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International Conference on Data, Information and Knowledge
for Water Governance in the Networked Society



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Top picture: Session at the International Conference

Source: David Sampedro

Bottom picture: Field trip in Veta la Palma (Doñana Natural Park)

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1. BACKGROUND AND OBJECTIVES

Information and knowledge requirements for natural resources management today are conditioned by numerous factors: increasing possibilities provided by polycentric and changing sources of information generation; rapid development of earth observation technologies; different avenues for sharing and disseminating data and information in an era of rapidly evolving information technologies; promotion of public policies and legislation that enhance the dissemination, harmonization and reutilization of publicly produced information; and growing demands for information and transparency in natural resources management from increasingly critical social actors. In this context of change and transformation it becomes relevant to reflect upon how particular information and knowledge for natural resources management in general, and water resources in particular, is generated, reproduced and becomes predominant.

The objective of the International Conference on Data, Information and Knowledge for Water Governance in the Networked Society was to analyze the current debates and innovations regarding collaborative generation, processing and dissemination of data, information and knowledge. It has focused specifically on the concepts of poly-centricity and collaborative generation of information, quality control, sustainability of the information cycle, public participation, open data generation, and reuse of information. It also analyzes the socio-political implications of the new context. That is, to what degree can we expect higher levels of citizen engagement with decision-making processes to emerge in this new context? Will social actors take advantage of the new political participation potential provided by new technologies? These are key drivers for water governance in the near future.

The *International Conference on Data, Information and Knowledge for Water Governance in the Networked Society* is part of the activities of the *Sustainable Water Action (SWAN) Research Project* (<https://swanproject.arizona.edu/>), a VII Framework I+D INCOLAB Project EU-USA. SWAN aims to create a scientific network to enhance EU-USA joint research on water, around the topics of integrated modeling and collaborative knowledge generation, with a prominent role of the social sciences; moreover, it is considering the interaction between science and politics beyond the theoretical limits of sustainability and governance. A fundamental characteristic of SWAN is its flexible and iterative nature in the definition of its objectives and priorities, enabling the teams involved to identify the key themes around which to build relevant collaborative research partnerships.

The background of the International Conference dates back to a Workshop on New paradigms in water resources and risks management: Key water data and information for sustainability, organized by the University of Seville (USE) SWAN Team on January 25, 2013¹. The degree of commitment and the high level of the contributions of the speakers and experts attending this Workshop encouraged to open up the debate to a wider international audience and undertake a more ambitious activity. The International Conference aimed to further develop the scientific foundation of SWAN through a relevant contribution to the debates on data, information and knowledge generation, dissemination and application, working from the conclusions of the workshop. The challenge was to put more emphasis on the collaborative generation of information, public participation, open data generation, and the re- use of information in the context of a networked society.

The *International Conference* has been organized by the USE SWAN research team². Other SWAN partners include the *Centre National pour la Recherche Scientifique (UMI iGLOBES)*, the *University of Arizona* (Tucson, USA), the *University of the West England* (Bristol), the *University of Seville*, *UNESCO-IHE* in Delft and the *Bulgarian Academy of Sciences*, BAS-NIGGG.

The target audience of the International Conference was experts addressing different disciplines of information management related to political decision-making processes, especially in the field of environmental management, natural resources and water resources and risks. The Conference was opened not only to academia but also to other stakeholders (users, businesses, government and social organizations involved). With an audience of 100 people (ANNEX 1), and 14 speakers from Europe (United Kingdom, Egypt, the Netherlands, France, Spain) and United States were invited (ANNEX 2 and ANNEX 3), the conference took place in the Pavilion of Mexico (Avenida de la Palmera, s/n), University of Seville, Spain.

Results and conclusions of the International Conference are disseminated through different venues:

- On the website of the USE SWAN Team, part of the GUEST Research Group: Territorial Structures and Systems (HUM 396), <http://grupo.us.es/giest/> and also in the webpage of the SWAN Project: <https://swanproject.arizona.edu>.

¹ See for more information:

<http://grupo.us.es/giest/es/node/856>

https://swanproject.arizona.edu/sites/default/files/filedepot/Newsletter_USE_SWAN_Issue1_9Mayo_2013%281%29.pdf

² For more information see http://investigacion.us.es/sisius/sis_proyecto.php?idproy=23360

- A special issue of the bi-annual USE SWAN e-Newsletter, circulated in research networks related to water management.
- Publication of a special issue in the international scientific journal Water Alternatives <http://www.water-alternatives.org/>.

Moreover, a twitter account with user name @waterP2P has been used as a support platform to disseminate of the conference debates under the hashtag #waterP2P14 (Figure 1). Other hastags and key terms were provided to conference participants in order to promote their collaboration in the dissemination of debates (see ANNEX 4).



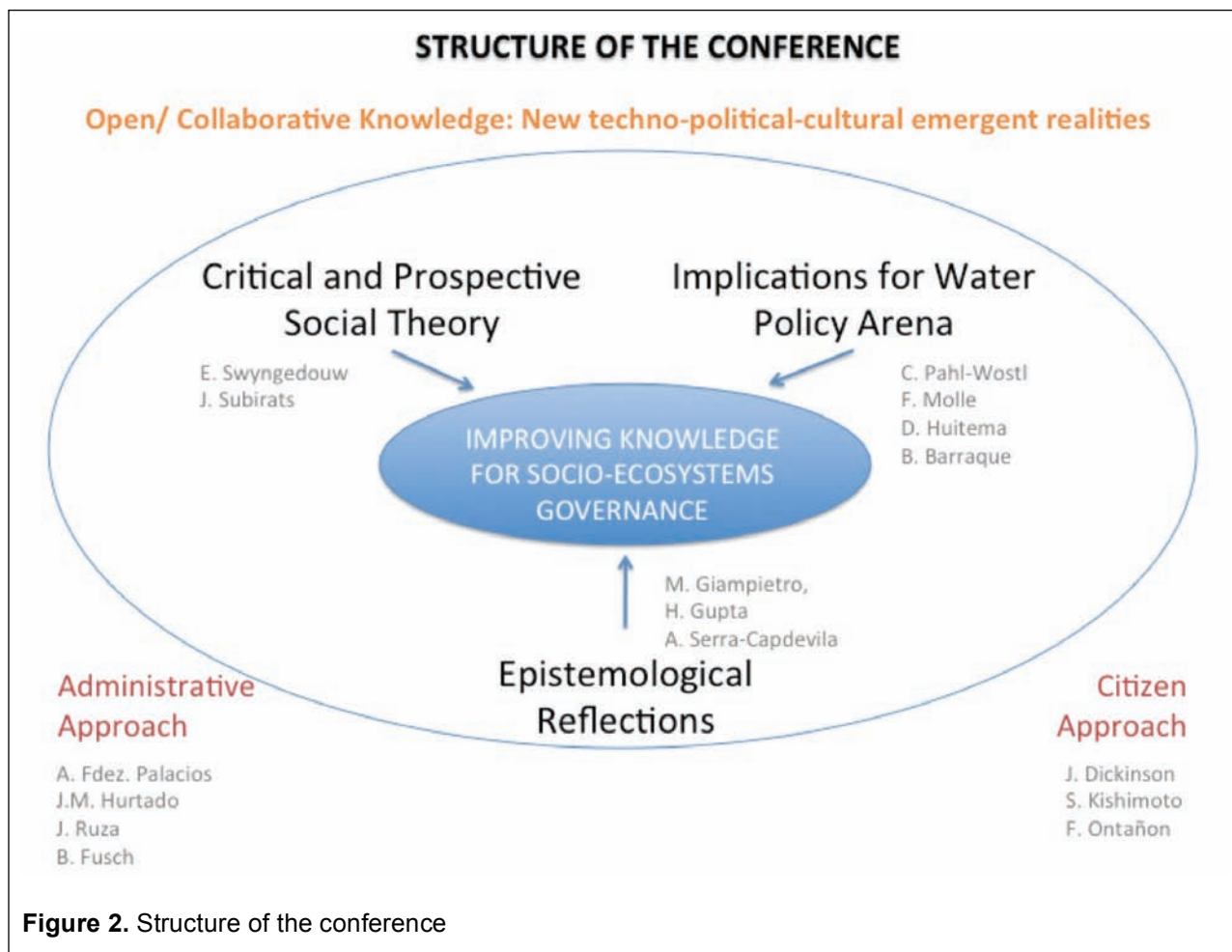
Figure 1. @waterP2P Twitter account

2. STRUCTURE OF THE CONFERENCE

The central focus of this meeting was to improve knowledge for socio-ecosystems governance. The conference took place during 2 days and the talks were structured around three main inputs (Figure 2):

- 1- Critical and prospective social theory
- 2- Epistemological reflections.
- 3- Implications for water policy arena.

Moreover, as a general background of the Conference, presentations on the new techno-political-cultural emergent realities from an administrative to a citizen approach were included.



3. CONFERENCE PROGRAM

MONDAY 9 JUNE 2014

M^a Fernanda Pita, *Department of Geography, University of Seville*

Franck Poupeau, *Swan Project Leader, Centre National de la Recherche Scientifique*

Leandro del Moral, *Head of The Swan University of Seville Team*

SESSION 1. Power, communication and the policy process:

Political and Technological Innovation. P2P Democracy and policy co-production

Joan Subirats, Universidad Autónoma de Barcelona, Spain

Interrogating Post-Democracy: Reclaiming egalitarian political spaces

Erik Swyngedouw, Manchester University, UK

Moderator: *Tom Evans, Ostrom Workshop in Political Theory and Policy Analysis, University of Indiana-Bloomington, USA*

Rapporteur: *Violeta Cabello, University of Seville, Spain*

SESSION 2. Key debates on water management models/paradigms.

SESSION 2.1

From panaceas towards a diagnostic approach in water governance and management.

Claudia Pahl-Wostl, University of Osnabrück, Germany

Water management models and the formation of policy bubbles

François Molle, IRD (France) and IWMI (Cairo, Egypt)

Moderator: *Chad Staddon, University of the West of England, UK*

Rapporteur: *Owen King, University of the West of England, UK*

SESSION 2.2

The river basin organization, reflections on politics and performance

Dave Huitema, Vu University - Amsterdam, The Netherlands

Learning to swim in the troubled waters of impure public goods

Bernard Barraqué, Emeritus Research Director Water Policies CIRED - HDR, France

Moderator: *Nuria Hernández-Mora, University of Seville*

Rapporteur: *Belén Pedregal, University of Seville*

TUESDAY 10 JUNE 2014

SESSION 3. Polycentric information for water governance: Generation, quality control and sustainability.

SESSION 3.1

Socially networked citizen science as a mechanism for supporting conservation and behavioral change

Janice Dickinson, Professor of Natural Resources and Director of Citizen Science at the Cornell Lab of Ornithology, Cornell University, USA

Processes of social participation in information: The experience of the Water Remunicipalization Tracker

Satoko Kishimoto, Water Justice Project Coordinator, Transnational Institute, The Netherlands

Moderator: *Graciela Schneier-Madanes, CNRS, DR(é), France*

Rapporteur: *Murielle Coeurdray, UMI, University of Arizona, USA*

SESSION 3.2

Public Data, ICT and Water Governance – The Need for an Information Policy to Achieve the Goal

Arturo Fernández-Palacios Carmona, IECA & Jose María Hurtado, Consejería de Medio Ambiente, Junta De Andalucía (Directorate Of The Environment, Regional Government Of Andalusia), Spain

Collaborative production and management of water information. How to make polycentric information available to managers, agencies and the public: Spanish experience with Water WISE, INSPIRE Directive and other water related databases.

