated crops is quickly exhausting the ground water reserves.^{7,8}

Water use is but one symptom of the problem that threatens Doñana's very survival: the entrenchment of the Park in a territory under rapid and



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environmentally unfriendly development. At the same time, water has often revealed the conflicts associated with unregulated development. Recent ecological 'disasters' should rather be considered indications that the water resources are being mismanaged.

4 Making sense of the management puzzle: increasing openness and connectedness.

Natural resources are not managed efficiently in the Guadalquivir lowlands, neither inside nor outside the Doñana nature reserves. This is partly due to a lack of information and the defective training of the professionals involved. However, we believe that the weakest links in the management chain are:

- institutional fragmentation,
- conflicting interests and worldviews among institutions and stakeholders,
- the deficient flows of information among institutions and stakeholders,
- the lack of strategic thinking at almost every level.

4.1 Integrating Doñana in its watershed

The Doñana nature reserves cannot be managed efficiently until they are integrated in their watershed. The water use strategy of the watershed must include the requirements set by the existence of a major international reserve in its estuary. At the same time, the Park should become a guarantee that the water resources are properly managed and public health standards met.

4.1.1 Overcoming conflicting worldviews

A critical step towards achieving integrated water management will be addressing the conflicts created by the need to harmonise multiple necessities. These include supplying drinking and agricultural water, maintaining the water quality standards for the productive fisheries in the estuary, and guaranteeing the ecosystem health of a National Park of critical international importance. At the same time it is necessary to cope with highly polluting industrial and mining activities, untreated or incompletely treated urban waste water, diffuse agricultural pollution, groundwater depletion (pumped for irrigation and tourist development), and groundwater pollution (due to agriculture and mining activities).

Decades of confrontation have resulted in mutual negation, supported by rather demagogic arguments. The creation of a platform in which the validity of each other interest is acknowledged, will be a major step for the re-negotiation of a way to harmonise water uses. Sustainability and equity, rather than fixed demands for goods or services, are the best ground on which such a re-negotiation can be rooted.^{4,1} They will provide a framework in which each other's demands can be contrasted and mutually accommodated.

A scenario for the use of the sustainability-equity framework can be built using Gleick's Basic Water Requirement criteria (Table 1). By scoring how many BWR criteria are fulfilled by each group of water users (tentatively



classified), we intent to highlight which areas of user activity should be accommodated. We must stress, however, that the accommodation to the

Table 1: Fulfillment of Gleick's⁴ seven Basic Water Criteria by different water users in the Guadalquivir watershed. (+) positive trend, (-) negative trend, (--) very negative trend, empty: no effect or lack of data.

<i>Stakeholders & lobbies</i>	H	E	W	R	DA	C	DE
Agriculture:							
Irrigation	-	-		-	+	-	-
Rice	-	-	-	-	+	-	-
Industry	--	--	--	--		-	-
Mines	--	--	--	--		-	-
Fisheries		--		--			
Drinking water supply	+				+		-
Dispersal of							
Urban pollution	--	--	--	--		--	--
Generation of energy		-			+	-	-
Forest management		-		--	-	-	-
Nature conservation	+	+		+	-	-	-

H: Human health / E: Ecosystems health/ W: Water quality/ R: Renewability
DA: Data collection & access/ C: Conflict resolution/ DE: Democracy and equity

sustainability standards will certainly involve a revision of each user's purposes and worldviews.

4.1.2 Modernising the 'hard' approach

The 'hard' scientific/technical platform can greatly aid in the re-negotiation among water users, by generating credible scenarios associated the user's demands. Rather than taking a fixed set of aims and generating a 'best solution', their role will be assessing the response of the 'hard' ecosystem to each new scenario constructed during the re-negotiation. This change of approaches will automatically improve two BWR criteria systematically violated by practically all institutions and stakeholders: the existence of conflict-resolution institutional mechanisms, and the democratic and equitable participation in water planning and decision making.

The proposed approach will represent a radical modernisation in Spain's natural resources management. Necessary steps are:

- the democratisation of resource use planning,
- transparency and accountability during the decision-making process,
- the abandonment of the demagogic arguments that have characterised Spain's 'hydraulic regeneration'⁹,
- the construction of a dynamic management scheme which combines a long-time commitment with sustainability with spatial and temporal flexibility ('adaptive management'; Christensen¹).

Computational tools provide an excellent framework for the generation of alternative scenarios describing the 'hard' ecosystem. However, the



interaction with a 'soft' platform in which members are re-negotiating their purposes will cause the iterative reconstruction of the 'hard' ecosystem (the 'reality,' or rather its description). Conceptual and computational tools will have to be 're-created' at every step (see also Christensen's¹ arguments for a continuous updating of the description of reality used by ecosystem managers).

4.2 Integrating Doñana in its territory: a global framework for nature conservation

Neither can the Doñana nature reserves be managed efficiently until they are integrated in a global territorial framework for nature conservation. On one hand, individual resources cannot be managed in isolation from their surrounding ecosystem components and processes¹. On the other, the attempt to maintain a parcel of 'pristine nature' isolated from a heavily used periphery is an impossible dream. The Park's management involves a great number of difficult choices, which should be taken from a global conservation perspective.

Habitat fragmentation is the greatest threat to wildlife², and the only way to overcome it is to re-negotiate ways to maintain or improve habitat quality in the surrounding non-protected areas. Unless the local population is finally engaged in improving their quality of life through a better environmental protection, the Park conservation has a doomed future.

But nature conservation officials also need a major change of perspective: they have to abandon their own drive for short-term production. The success of a Park's management should be measured neither by the number of visitors, nor by the number of individuals of charismatic endangered species. The indicators currently used for the management of the Doñana reserves are short-term, production-oriented and hidden or tacit. They should become long-term, negotiated and public. They should also relate to the sustainability of the whole region rather than limit themselves to the Park.

4.3 Creating the right institutional framework: strategic thinking against conceptual fragmentation

How can the current deadlock be overcome? A major step will be the creation of an improved institutional framework. This could be achieved through the generation of a number of positions for strategic thinking, responsible for improving the information flows between institutions and generating a common negotiation language. Eventually, the insight gained could be used to achieve desirable and possible changes in the institutional structure and functioning, which will be perceived by the institutions involved as significant improvements. Here, as stated by Christensen et al.¹, 'more professionals with an understanding of scientific, management and social issues, and the ability to communicate with scientist, managers, and the public' are desperately needed.

Recent developments in European water management and conservation policies offer encouraging support to these ideas. However, good policy alone does not generate good practice. The survival of large protected wetlands, like



the Doñana reserves, will require much more attention to the establishment of institutional frameworks that take heed of the particularities of local socio-nature while pursuing long-term strategic aims.

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