Javier Ruza Rodríguez, Dirección General del Agua, Ministerio de Agricultura, Alimentación y Medio Ambiente (Water Directorate, Ministry of Agriculture, Food and the Environment of Spain)

Moderator: *Juan Valdés, University of Arizona, USA*

Rapporteur: *Natalia Limones and Sergio Segura, University of Seville , Spain*

SESSION 4: Key issues in information dissemination, visualization, and translation to different audiences.

SESSION 4.1

Sustainable Development Indicators: Dealing with complexity in governance

Mario Giampietro, Icrea, Universidad Autónoma De Barcelona, Spain

Tools for collaborative management of information

J. Félix Ontañón, Co-Founder, Open Kratio

Moderator: *Stoyan Nedkov, BAS-NIGGG, Bulgaria*

Rapporteurs: *Kremena Boyanova and Tanya Trenkova, BAS-NIGGG, Bulgaria*

SESSION 4.1

The National Drought Mitigation Center: Building a conduit to bring the science to citizens

Brian Fuchs, Drought Mitigation Center, University of Nebraska – Lincoln, Usa

Participatory knowledge generation for decision-making

Hoshin Gupta and Aleix Serrat-Capdevila, University of Arizona

Moderator: *Laszlo Heyde, UNESCO-IHE*

Rapporteur: *Juanma Camarillo and Maria Villarín, University of Seville, Spain*

Sessions 1 and 2 were highly theoretical and reflexive, while sessions 3 and 4 aimed to present innovative practices and real operational-technological applications in the world of collaborative information for water management, always within a relevant theoretical framework.

FINAL REMARKS

Nuria Hernández-Mora, Violeta Cabello, Natalia Limones and Belén Pedregal (University of Seville, Spain), with contributions from Owen King (University of the West of England), Murielle Coeurday (UMI, CNRS/University of Arizona, USA), Kremena Boyanova and Tanya Trenkova (BAS-NIGGG, Bulgaria).



INTERNATIONAL CONFERENCE ON DATA, INFORMATION AND KNOWLEDGE FOR WATER GOVERNANCE IN THE NETWORKED SOCIETY
 University of Seville, June 9-11, 2014

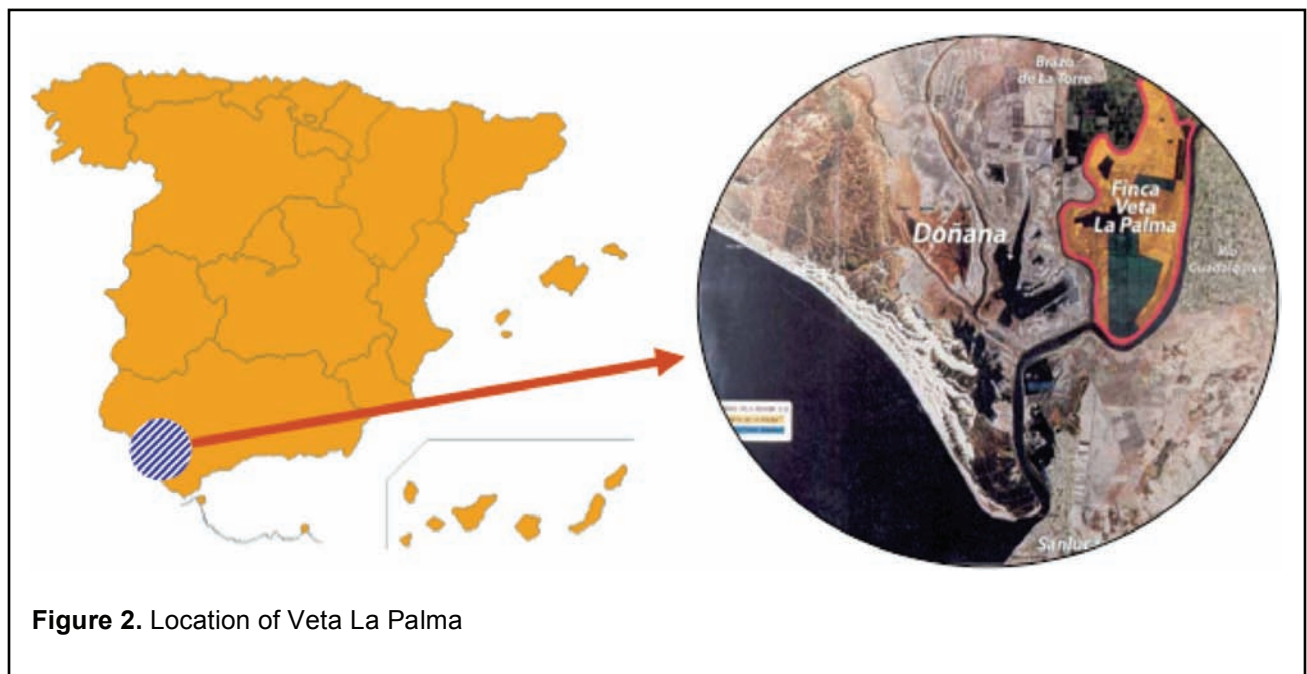
	MONDAY, JUNE 9	TUESDAY, JUNE 10	WEDNESDAY, JUNE 11
9:00	Arrival & accreditation	9:00 Session 3: <i>Janice Dickinson</i> , Cornell University, Ithaca, New York	
9:30	Welcome & Introduction <i>Mª Fernanda Pita</i> , University of Seville <i>Franck Poupeau</i> , SWAN Project Leader, CNRS <i>Leandro del Moral</i> , Head of the SWAN University of Seville team	9:30 Session 3: <i>Satoko Kishimoto</i> , Transnational Institute, Amsterdam	
10:15	Session 1: <i>Joan Subirats</i> Universitat Autònoma de Barcelona	10:00 Questions and debate	
11:00	Coffee Break	10:45 Coffee Break	
11:30	Session 1: <i>Eric Swyngeouw</i> Manchester University	11:15 Session 3: <i>Arturo Fernández Palacios & Jose María Hurtado</i> , IECA, Regional Government of Andalusia	
12:15	Questions and debate	11:45 Session 3: <i>Javier Riza</i> , Water Directorate, Ministry of Agriculture, Food and the Environment of Spain	Water landscapes in Andalusia. Nature, economy and society. The experience of Veta La Palma (Doñana Natural Park)
13:00		12:15 Questions and debate	
14:30	Session 2: <i>Claudia Pahl-Wostl</i> University of Osnabrück	LUNCH BREAK	
15:00	Session 2: <i>François Malle</i> IRD (France) and IWMI (Cairo)	14:30 Session 4: <i>Mario Giampietro</i> , Universitat Autònoma de Barcelona	
15:30		15:00 Session 4: <i>Félix Ontañón</i> , Open Kratio, Sevilla	8:30-16:00
16:15		Questions And Debate Coffee Break	
16:45	Session 2: <i>Dave Huitema</i> VU University-Amsterdam	16:45 Session 4: <i>Brian Allan Fuchs</i> Drought Mitigation Center, Lincoln, Nebraska	
17:15	Session 2: <i>Bernard Barraqué</i> CIRED-CNRS, France	17:15 Session 4: <i>Hoshin Gupta & Aleix Serrat- Capdevilla</i> , University of Arizona	
17:45	Questions and debate	17:45 Questions and debate	
18:30	ADJOURNEMENT	18:30 Closing remarks	
		18:45 ADJOURNEMENT	

WEDNESDAY 11 JUNE 2014

FIELD TRIP: VETA LA PALMA

Veta La Palma is a large agricultural landscape, with an area of 11.300 hectares. It is located in the “Isla Mayor” island, part of the Guadalquivir marshes, in the Doñana Natural Area (ANNEX 5). Aquaculture is developed in 3.200 hectares of these permanently flooded marshes. The remaining area is used for ranching and to for the cultivation of feed grains and rice (Figure 3).

The interest of this visit was focused in the integration of the economic activity and biodiversity conservation in the deeply transformed environment that is *Veta La Palma*. This integration has had positive results, both economically and in terms of a significant improvement in the quality of the natural environment.



4. ABSTRACTS OF THE PRESENTATIONS

4.1. SESSION 1. POWER, COMMUNICATION AND THE POLICY PROCESS

The purpose of the first session is to reflect on the current political, historical and socio-economic context that frames the radical changes occurring in the world of information and knowledge affecting political decision processes in general and discussions on water policy paradigms in particular. It is important to discuss about the key theoretical and political issues (the current traits of power, the neoliberal globalization, the post-political age, post-democracy, etc.) that are determining the needs, the strengths and the limitations of the instruments of the 'networked society'.

Key words: power, information, communication, social networks, public participation, post-democracy.

Abstracts:

Political and Technological Innovation. P2P Democracy and policy co-production

Joan Subirats; Autonomous University of Barcelona, Spain.

In this presentation, we aim to provide elements to rethink the ways in which the Internet has so far been used by the institutional policy, the policies and public administrations. We offer some alternatives to facilitate a better understanding of what is involved with the change of era in which we are immersed. Change of era that involves breaking with many of the fundamentals underlying the representative delegation in the political field or in the management in the administrative intermediation field. We will first examine the most common guidelines that have been followed so far – which characterize Internet as a new tool to keep doing better or more nimbly what has been done -, noting what for us are clear limits to this approach. We then analyze the extent to which the Internet can encourage, and indeed is already favoring, changes in the elaboration, formation and implementation of public policies, and how those changes requires repositioning the position and role of governments and public administrations.

Is the growing presence and significance of Internet involving significant changes in the traditional ways of doing politics and public decision making?. In this paper we aim to provide answers to this question. In general, we understand that although many habitual patterns remain unchanged, we also begin to detect significant changes in the number and configuration of actors, resources available to these actors, how they use them, and also interaction and

political participation strategies. We understand that we cannot simply call "crisis," the set of changes and transformations that are occurring worldwide. Technological transformation involves structural changes, also in politics and public policy.

The new social reality that is configuring itself via technological change has multiple effects and is opening new avenues for social and scientific innovation. It is clear that the Internet, as a platform for communication and exchange, has generated and will continue to generate numerous initiatives that break the traditional models of creating wealth or knowledge, for instance. Possibly the most obvious example, and the one most intrinsically connected to the process of creation of the Internet, and its functional characteristics, is the movement created by the possibility of sharing, of building collectively, of collaborating to create goods and knowledge based on aggregation and cooperation between users.

That's why we are also interested here in the democratic implications of the debate over the role of ICT's, which lead inevitably to debates around access and regulation - precisely the domain in which politics has traditionally operated. Harold Laswell once said that politics is about deciding who gets what (access), when and how (regulation). Today we see political ferment gathering around these ever-more-frequent conflicts that do not find an adequate response in the traditional market-state dichotomy, and creating new social dynamics that increasingly turn to the arena of the commons to try to find a way out of their dilemma.

Interrogating Post-Democratization: Reclaiming Egalitarian Political Spaces

Erik Swyngedouw, University of Manchester, UK/Sciences Po, Paris

There is now an emerging body of thought on the dynamics of de-politicization, the 'disappearance of the political', the erosion of democracy and of the public sphere, and the contested emergence of a post-political or post-democratic socio-spatial configuration. I situate and explore this alleged 'post-democratization' in light of recent post-Althusserian political thought. I proceed in four steps. First, I discuss the contested configurations of this post-politicization and the processes of post-democratization. In a second part, I propose a series of theoretical and political arguments that help frame the evacuation of the properly political from the spaces of post-democratic policy negotiation. This diagnostic is related to a particular interpretation of the distinction between 'the political' and 'polic(e)y/'politics'. In a third part, I argue how emancipatory-democratic politics can be reclaimed around notions of equality, and freedom. In the concluding part, perspectives for re-vitalizing the political possibilities of a

spatialized emancipatory project are presented. The crux of the argument unfolds the tension between politics, which is always specific, particular, and 'local' on the one hand and the universal procedure of the democratic political that operates under the signifiers of equality and freedom on the other. Attention will be paid to the role and place of the 'environmental concern' within this process of de- and re-politicization.

4.2. SESSION 2. KEY DEBATES ON WATER MANAGEMENT MODELS

The session focuses on the debates about current and emerging paradigms of water resources management. It is necessary to critically reflect on the limitations, contradictions and conflicts found in the practical applications of the IWRM paradigm. The session aims to include different lines of reflection: critical discourses about the ideas surrounding 'nirvana concepts' and 'panaceas'; analysis of the relationships between water governance and the global socio-economic and political processes; and emerging alternative (or complementary) proposals such as ecosystem management, polycentric management or eco-adaptive management of water.

Key words: shifts of paradigms, complexity, sustainability-security-insecurity, integration, polycentrism.

Abstracts:

From panaceas towards a diagnostic approach in water governance and management

Claudia Pahl-Wostl; Institute of Environmental Systems Research, University of Osnabrück (Germany).

Numerous recommendations often relying on simplistic 'standard' panaceas have been put forward for water governance reform without testing of appropriateness in diverse contexts. Furthermore water governance problems have become more and more complex and defy simplistic solutions. A diagnostic approach supports context-sensitive analysis, assesses the transferability of insights between similar classes of problems and contexts and develops guiding principles that can still be tailored to context.

The paper will summarize conceptual and methodological foundations and results from comparative analyses of water governance systems using such a diagnostic approach. It will argue that a transformation is under way towards adaptive and integrated water governance and management putting more emphasis on societal learning. It will elaborate on the yet

untapped potential offered by new modes of coordination and knowledge generation in a networked global community to support such a transformation.

Water management models and the formation of policy bubbles

François Molle; Institute for Research and Development (IRD, France) and International Water Management Institute (IWMI, El Cairo, Egypt).

This communication addresses the issue of the production of knowledge, focusing on the emergence and promotion of policy concepts. Taking the example of water pricing in agriculture, it describes and analyzes how the idea/concept was mainstreamed as a global policy recommendation in the 90s, and how the associated policy bubble grew before being deflated in the mid 2000s. Another example, irrigation management transfer from water bureaucracies to water user associations, is used to show how the literature on the topic can be used to manufacture evidence out of thin air. It provides broader insight on how common wisdom is reproduced through the repetition of general statements in largely shallow and self-serving accounts of actual processes. In conclusion the presentation offers a reflection on intellectual conformism and several mechanisms whereby a certain type of depoliticized knowledge is produced in ways that are consistent with the interests and ideologies of the individuals and institutions that have the power to influence the production of knowledge in the water sector.

The river basin organization, reflections on politics and performance

Dave Huitema; VU University-Amsterdam, The Netherlands.

This presentation will detail the conceptual groundwork and the results from of a book that appears in August this year and that will provide an in depth investigation of the formation of river basin organizations (RBOs) in a very diverse set of countries around the globe (*Huitema and Meijerink, The politics of river basin organisations. Coalitions, institutional design choices and consequences, Edward Elgar*).

Conceptually, the book accomplishes various goals: (1) on the basis of Elinor Ostrom's rule types it develops a systematic typology of RBOS that distinguishes between autonomous RBOs, agencies, coordinating and partnership type of RBOs. (2) It suggests that the process of establishing RBOs can be understood as a highly political process of institutional change, with opponents and proponents that seek to strengthen their power bases by steering institutional change trajectories in a certain direction. (3) it introduces and defines relevant concepts for the

evaluation of RBO performance, notably their contribution to improved coordination, accountability, legitimacy, and environmental effectiveness.

Empirically, the book contains a set of (national, regional) case studies that were selected on the basis of author expertise in connection with these cases (not random). Given the emphasis on autonomous and more recently partnership type of RBOs, it is interesting to observe that in most case studies presented in the book, the type of RBOs proposed are of the coordinating and the agency type. The chapters in the book also demonstrate how strongly politicized discussions about the foundation of RBOs are. Using Thelen's typology of institutional change – RBOs are often intended as a displacement of existing institutions, but in reality they end up as an extra layer of institutions on top of what existed already. Control over data and information is often a key issue in these debates, with pre-existing institutions sometimes being unwilling to share information with new RBOs. The effects of this are clearly visible in the performance of RBOs that are eventually formed: the book arrives at a relatively pessimistic conclusion on the added value of the RBOs that have been discussed in the book. The main conclusion is that the foundation of RBOs does not always enhance coordination across policy sectors, and often creates complex accountability relationships.

Learning to swim in the troubled waters of impure public goods

Bernard Barraque; International Center for Scientific Research on Environment (CNRS AU CIRED –HDR, France).

The public vs. private debate which developed after the World Bank and other liberal institutions expressed their support for various forms of water privatization, and attracted the opposition of many supporters of public management instead, has remained in a sort of myopic antagonism resulting in a double confusion of water as a resource and water as a service on the one hand, and of developed and developing countries' situation on the other.

In the paper we shall recall the quadrangle of Samuelson and Ostrom based on rivalry and excludability to insist on water being a common pool resource in frequent territorial situations (rivalry but no excludability); but we shall also insist on the other category of water as impure public good: no rivalry but excludability characterizes a club or toll good, and this is how modern water supply started in western Europe and the US; except that when these services became public services for the sake of public health, club membership dues were progressively lowered together with the universalization of tap water so as to make it attractive to all urban (and later

most rural) population, but under the shape of a commercial service: not a simple *marchandisation* as French-speaking opponents of privatization simplify, but a consumerization for sure (public utilities in US, CH, NL and DE have no moral problem in sending water bills to their customers), where water users and the operator are bound in the long term by the fixed costs of the infrastructure.

Our recent research was attracted to the transition which took place between the two forms of impure public goods along the decades of capitalist societies' development: from an 'ostromian' ideal of equitable allocation of rights and duties, to another ideal based on freedom and equality instead, this one based on the quantification (rationalization/ monetization) of water use thanks to decisive innovations like the network under pressure, the closing tap and the volumetric meter. We shall illustrate this (still incomplete) transition with a few historic examples, and comparisons of urban water supply with irrigation communities, with sanitation (and the passage of from a duty to a commercial service), and with garbage collection (where metering is quasi-impossible).

Lastly, we would like to propose a differentiation between developed and developing countries, where the level of trust in public services at the scale of the city is too low for good public services to develop at a reasonable cost, and where the only alternative we can see is to adopt technologies embedded in water as a resource at neighborhood level, which will unfortunately materialize, and may be reinforce, the pursuance of the fragmented city (Jaglin) or the splintering urbanism (Graham, Guy and Marvin).

4.3. SESSION 3. POLYCENTRIC INFORMATION FOR WATER GOVERNANCE: GENERATION, QUALITY CONTROL AND SUSTAINABILITY

This session focuses on new practices of collaborative and distributed generation of data prompted by the New ICTs in the era of the networked society, and to their potential for meeting the information needs for water management. Particular attention is paid to data and information quality control. This process must ensure the consistency of information on water throughout its life cycle, despite the complexity and diversity of the sources that a networked society offers. The issue of information sustainability will also be addressed. This implies ensuring its free access, optimizing generation efforts and minimizing overlaps.

Keywords: polycentrism/collaborative information generation, quality control, information sustainability, citizen participation, open data generation, re-use of information.

Abstracts:

Current and future potential of Web-based citizen science

Janice Dickinson, Professor of Natural Resources and Director of Citizen Science at the Cornell Lab of Ornithology, Cornell University, Ithaca, New York.

Citizen science has been transformed by the Worldwide Web and continues to grow as electronic sensors and other smart phone technologies find their ways into the pockets of people worldwide. At first, Web-based citizen science was very “top down”; professional scientists decided what they wanted to know and designed projects that would engage participants in providing the data. This opened up potential to monitor things and organisms across months and years and at huge geographic scales, generating “big data”. New computational methods were then devised to observe patterns in the data and produce dynamic visualizations that have never been seen before. Next we saw an emerging interest in the human side of citizen science practice, beginning with the idea that as people learn, the quality of their data improves. Today, we have begun to recognize that traditional citizen science projects are not built to take full advantage of the collective capacity of large human groups. Recognizing the human capacity for collaboration and collective intelligence, we can design projects to generate new information, ideas, and solutions, taking fuller advantage of the social Web’s capacity to tap human participants’ capabilities, and recognizing that, while smart phones can be built that contain more accurate sensors, human participants are certainly the most intelligent “sensors” in the world today. By combining social networking and offering participants the ability to provide user-generated content, citizen science platforms can be designed for socially-mediated collective action, where participants not only generate data, but also take part in data validation, the development of new tools, as well as the design, enactment, and testing of restoration and management solutions, allowing us to work more efficiently and in larger groups than ever before.

Processes of social participation in information: The experience of the Water Remunicipalization Tracker

Satoko Kishimoto, Transnational Institute, Water Justice Project Coordinator

An important characteristic of the global water justice movement is that those belonging to it regard it as a united network and the numerous victories achieved with the movement are felt as collective achievements. This is the case despite the fact that it has no systematic global

coordination mechanism and that it enjoys a non-hierarchical and open character. Another important feature is that local resistance against privatization projects and local movements for building democratic water systems on the ground are organically connected and supported internationally, while at the same time the global policy advocacy work for democratic public water provision is strengthened by local experiences and victories.

There is a stark contrast between grass-root activists and campaign NGOs on the one hand, who maximize their capacity and political impact by sharing experiences and knowledge and on the other hand the far better resourced neoliberal actors who anxiously protect and guard information as a commercial asset. Clearly, the networked society equipped with information technologies has enabled these interconnected grassroots movements to have such rich local-to-global (and the other way around) transnational exchanges. TNI plays a connecting role as a transnational actor, with the challenge to develop (and renew) strategic tools for information-sharing and practical cooperation. Facilitating and helping create the conditions in which knowledge is produced and shared by movement actors through collaborative methods builds a basis for developing joint strategies. The *Water Remunicipalisation Tracker* (www.remunicipalisation.org) is one such tool to contribute to better integration of local knowledge into global advocacy for water justice.

Over the last 5 years, the Water Justice project has compiled examples of how communities in different parts of the world are moving from failed privatized water management to successful publicly managed water and wastewater services. These examples are presented on the *Water Remunicipalisation Tracker*. Approaches differ depending on local circumstances but important lessons can be learned from the different experiences of remunicipalisation.

When the tracker was launched in 2007, 'remunicipalisation' as a term existed but was rarely used in the water movements, nor in academic circles or among water sector professionals. Since then the term has been popularized and become a key political demand for many citizens' campaign for democratic control over water services. Remunicipalisation is now a growing political trend, not only in the water sector but also for electricity and other essential services in Europe and elsewhere. More than 86 cities in the world remunicipalised water services³. Of these, all except three took place between 2000 and 2013, and the pace has nearly tripled since 2009. There is growing awareness that private sector water management is very expensive and that 'public-private partnerships' makes it difficult for municipalities to monitor services and

³ <http://www.psir.org/reports/list-water-re-municipalisations-worldwide-november-2013>

contracts. Many local authorities choose for remunicipalisation as a practical and logical option.

Through this tracker, TNI's Water Justice project aims to increase the visibility of the remunicipalisation trend by bringing together diverse and inspiring experiences. Rather than providing a comprehensive overview of the often complex processes that involve a wide range of actors, the tracker focuses on understanding why and how the remunicipalisation process took place as well as the obstacles that were encountered and the results that were achieved. The cases thus outline background, key actors, current water management model, financing, status and provide resources for details. Target audiences of the tracker are politicians, trade unions, water users, ecologist associations, activists, public water officials and other key actors in the struggle for fair, democratic and sustainable public models.

The tracker is work-in-progress and clearly designed to actively invite contributions from local campaigners. This participatory approach has proven not to be so easy and active facilitation from TNI has been necessary. Local campaigners, for example, may need encouragement to contribute to the website as well as guidance in writing up a concise story that allows international readers to grasp the essence of the remunicipalisation experience. So TNI needs to facilitate the process actively and case studies are often written by commissioned researchers based on the input from local water campaigners. In this way, the tracker integrates local knowledge and the website comes to life in a sustainable manner.

While the tracker is a good tool to provide a global overview and to share stories, the necessity was felt to provide in-depth studies on certain cases, based on rigorous research methodology. The book *Remunicipalisation: Putting Water Back into Public Hands* was published in 2012. In order to reach a broader audience, a five minutes animation video to introduce water remunicipalisation was also created. These different communication tools can reinforce each other in networked society.

Public Data, ICT and Water Governance: The Need for an Information Policy to Achieve the Goal

Arturo Fernández-Palacios, IECA & *Jose María Hurtado*, Directorate of the Environment, Regional Government of Andalusia

New technologies bring about large potential improvements in the production of public information and, by enabling immediate access to huge amounts of data, to the process of information disclosure. This colossal supply of data masks, however, important gaps and

inadequacies in the capacity to process information and use it for actual improvements in governance. To address these issues, data must be relevant to the definition of problems, it must be provided in the correct format, it must be certified and also have the capacity to integrate with other information sources. The public must not only have access to information for consultation, but it should also be able to tap the information with readily available technologies. This paper reflects on the need to implement a cross-cutting public sector information policy in order to ensure that information fulfills its catalytic role in the improvement of governance. The article discusses the need to: address the sustainability of costly data gathering processes through coordination mechanisms; implement information gathering and dissemination processes within a framework of interoperability; ensure that the cross-relationship and comparison capacity, that are essential for integrated approaches such as that of the Water Framework Directive, are built into the information system; and establish proactive processes for data dissemination through channels and formats that promote public awareness and public participation.

Collaborative production and management of water information. How to make polycentric information available to managers, agencies and the public: Spanish experience with Water WISE, INSPIRE Directive and other water related databases.

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In a society that is becoming more and more complex and in which the improvement of the communication possibilities significantly expands the scope of the environmental management decision-making process, no longer an exclusive field for administrators, collaboration in the production and management of water information, becomes increasingly more important. One of the key issues is the growth in the number of actors involved, such as water users, NGOs, the scientific community and stakeholders related to the water management.

At European level, 28 Member States have to share information in order to define strategies and policies and also to assess the compliance with the European legislation. The source of information for the development, adoption, implementation and evaluation of the water policy is the European Environment Agency (EEA). It involves 33 member countries and 6 cooperating countries, using a European Environment Information and Observation Network (Eionet) where more than 1000 experts and 350 national institutions cooperate.

The water management organization in Spain is as complex as the European one. Many

organizations are involved in data provision and in the decision making process. 25 River Basin Districts have been identified in the water planning process required by the Water Framework Directive WFD (2000/60/EC). But it is not just a question of water agencies, water issues cannot be addressed without coordination with sectorial policies (rural and urban development, irrigation plans, transport, energy...) most of them developed under the responsibility of the 17 regional governments existing in Spain.

The article makes an historical review of the process carried out by the EU institutions, since 1998 when Eionet priority data flows started, compared with the process in Spain, focusing on the evolution of the strategic decisions taken, analyzing the main drivers and the results. Starting from the reports presented in writing paper; to the electronic spreadsheets; the use of email soon replaced by electronic tools that incorporate automated data checking routines; to the ultimate trends in online data sharing. In essence the process has led us, from reporting, to online access to data and interoperability; from centralized databases to decentralized systems that ensure the possibility to combine datasets from different sources in a consistent way at national and European level. Some of the initiatives at EU level analyzed in the article are: Central Data Repository (CDR) and the Reporting Obligations Database (ROD) both part of the Repornet tools of the EEA; Water Information System in Europe (WISE); the Infrastructure for Spatial Information in Europe INSPIRE (directive 2007/2/CE).

The experience in Spain in developing the National Inventory of Wastewater Discharges (*Censo Nacional de Vertidos*); National Water Rights Registry (*Registro de Aguas*); NABIA (National System on Water Status and Water Quality); National Mapping System for Flood Prone Areas (SNCZI); Urban Waste Water Database (EDARNET) is also analyzed jointly with the efforts to implement INSPIRE. A review is also made on some yet to be born initiatives to involve all the society, mainly through the implication of volunteers in observation programs (algae bloom observation in reservoirs, collaborative completion of the inventory of pressures, collaborative stock photos on water taxa ID-TAX).

The main lesson learnt in all this process is that collaboration is not just a question of technology. To make polycentric information available to managers, agencies and the public, the paramount attention needs to be placed on standardization, institutional arrangements and organizational aspects without forgetting that reliable collaboration needs awareness by all parts involved requiring education and loyalty.

4.4. SESSION 4. KEY ISSUES IN INFORMATION DISSEMINATION, VISUALIZATION, AND TRANSLATION TO DIFFERENT AUDIENCES

The fourth session looks at how different platforms for exchange and collaboration allow the forging of social learning and knowledge on water, as products of the last stage of the information cycle. Special attention will be given to the new tools and methodologies that allow the generation of useful knowledge for water management and decision-making: indicators, creation of web viewers, modeling, etc. and how these tools evolve in the light of the continuing scientific, technological and social change. The session analyzes the conditions under which knowledge could be produced and openly shared, freely and easily according to the potential characteristics of the new network society.

Keywords: Knowledge, dissemination, accessibility, visualization tools, scenario building, making information accessible to different audiences, indicators.

Abstracts:

Sustainable Development Indicators: Dealing with complexity in governance

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The use of sustainable development indicators in a process of governance requires the ability of guaranteeing an effective quality control on the production and selection of quantitative information. This quality assurance has to deal with three sources of uncertainty: (i) uncertainty on the normative side – who decided the relevance of the problem structuring? How do we know that “the problem” to be solved is considered as such in the narratives used by the other social actors?; (ii) uncertainty on the descriptive side – how robust are the explanations and the predictions generated by scientific models? How can we deal with a complex information space including different scales and dimensions of analysis?; (iii) uncertainty on the efficacy of the process of decision making – is the process used for the deliberation guaranteeing political legitimacy to the final decision? Was the method used to compress the different perceptions, narratives and motivations for action considered in the deliberation fair?

The talk first discuss the complex nature of the concept of indicator – a number measuring a relevant attribute that in order to get meaning has to be contextualized within a system of benchmarking. Then, it illustrates the unavoidable entanglements between the normative and the descriptive side when dealing with integrated assessment (the combined use of sustainable

development indicators). The need of adopting a new approach to the development of sustainable development indicators, based on complex system thinking, is illustrated with a few examples taken from practical applications. When dealing with an integrated analysis based on multiple indicators – e.g. when studying the nexus between food, energy, water and land use – it is impossible to rely on reductionism – i.e. on quantitative assessments based on the adoption of a scale and a dimension at the time. Finally, in relation to the quality control on the process of production and use of quantitative information it is possible to help the structuring of the discussion and the framing of the quantitative analysis using in combination three tools developed in the field of participatory integrated assessment: equity matrix, impact matrix and ethical matrix.

The very concept of complexity entails that the three sources of uncertainty cannot be tamed and that therefore it is impossible to select “optimal solutions” or “the right policy”. On the other hand, if we can enrich the diversity of perspectives and narratives used to deliberate about a given issue we can at least hope to get better decisions.

Tools for collaborative management of information

J. Félix Ontañón, Open Kratio, Seville, Spain

Several European policies about management of water has been called for helping members of the EU on their decision-making process. The databases built, as result of these policies, have a huge potential for concerning citizens about the importance of the management of water. Opening those databases freely available, without copyright restrictions, would boost the interest of re-using it, and even of building commercial applications. Actually, opening data is today one of the key points at the Digital Agenda: Europe has an Open Data Strategy⁴, which is expected to deliver a €40 billion boost to the economy per year.

While opening water management data could be done in a variety of ways, there are some guidelines that could be followed in order to make the work of citizens and developers easier. This conference introduces the project #adoptaunaplaya⁵, which aims to correlate pollutant and waste report data with the quality of bathing waters in Spain. The challenges found on re-using this databases and the lessons learnt will lead us to talk about some recommendations for the water open-data strategy.

⁴ http://europa.eu/rapid/press-release_IP-11-1524_en.htm

⁵ <http://openkratio.github.io/calidad-aguas>

The National Drought Mitigation Center: Building a conduit to bring the science to citizen

Brian Fuchs; Drought Mitigation Center, University of Nebraska – Lincoln, USA.

The National Drought Mitigation Center works as a partner with the National Oceanic and Atmospheric Administration (NOAA) and the United States Department of Agriculture (USDA) to produce the weekly United States Drought Monitor (<http://www.droughtmonitor.unl.edu>). In the effort of producing the weekly U.S. Drought Monitor product, the scientists involved have relied on an open flow of data as well as commentary from “citizen scientists” who are contributing by the way of reporting of drought impacts and collecting precipitation reports. As the U.S. Drought Monitor has evolved, one key to the success of the product has been the open sharing of data as well as the development of unique datasets for drought monitoring. Almost all of the data associated with U.S. Drought Monitor is open and obtainable freely via the web. Recently, some contributors are providing raw data in GIS formats to allow the U.S. Drought Monitor authors to plot these data values directly to better analyze these data while producing the map each week. The abundance of multiple drought indicators and indices used to create the weekly U.S. Drought monitor has continued to grow in that now each week up to 50 different and unique data inputs are used. With the influx of all these data, the accuracy of the map has also improved.

The National Drought Mitigation Center recently released a new product, the Drought Risk Atlas (<http://droughtatlas.unl.edu>). To create an atlas of historical drought indices, the best long-term and most complete weather stations were compiled. Over 12,000 stations are in the NOAA cooperative network, with observations going back to the 1870's. To provide the best climate assessment of drought indices, only the best stations were used. The criteria were established and of the 12,000 stations available, 3,059 stations were identified to calculate drought indices for to provide a historical perspective of how drought has impacted these locations. It is hoped that these stations best represented the United States and provide a tool to quickly understand drought in any area of interest.

Participatory knowledge generation for decision making

Hoshin Gupta and Aleix Serrat-Capdevila; University of Arizona, Tucson, USA

This is a talk presented by “physical scientists” who have, over the years, been progressively drawn into the experience of interacting with social-behavioral scientists, stakeholders, managers, and policy experts, in the context of problems related to the sustainability of water

and related environmental services. We will discuss our experiences, beginning with the University of Arizona-based Water Center called SAHRA, and progressing through the EU Funded SWAN project, towards a planned international activity/organization to be called the Transatlantic Dialogue On Water. Our goal is to reflect on experiences and lessons learned through our interactions with people from diverse backgrounds and perspectives. The overarching challenge seems less to be one of understanding the problem” and more one of understanding each others' understandings of the problem”—in the context of Systems Theory, this might be perceived as the challenge of developing what might be called a shared Conceptual Model. As physical scientists, this seems to require us to relinquish our desire to progress rapidly towards a “solution”, and instead focus on the movement towards a shared understanding of the problem and its various dimensions.

5. FINAL REMARKS

Participants and sessions' rapporteurs were asked to share their inputs and comments through a collaborative in-real time text editor (<https://titanpad.com/>). Based on the presentations, debates and the collaborative document, the following final remarks were read at the closing ceremony. They haven't been homogeneously edited on purpose, in order to show the different authors' styles and inputs. They were elaborated by Nuria Hernández-Mora, Violeta Cabello, Natalia Limones and Belén Pedregal (University of Seville, Spain), with contributions from Owen King (University of the West of England), Murielle Coeurday (UMI iGLOBES CNRS/University of Arizona, USA), Kremena Boyanova and Tanya Trenkova (BAS-NIGGG, Bulgaria).

5.1. FROM CRITICAL AND PROSPECTIVE SOCIAL THEORY

#Representative Democracy as a #Postdemocratic governance regime is in #crisis

Representative democracy is based in the idea that the interests of those that are absent are represented by those that are present. However, those that are absent do not feel represented and demand to be present. Technology could with some conditions help to make that possible.

#ICTs catalyze innovative democratic practices

ICTs and social networks are catalyzing innovative democratic practices that are challenging post-democratic consensual forms of government and are generating egalitarian political spaces. Citizens can be more effective in their efforts to influence public policies but can also self-organize to generate solutions when they perceive the administration is not responsive.

#Internet is not just a new tool for communication, but neither it is a #panacea

Internet is not just as a new tool for communication, it is triggering structural changes in the way citizens organize and reclaim politics, #technooptimist positions should also be avoided. There are positive and negatives effects of the internet era and links between offline and online public spaces need to be reinforced to ensure its evolution as a political democratic catalyzer. Attention should be paid to the control over what information is made available, what information is withheld and why, politicizing the #Access to water data and information.

5.2. FROM PRACTICIONERS: SCIENCE & CITIZEN APPROACH

ICTs have **changed the geographic scale** at which we can observe nature. The Internet has helped to decentralized collaborations resulting in the flow of large amounts of information laterally through social networks.

Quality control, privacy and trust considerations are ongoing challenges of these collaborative efforts that must be addressed.

ICTs allow the emergence of networks at different scales, **connecting the local to the global**, reinforcing each other through the sharing of information and the production of collaborative knowledge.

Conservation research, when it involves **public engagement is inherently political**, just as most other applied research. It is important to recognize and make existing research biases explicit.

Tools that facilitate collective learning become particularly relevant when resources are limited or power relations are imbalanced.

Open data and transparency provide opportunities to managers (policy coordination and improved data), **companies** (new market opportunities), **citizen organizations** (improved social monitoring of public policies) and the **research and development community** (new inferences, hypothesis validation, new discoveries).

5.3. FROM PRACTICIONERS: ADMINISTRATIVE APPROACH

There is no organization/institution at national level devoted **to implement an ICT policy**. Political commitment at the highest level is needed.

Collaboration and data accessibility is not just a question of technology. To make polycentric information available to managers, agencies and the public, attention needs to be placed on **standardization, institutional arrangements and organizational aspects** without forgetting that reliable collaboration needs awareness by all parts involved requiring education and loyalty.

Enhancing **public participation in water management requires:**

- Data information systems that take into account the needs of all actors.

- Data collection that **fulfills legal and reporting requirements** and serves to improve **management, planning and policy**.
- Facilitate public access to data / **open data as a means to improve water management**.
- **A commitment** from public administrations and citizens **to collaborate**

5.4. IMPLICATIONS FOR WATER POLICY ARENA

We must be cautious of **global solutions** to socio-geographically specific problems. Standard "panaceas" do not exist. Complex water governance problems require adaptive solutions that rely on social learning processes. These processes are facilitated and enhanced through the possibilities for collaborative knowledge generation offered by the networked global community.

IWRM and its component elements (river basin management, full-cost recovery and participatory governance approaches) are examples of prescriptions uncritically offered as panaceas.

Common wisdom is reproduced through the repetition of general statements in largely shallow and self-serving accounts of actual processes. Through intellectual conformism a certain type of depoliticized knowledge is produced in ways that are consistent with the interests and ideologies of the individuals and institutions that have the power to influence the production of knowledge in the water sector.

Sharing information and data implies sharing power, and therefore is an inherently political process. Any transformation in institutional arrangements inevitably has supporters and detractors because it alters the power balance.

5.5. EPISTEMOLOGICAL REFLECTIONS

Integrated indicator systems allow handling the large amount of information required to manage complex socio-ecological systems. Natural resources accounting and sustainability indicators should integrate multiple scales and dimensions of analysis connecting the social metabolism to its impact on ecosystems.

Participatory Sustainability Assessment is more policy than science. It is necessary to deal with multiple and conflicting perceptions and, therefore, the definition of the problem structure

becomes essential. **Ethical uncertainty** should be considered along with descriptive and normative uncertainty.

Bridging the gap between science, society and management continues to be a basic methodological, epistemological and conceptual challenge. The type of data used, the way it is gathered, processed, reproduced and disseminated becomes essential.

Making inroads toward **open governance** may facilitate this integration and enable collaboration. A lot more work needs to be done....#WATERP2P15???

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7. ANNEX 2: SPEAKER BIOS

Bernard Barraqué. CNRS (National Scientific Research Centre), Paris. He is emeritus research director on water policies within CIRED, Centre International de Recherches sur l'Environnement et le Développement. In the last years before retiring, he coordinated EAU&3E, a research project on the sustainability of water and sanitation services in large cities in France (and other developed countries): environmental, economic, social and governance dimensions (see <http://eau3e.hypotheses.org>).

Janice Dickinson, Cornell University. Her research has evolved gradually from studies of the behavioral ecology of insects and birds to a program that incorporates elements of conservation science, public education, and human cooperation within the contexts of citizen science and sustainable practices. Currently, her work includes citizen science research on climate change effects on winter bird distributions, continuing studies of cooperation and population ecology of western bluebirds, and pursuit of understanding of the human dimensions of sustainability, including human denial of climate change. Viewing citizen science as a collective action, she is interested in how the internet can best be used to support science-based conservation communities enacting and sharing residential habitat improvement strategies and energy conservation practices. Taking this further, can we mobilize the highly educated aging population to bring their talents to the table with new solutions and inventions? While her background is in evolutionary ecology, her interests in human behavior have come to incorporate psychological bases of behavior and proximate decision rules with emphasis on how we might use the internet to support cooperative endeavors around shared meaning. Her newest citizen science project, The YardMap Network, will pursue these ideas.

Arturo Fernández-Palacios, is a geographer and, since 1988, has been specialized in remote sensing, cartography and information systems applied to the evaluation of natural resources and in environmental management, performing this for the Regional Environmental Ministry of Andalusia. He has been the Chief of the Service in charge of coordinating the strategic planning and the participatory processes for this same body. Since 2007, he is the Deputy Director of Cartography of the Statistics and Cartography Institute of Andalusia, organization in charge of coordinating the production of information necessary for all public policies of the regional government and of promoting its maximum diffusion and accessibility. Much of its current task is devoted to the implementation of the INSPIRE Directive in Andalusia.

Brian Fuchs is a faculty member and climatologist for the National Drought Mitigation Center (NDMC) <http://www.drought.unl.edu> which is housed within the School of Natural Resources at the University of Nebraska in Lincoln. He received a B.S. in Meteorology/Climatology in 1997 from the University of Nebraska and a M.S. in Geosciences, with an emphasis in Climatology, in 2000 from the University of Nebraska. He first came to the School of Natural Resources in May of 2000, working as a Climatologist for the High Plains Regional Climate Center. He started working with the National Drought Mitigation Center in December 2005. His job functions are quite broad, but he is focused mainly on drought related issues and research projects. The drought related work concentrates on research involving mitigation, risk assessment, monitoring, impacts and reporting of drought. As a Climatologist, he work on the applied research projects for the center as well as authoring the United States Drought Monitor <http://www.droughtmonitor.unl.edu> and the North American Drought Monitor with several others. The work he does helps others to better understand the impacts related to drought across a diverse group of industries from agriculture, energy, tourism, transportation as well as social and environmental concerns.

Mario Giampietro, Autonomous University of Barcelona, Catalan Institution for Research and Advanced Studies (ICREA), Spain. He works on integrated assessment of sustainability. Using new concepts developed in Complex Systems Theory, he has created an innovative scientific approach that can integrate quantitative analyses referring simultaneously to technical, economic, demographic, social and ecological variables. In this way, it becomes possible to characterize, in relation to multiple criteria of performance, the interaction of socio-economic systems and ecological systems across multiple scales using integrated sets of indicators, which can be chosen “à la carte” by social actors.

Hoshin Gupta is a professor of Systems Analysis in Hydrology at the University of Arizona (USA). He is very interested in the interaction between climate and hydrology and in the application of emerging technologies to the science of water, as well as in the interaction between hydrology and society and the application of models combining hydrological and socio-economic data. He is an expert in modeling for decision-making and investigates how to combine quantitative and qualitative data in the construction, calibration and application of mathematical models.

Dave Huitema. VU University - Amsterdam and Open University (Netherlands). He is Professor Environmental Policy at the Institute for Environmental Studies (IVM) at the VU University

Amsterdam and the School of Sciences at the Netherlands' Open University. He specializes in Public Policy and Public Administration and mainly works on environmental governance issues, with a focus on water and climate change specifically. His research interests include adaptive co-management, policy innovation, change and learning, public participation, science-policy interactions, and policy instruments.

José María Hurtado, Civil Engineer, began his career in 1983 working for an important company specialized in Hydraulics Engineering until 1990, when he joined the Regional Government of Andalusia, where, after running hydraulic constructions and projects, he has been Deputy Director of the regional administration body in charge of water management since 2004, which is currently the General Secretariat for Integral Management of the Environment and Water of the Junta of Andalusia. In this post, he has participated in the strategic planning of the management of water resources and especially in the implementation of the Water Framework Directive in the Andalusian autonomous community, in which public information and participation play a prominent role.

Satoko Kishimoto, Transnational Institute. She was an environmental activist and active in the youth environmental movement in Japan in the 1990s. She began working with TNI in 2003, at the time of 3rd World Water Forum held in Kyoto, Japan. TNI successfully organized a seminar on *Alternatives to Water Privatisation*, which was the starting point of the Water Justice Project. In 2005, the Reclaiming Public Water (RPW) Network was created with the contributors to the book *'Reclaiming Public Water'*. TNI serves as the coordinating hub of the RPW network and Satoko is the coordinator of the network. The RPW network connects activists, trade unionists, researchers, community activists, and public water operators from around the world, and advocates progressive public water reforms and Public-Public Partnerships as the key elements for solving the global crisis in access to clean water and sanitation.

François Molle is Director of Research at the Institut de Recherche pour le Développement (IRD), France. He has 27 years of experience working on issues of water management, water governance and water policies. He is currently seconded to the International Water Management Institute and based in Cairo, where he develops research activities in the Middle-East and North-Africa region. He has authored 200 publications, including 80 journal articles, book chapters, and edited volumes. He serves as an editorial board member for several journals and is co-editor of Water Alternatives (<http://www.water-alternatives.org>). François

Molle graduated from Ecole Polytechnique, France, holds a Ph.D from the University of Montpellier and teaches in several Master programs in the field of Human Geography.

J. Félix Ontañón (<http://fontanon.org>) is a computer engineer and Digital Citizenship ICT consultant. As a committed citizen he is a member of [OKFN-sp](#) and co-founder of the citizen organization [OpenKratio](#) (formerly Open Data Sevilla), which advocates spreading the principles of *#opengovernment*, *#openculture* and *#opendata* at Spain. In these groups he has helped Universities to open and visualize their economic data and contributed to the future [Transparency](#) and [Citizenship Participation](#) Regional Laws of Andalusia. OpenKratio is the organization behind [Open Data Sevilla](#), an annual national summit about *#opendata* and *#opengovernment*. *His motto: I want the Administration to be electronic, the Government open ... and the software, free!* **Open Kratio** (openkratio.org) is made up of a group of people that aim to disseminate the principles of Open Government and Open Data, especially in public administration. OpenKratio intends to be a citizen action group that helps to increase social transformation and interest in order to improve democracy. This group believes this could be achieved through participation and collaboration initiatives in the public and political space by adopting the principles of the "open" movement.

Claudia Pahl-Wostl is professor for resources management and director of the Institute for Environmental Systems Research at the University of Osnabrück, Germany, and co-chair of the Global Water System Project (<http://www.gwsp.org>). Her major research interests are adaptive, multi-level governance and management of water resources, social and societal learning and their role in sustainability transformations, and conceptual and methodological frameworks to analyze social-ecological systems. She is (co)author of numerous papers in peer-reviewed journals, chapters in edited books, policy briefs and popular reports.

Javier Ruza, Ministry of Agriculture, Food and the Environment of Spain. Javier Ruza is a specialist in Environmental Hydrology. He has been working in the world of water both in the public and private sectors since 1990; the last 17 years in the Directorate General for Water of the Ministry of Agriculture, Food and Environment where he has been Deputy Director for water management. His work has dealt with the coordination of the 25 different River Basin Authorities and in particular with the exchange of information on different water aspects. He has been the creator and coordinator of the working group on '[Water status](#)' for the exchange of information on water status and water quality between River Basin Districts and the Ministry; and the working group to create the [National Inventory on Waste Water Discharge Permits](#). He has

been in charge of the National Register on Water where all water abstractions and their uses are registered, and of the [National Mapping System for Flood Prone Areas](#) (SNCZI). One of the purposes of these data collection system is to attend to [European Environmental Agency EIONET priority dataflows](#), and to give an answer to the information required by the European Commission Water Information System in Europe ([WISE](#)). He is currently the representative of the Spanish Central Government in the Directive Council on the Spatial Information Infrastructure ([CODIIGE](#)), created for the implementation of the [INSPIRE Directive](#) (Infrastructure for Spatial Information in the European Community) in Spain. He is also the coordinator of the Technical Working group on '[Hydrology](#)' of CODIIGE. He is also in charge of the follow-up of the implementation of the 25 Programmes of Measures ([PoM](#)) of the different River basin management plans in Spain.

Aleix Serrat-Capdevila is a Research Associate Professor in the Department of Hydrology and Water Resources (HWR) at the University of Arizona. He holds an engineering degree from the Polytechnic University of Catalonia and MS and PhD in HWR from the University of Arizona. He has worked in refugee camps and neighboring villages in Guinea-Conakry, West Africa and for a consulting firm in Barcelona and the Catalan Water Agency. His research focuses on change impacts in hydrology and participatory modeling. Since 2010, he has worked for the International Center for Integrated Water Resources Management (ICIWaRM), a Category II UNESCO Center, through a National Research Council Fellowship.

Erick Swyngedouw. Manchester University, UK, School of Environment and Development. He is committed to political economic analysis of contemporary capitalism, producing several major works on economic globalisation, regional development, finance, and urbanisation. Latterly his interests have turned to political-ecological themes and the transformation of nature, notably water issues, in Ecuador, Spain, the UK, and elsewhere in Europe.

Joan Subirats. Professor of Political Science and director of the Doctoral Program of the Institute of Government and Public Policy at the Universitat Autònoma de Barcelona. His research fields include: political analysis, democratic innovation, public participation and local and regional government. He has been a visiting professor at the University of California-Berkeley, CIDE-Mexico, New York University, Università di Roma, and Distinguished Visiting Professor of the Prince of Asturias Chair in Georgetown University (2002-2003).

8. ANNEX 3: SLIDES AND RECORDINGS OF THE PRESENTATIONS

Recordings of conference sessions can be downloaded from the University of Seville's **webstream** server: <http://tv.us.es/>

The **slides of the presentations** of the different Conference Sessions can be downloaded from the following websites:

- SWAN Project: <https://swanproject.arizona.edu/international-conferences>
- University of Seville GUEST Research Group: <http://grupo.us.es/giest/es/node/905>

9. ANNEX 4: KEY WORDS & HASHTAGS

Help us disseminate conference debates by twitting these key words and hashtags, and by mentioning our twitter account **@waterP2P** and / or personal accounts of speakers:

@subirats9 – Joan Subirats

@fontanon – Felix Ontañon

@ErikSwyngedouw – Erik Swyngedouw

@LeandrDelMoral - Leandro del Moral

@satokokishimoto – Satoko Kishimoto

Data & Technology

TERM	DEFINITION	HASHTAGS
Big Data	<p>“A cultural, technological, and scholarly phenomenon that rests on the interplay of:</p> <p>(1) Technology: maximizing computation power and algorithmic accuracy to gather, analyze, link, and compare large data sets.</p> <p>(2) Analysis: drawing on large data sets to identify patterns in order to make economic, social, technical, and legal claims.</p> <p>(3) Mythology: the widespread belief that large data sets offer a higher form of intelligence and knowledge that can generate insights that were previously impossible, with the aura of truth, objectivity, and accuracy.” From Critical Questions for Big Data Boyd & Crawford (2012). http://www.opentracker.net/article/definitions-big-data</p>	#bigdata
Data Reutilization	The re use of data and information as an alternative way to improve and increase data availability and access	#DataReuse
Hackerspaces	Also known as hacklab /makerspace /hackspace, it is a community-operated workspace where people with common interests, often in computers, data, IT, machining, technology, science, digital art or electronic art, can meet, socialize and collaborate. From: http://www.lifehacker.com.au/2012/05/how-to-find-and-get-involved-with-a-hackerspace-in-your-community/	#hackerspace #hackspace #hacklab #hackaton #civichacking
Internet of Things (IoT)	A computing concept that describes a future where everyday physical objects will be connected to the Internet and be able to identify themselves to other devices. [...] The idea behind the concept is that the first version of the Internet was about data created by people, while the next version is about data created by things. http://www.techopedia.com/definition/28247/internet-of-things-iot	#iot #internetofthings

Linked Data	Linked Data is about using the Web to connect related data that wasn't previously linked, or using the Web to lower the barriers to linking data currently linked using other methods. It is about best practices for exposing, sharing, and connecting pieces of data, information, and knowledge (linkeddata.org)	#linkeddata #linkedata #datalift #linkedopendata
Open Data / Open Information / Open Knowledge	Data/ Information/Knowledge that is free to use, reuse, and redistribute it without legal, social or technological restriction. It encompasses methodologies in an open and transparent manner. From opendefinition.org	#opendata #openinformation #openinfo, #openknowledge #datasharing
Open Source	A development model that promotes universal access via free license to a product's design and an universal redistribution of that, including subsequent improvements to it by anyone. From Lakhani, K. R., & von Hippel, E.,2003: "How Open Source Software Works: Free User to User Assistance".	#opensource #freeopensource
Spatial Data Infrastructure (SDI)	A data infrastructure implementing a framework of geographic data, metadata, users and tools that are interactively connected in order to use spatial data in an efficient and flexible way. Another definition is the technology, policies, standards, human resources, and related activities necessary to acquire, process, distribute, use, maintain, and preserve spatial data. From wikipedia.	#SDI #IDE (sp)

Social & Policy

TERM	DEFINITION	HASHTAGS
Citizen Science	The Cornell Lab of Ornithology offers the following working definition: "Projects in which volunteers partner with scientists to answer real-world questions" http://www.birds.cornell.edu/citscitoolkit/about/definition	#citizenscience
Commons	Commons refers to the cultural or natural resources available and accessible to all members of a society, including natural materials such as air, water, and a habitable earth. These resources are held in common, not owned privately. From D. Bollier: "Reclaiming the commons", published in the Summer 2002 issue of Boston Review.	#commons #procomun (sp)
Crowdfunding/ Crowdsourcing	A way of raising work or finance by asking a large number of people each for a small amount of money as a donation From: http://www.ukcfa.org.uk/what-is-crowdfunding	#crowdfunding #crowdsourcing #collaborativefund #crowdcrafting #netfunding #sharefunding

9. ANNEX 4: KEY WORDS & HASHTAGS

<p>Cyberscience</p>	<p>A fast-growing mode of discovery which enhances traditional theory and experiment by providing a unique virtual laboratory to investigate complex problems that are otherwise impossible or impractical to address (PSU Institute for CyberScience).</p> <p>The Citizen Cyberscience must entail a collaboration between academia and international research organizations in the field of Internet technology and its applications to applied research with a view to creating concrete and usable social tools. From: http://www.unitar.org/unitar-unige-and-cern-collaborate-citizen-cyberscience-centre)</p>	<p>#cyberscience #citizencyberscience</p>
<p>Decentralization, Redecentralization</p>	<p>The process of redistributing or dispersing functions, powers, people or things away from a central location or authority.</p> <p>From TheFreeDictionary.com & Merriam-Webster Dictionary. Redecentralization is a new process/wave of decentralization.</p>	<p>#redcentralization #redcentralize #decentralization #decentralize</p>
<p>e- democracy/ e – government</p>	<p>Short for electronic government/ democracy (also known as e-gov, Internet government, digital government, online government, or connected government, etc.), it consists of the digital interactions between a government and citizens (G2C), government and businesses/commerce (G2B), government and employees (G2E), government and governments /agencies (G2G), as well as citizen interaction with their government (C2G). From: http://www.digital.vic.gov.au/ & Jeong, 2007: "Fundamental of Development Administration" & WIKIPEDIA.</p>	<p>#edemocracy #egovernment</p>
<p>Flok Society Project / Good Knowledge / Buen Conocer (sp)</p>	<p>FLOK (which stands for "Free/Libre Open Knowledge") proposes a fundamental disruption of society. FLOK's reason-to-be is to create a legal, economic and social framework for an entire country (Ecuador) that is consistent with principles that are the basic foundations of the Internet: peer-to-peer collaboration and shared knowledge."</p>	<p>#flokociety #buenconocer (sp) #buenvivir (sp)</p>
<p>Knowledge / Capacity Building</p>	<p>A conceptual approach to knowledge development that focuses on understanding the obstacles that inhibit people, governments, international organizations and non-governmental organizations from realizing their developmental goals in terms of intellectual capital while enhancing the abilities that will allow them to improve, always from a perspective of collaboration. From WIKIPEDIA & http://www.iadb.org/en/topics/development-effectiveness/knowledge-and-capacity-building,1257.html</p>	<p>#capacitybuilding #educationbuilding #communitywork</p>

9. ANNEX 4: KEY WORDS & HASHTAGS

Lateral Power	<p>The power of the people in collaboration is called lateral power by the European Commission adviser Jeremy Rifkin</p> <p>From: http://www.euronews.com/2012/05/31/jeremy-rifkin-and-lateral-power-energy/</p>	<p>#lateralpower</p> <p>#sharingenergy</p> <p>#postscarcity</p>
Networking	<p>An activity by which groups of like-minded people recognize, create, or act upon business or creative opportunities. From WIKIPEDIA.</p>	<p>#networking</p> <p>#coworking</p>
Open Government	<p>A governing approach that sits on three pillars: Participation, Collaboration and Transparency. The drive for transparency through open data and participative information wants to emphasize the recovery of trust in politics by the citizens. From: http://www.ogov.eu/</p>	<p>#opengovernment</p> <p>#ogov</p> <p>#govit</p> <p>#socialgov</p>
Open Science	<p>A movement to make scientific research, data and dissemination accessible to all levels of an inquiring society, amateur or professional. It encompasses practices such as publishing open research, campaigning for open access, encouraging scientists to practice open notebook science, and generally making it easier to publish and communicate scientific knowledge. From: WIKIPEDIA.</p>	<p>#openscience</p> <p>#liberaconocimiento (sp)</p>
Panaceas	<p>Historically simplistic approach to policy analysis (Ostrom and Cox, 2010). In the water policy arena, idealized design principles based on institutional and technological options that have been applied to water issues without long-term monitoring of their performance and effectiveness and without revision and critical reflection on practice that would have responded to failure earlier (C.Pahl-Wostl, Lebel, Knieper and Nikitina, 2012)</p>	<p>#panaceas</p>
P2P (Peer to Peer)	<p>A decentralized approach (or network) where tasks are shared amongst multiple interconnected peers who each make a portion of their resources directly available to other network participants, without the need for servers. From Rüdiger Schollmeier, 2002: "A Definition of Peer-to-Peer Networking for the Classification of Peer-to-Peer Architectures and Applications". In the essay "Peer to Peer and Human Evolution". Michel Bauwens (2005) expands the P2P meme beyond computer technology. He argues that egalitarian networking is a new form of relationship that is emerging throughout society, and profoundly transforming the way in which society and human civilization is organised. The essay argues that this new form of non-representational democracy is a crucial ingredient in finding the solutions to current global</p>	<p>#peertopeer</p> <p>#p2p</p> <p>#peer2peer</p>

9. ANNEX 4: KEY WORDS & HASHTAGS

	challenges; as well as a new and progressive ethos representing the highest aspirations of the new generations. From Wikipedia.	
Polycentric Governance	A governance system that combines decentralization and a distribution of power and authority across levels with effective coordination. Bottom-up and top-down processes are balanced. Decentralization without coordination results in fragmentation with an assumed negative impact on performance. The ability to respond to challenges from climate change is strongly related to polycentric governance and innovative ways for dealing with uncertainty (Ostrom and Cox, 2010; C.Pahl-Wostl, Lebel, Knieper and Nikitina, 2012).	#polycentric #nogovt
Post-democracy or Post-political stage	An emerging body of thought on the dynamics of depoliticization, the 'disappearance of the political', the erosion of democracy and of the public sphere, and the alleged emergence of a post-political or post-democratic socio-spatial configuration. This perspective implies the idea that a consensual mode of governance has apparently reduced political disagreement to either an ultra-politics of radical and violent disavowal exclusion and containment or to a para-political inclusion of different opinions on anything imaginable (as long as it does not question fundamentally the existing state of the neo-liberal configuration) in arrangements of impotent participation and consensual 'good' techno-managerial governance (Swyngedouw, 2011)	#postdemocracy #postpolitical
Relational goods	Goods that cannot be enjoyed alone. There is some relation between this idea and the model of Joint Production, networking and collaboration, or the concept of "crowding in". From WIKIPEDIA & C. J. Uhlner , 1989: "Relational Goods and Participation: Incorporating Sociability into a Theory of Rational Action"	#relationalgoods
(Water) Remunicipalization	A major trend has emerged as more and more communities insist on returning resources to public management through remunicipalisation, forcing multinationals to pull out of services. From http://www.remunicipalisation.org/	#remunicipalization #municipalization #publicpower
Social Media / Social Network	The interaction among people in which they create, share or exchange information and ideas in virtual communities and networks. It is a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of user-generated content. It can be considered as a tool while social network is the community. From Ahlqvist, Toni; Bäck, A., Halonen, M.,	#socialmedia #Socialnetwork

	<p>Heinonen, S,2008: "Social media road maps exploring the futures triggered by social media" & Kaplan Andreas M., Haenlein Michael, 2010: "Users of the world, unite! The challenges and opportunities of social media".</p>	
Tecnopolitics	<p>Arising from #15M and #Occupy movements it is defined as the tactic and strategic use of digital tools for collective organization, communication and action. From a network-system perspective, tecnopolitics can be described as the power of multitudes, brains and bodies, connected through social networks to co-create and self-regulate collective action. It includes cyberactivism as collective action within the digital sphere but it goes beyond that by considering the interconnection of digital and physical political processes. Tecnopolitics is the collective capacity of using networks to invent new forms of political action that start in the network but end up out of it.</p>	<p>#tecnopolitics #cyberactivism</p>
Water security	<p>The reliable availability of an acceptable quantity and quality of water for human and ecosystem health, livelihoods and production, coupled with an acceptable level of water-related risks. From: http://www.iwaponline.com/wp/00906/wp009060545.htm</p> <p>Over the last decade this concept has emerged from its original niche in studies of international hydropolitics to become much more widely used. To some extent it seems even to be supplanting the hegemonic position hitherto occupied by the "sustainable water" concept (Staddon and James, 2012).</p>	<p>#watersecurity</p>

10. ANNEX 5: FIELDTRIP GUIDEBOOK



] 9 & 10 JUNE 2014

INTERNATIONAL CONFERENCE ON DATA, INFORMATION AND KNOWLEDGE FOR
WATER GOVERNANCE IN THE NETWORKED SOCIETY

] UNIVERSITY OF SEVILLE, SPAIN

FIELD TRIP TO VETA LA PALMA

SPATIAL CONTEXT: DOÑANA NATIONAL PARK

Maria Fernanda Pita
with the collaboration of Juan Manuel Camarillo

Translation into English:
Natalia Limones, Violeta Cabello & Nuria Hernández-Mora

University of Seville SWAN Team

"... from the mouth of the river, pine forests extend without interruption, mile after mile, hills and valleys enhanced by its dark green foliage, while the undergrowth reveals the wealth of aromatic plants, all illuminated by sunlight that speckle intermittently. Large areas of the west Sahara desert, with miles of sparkling sandy wasteland, devoid of any vestige of vegetation: exaltation of a magnificent desolation, the splendor of sterility..."

A.Chapman y W.J. Buck, *Unexplored Spain*, 1910.

1. Introduction

Established in 1969, Doñana National Park covers an area of 52,740 hectares, surrounded an additional 53,000 ha that are protected under the figure of natural park. It is the largest protected natural area in Europe. It occupies the triangle between the Guadalquivir River on the East, the road Almonte-El Rocío-Matalascañas on the West and the Atlantic Ocean on the south. It coincides with the southern end of the Gulf of Cadiz and the mouth of the Guadalquivir (see Figure 1 and 2).

Being the largest and most famous national park in Spain, it consists on a giant wetland refuge for 80% of the migratory winged wildlife of the continent. Probably this is its mayor interest, it is the necessary and unique transit point for the birdlife of the European continent in their migration to Africa during the winter. But Doñana is also noted for its high biodiversity, its abundant wildlife, for containing the longest "wild" beach in southern Europe and for including a wide diversity of ecosystems that become even more important for the fact of coexisting together. Doñana is primarily a meeting place and a border between different ecotypes: between Europe and Africa (flora and fauna reflect very well this proximity), between the river and the sea (the estuary witnesses the continuous struggle between fresh and salty water), between sand and clay (sand modeled by the sea and clays deposited by the river). From its boundary character, Doñana receives most of its richness and diversity, which is by far higher than that derived from the sum of its individual parts.

It is also, as we shall see later, a space in which the maintenance of these natural values becomes increasingly difficult for two basic reasons. First, because of the enormous attraction it has for different competing uses and economic activities, among which tourism and agriculture stand out. Second, because of its situation at the mouth of the Guadalquivir river, thus receiving the accumulated impacts (point and nonpoint source pollution, reduction of instream flows, impoundments, etc.) of the different economic activities that take place throughout the basin..

Doñana's landscape is not spectacular, but if it is full of interest and beauty, a scenery evocative of serenity if you take the time to learn how to look at it and appreciate it. It is a predominantly flat landscape in which the only notable topographic features are the mobile dune system that develop along the Atlantic coast, with dunes that get up to 15 m high.

It should be noted however, that June may not be the most attractive time to visit the park, since two of the most dynamic players, water and waterflow, are entering their low point. During the winter season

most of the park is flooded and marshes appear completely covered with water, resulting in vast silver plains of highlighted beauty. In June the rigorous summer drought begins, revealing large expanses of dry and cracked clay-covered areas. On the other hand, life in the park experiences the strong seasonal contrast that characterizes the Mediterranean ecoregion: wet winters and very hot dry summers. In winter, wintering birds arrive from northern Europe in search of sun and heat; in spring most of the plant species bloom. During the summer months, we only find the presence of African birds that come to the park seeking a milder summer and most of the wildlife refuge in the few places that retain some water. Nonetheless, we can get an idea of what Doñana is in all its dimensions and we hope that the visit will constitute an incentive to revisit on a more appropriate season.

Following this panoramic introduction to the Park, the following pages present a more in-depth description of its geomorphological genesis and main ecosystems; a brief historical review of the most significant events in the process of human occupation and its constitution as a natural reserve; and a review of its current situation and main challenges.

FIGURE 1: Location map: Andalusia, Doñana and Veta la Palma

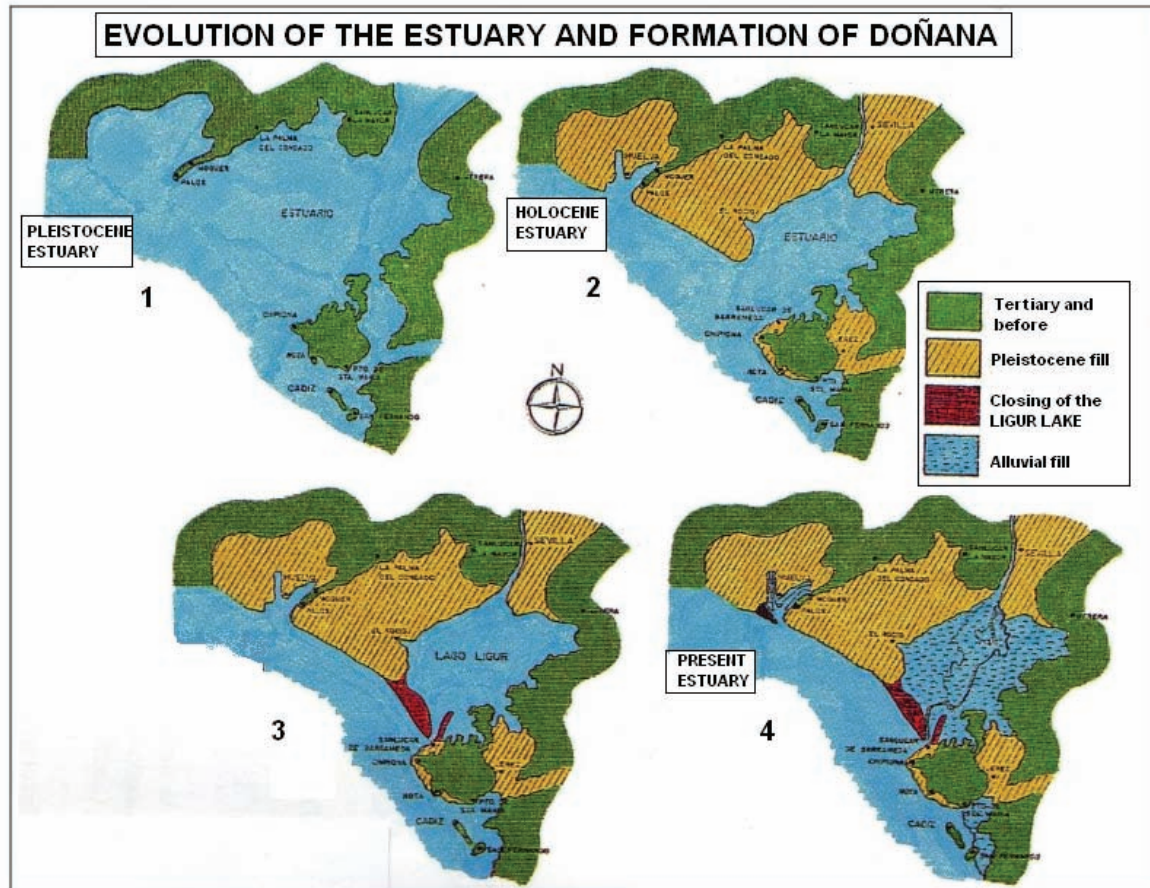


2. Geomorphologic genesis of Doñana National Park.

Doñana National Park is the result of ancient processes of filling and clogging in the estuary of the Guadalquivir. Its earliest origins lie in the Tertiary when the thrust between the African and the Eurasian plates formed the Betic chains in the Alpine orogeny. As usual in these type of phenomena, the area in front of the chain (see in Figure 1 Sierra Morena, edge of the Meseta) subsided during the Miocene (10 million years ago), being enclosed by fractures and occupied by the sea. The gulf was formed predominantly by marine sedimentation (it should be noted that this marine character of the whole valley of the Guadalquivir is what makes it one of the most fertile valleys in Europe).

During the Quaternary, the fluvial network was formed and the park area was gradually generated in the final stretch of the valley. Along with the rivers, the continental sediments arrived, progressively silting a great estuary (Figure 2).

FIGURE 2: Evolution of the estuary and formation of Doñana



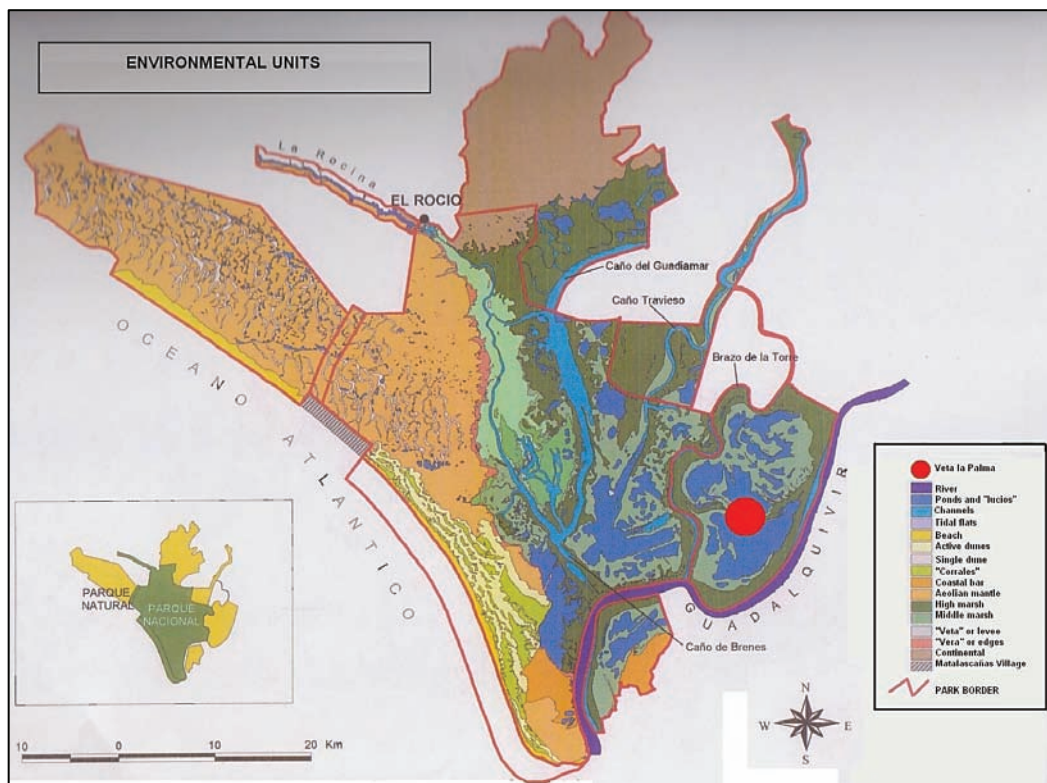
The erosive action of the waves and longshore drifts contributed to this silting. The dominant southwesterly wind generates a powerful stream of littoral drift while the westbound direction tends to accumulate sand in the estuary. The accumulation progressively created bars and arrows that closed the estuary (Figure 2).

Today the estuary is totally enclosed by the dunes, being only connected to the sea through the mouth of the river. The result is the configuration of a very flat and poorly drained area occupied by streams dragging sediments and, of course, with a very high water table. The whole area is isolated from the sea by a large stretch of sand where erosion forms different dune ridges.

We can identify two different domains: the NW of the park where the sand has been stabilized by vegetation, and the coastal mobile dunes in the SE, which are now moving into the marsh. It is also possible to identify four distinct ecological systems (Figure 3 corresponding to the environmental units):

- The mobile dune systems and the beach.
- The stabilized sands, which are called *cotos*.
- The marshes.
- The edge or *La Vera*, which is a narrow strip that marks the transition between the marshes, dunes and preserves.

Figure 3: Environmental units of Doñana



Each of these systems shows different characteristics in terms of geological substrate and dynamic height of the water table. In turn, the diverse spatial distribution of the vegetation and fauna generate different ecosystems.

3. Environmental units

3.1. Mobile dunes systems

The moving dunes advance inward from the Atlantic forming bands NW-SE. The process of dune formation starts as the wind pushes the fine sand inland which accumulates in the lee of small obstacles, such as vegetation, forming the initial dune. On the windward side the slope is gentle and sand climbs up pushed by the wind. At its edge, the dune is perpendicular to the wind direction. As sand accumulation increases, individual dunes pile up and join each other, forming parallel dunes or sand dune bands.

Each dune front reaches 10 to 15 m high. Forward speed is between 5-6 meters per year in well-developed fronts and about 10 cm per year in the less active ones. Currently, dune activity extends in a 20 km band parallel to the coastline. There are 4 active dune fronts with progressively higher altitudes with 3 middle valleys occupied and stabilized by vegetation.

In this **pens or interdune areas**, material is also sandy but cemented and stabilized by the high water table, which causes waterlogging in winter. Consequently, dynamism of these areas is much lower and vegetation stable. In areas with deeper groundwater, the dominant vegetation consists of shrubs while in the rest it consist on lagoons herbs. Those pens that are flooded for much of the year have marsh vegetation. In all of them, plantations of stone pine (*Pinus pinea*) are abundant, perfectly adapted to these sandy soils.

As for the fauna, it is worth highlighting the presence of the long-tailed lizard (*Psammodromus algirus*), vipers (*Vipera lastati*), the Montpellier snake (*Malpolon monspessulanus*), Mulberry turtle (*Testudo graeca*), the alcotán, the short-toed eagle (*Circaetus gallicus*), the owl (*Tyto alba*), rabbit (*Oryctolagus cuniculus*) and, finally, the Iberian lynx (*Lynx pardina*), which is the symbol of the Park and is classified as endangered, and the wild boar (*Sus scrofa*).

3.2. The cotos

Located in the NW corner of the park, they consist of sand and dunes stabilized by lush vegetation that impedes their mobility. Less dynamic than the dunes, their morphology is stable and close to flatness with small ripples. The water table is closer to the surface than in the dune (although not as much as in the pens), with surface drainage and waterlogging in the rainy season despite the permeability of the sands.

The main ecosystems in these areas are:

- **Sabinares.** Generally occupy the drier (and highest) stabilized sand areas and are characterized by the presence of juniper (*Juniperus phoenicea*).
- **White forest.** Lower than sabinar stratum where the water table is still relatively low, it is constituted by a xerophytic low scrub where the *jaguarzo* (*Halimium comunatum* and *halimifolium*) predominates.
- **Black forest.** Located in lower areas close to the water table so that the dominant species are hydrophylic. It is worth noting the presence of heather (*Erica sp.*), the fibrous (*Calluna vulgaris*), the matagallina (*Daphne guidium*) and myrtle (*Myrtus communis*). The lowest end of the *cotos* are wetter, containing even lakes or ponds dominated by rushes (*Juncus maritimus*) and clubs (*Trifolium fragiferum*).

Cork oak (*Quercus suber*) forests, the native forest areas where the water table moisture was estimable, are preserved in some spots, accompanied by madrone (*Arbutus unedo*) and ferns.

The dominant fauna in these ecosystems consists of reptiles, birds and mammals. The former include the tortoise (*Testudo graeca*), the Montpellier snake (*Malpolon monspessulanus*), the common viper (*Vipera lastati*), common lizard (*Lacerta lepida*) and coliroja lizard (*Acanthodactylus erythururus*). The common partridge (*Alectoris rufa*), the magpie (*Pica pica*) and curlew (*Burhinus oedicephalus*) are the most representative species of birds. As for mammals, the common hedgehog (*Erinaceus European*), fox (*Vulpes vulpes*), genet (*Genetta Genetta*), mongoose (*Herpestes ichneumon*), the Dormouse (*Elyonix lusitanicus*), lynx (*Lynx pardina*) deer (*Cervus elaphus*) and wild boar (*Sus scrofa*).

3.3. The marsh

It is a flat, depressed area occupied predominantly by silt and clay from river deposits. The marsh today is clogged, closed to the sea and free of flood tide. Therefore, it is not a tidal marsh but, rather, a freshwater marsh. Its flat topography floods and hardly drains due to the base impermeability and a substantially shallow water table. It has a very marked seasonal alternation between winter (rainy and abundant water courses season) and summer (no input from rain and low flows in watercourses).

The essential role exercised by the Guadalquivir river and its tributary, the Guadiamar, in the functioning of the marsh was extremely minimized after the human efforts to dry the marshes during the last century. The construction of successive walls and dams on the Guadalquivir have led to the maintenance of its influence only in the left margin of the marsh. The Guadiamar was diverted to the Guadalquivir through the Tower arm. As a result, nowadays the marshes receive the primary water input from streams from the north farmland brooks and its main contributor, the Rocina brook. While the latter has an excellent water quality, the streams from northern plains suffer major pollution problems and increased erosion due to deforestation of their margins, thus contributing a significant sediments load to the area.

A large deep aquifer of high quality water underlies the marsh. The marsh and the aquifer are separated by an impermeable clay layer, hydrologically isolating them from each other to a large extent. The aquifer is intensely exploited to meet agricultural needs, giving rise to significant controversies and disputes.

The following different ecological domains can be distinguished in the marsh:

- Brooks and arms. Permanent water streams very abundant in the marsh. Vegetation only occupy the banks.
- *Lucios*. They are depressions that are flooded almost all year long with hardly no vegetation.
- Streaks and *paciles*. Emerged areas in the flooding zone. Generally correspond to ancient high dune ridges.
- Dry marsh. Northern part of the marsh, with short flooding periods usually not exceeding 3 months. It has a high salinity and typical vegetation includes *almajos* (*Salicornia sp.* and *Arthrocnemum sp.*) and other halophilic species.
- Flooded marshes correspond to the southern area. Flooding lasts longer than six months per year and reaches depths ranging from a few centimeters to half a meter. Major flooding determines the lower salinity.

The fauna occupying these marsh areas is extraordinarily rich and diverse. Some examples include toads (*Pelobates cultripedis*) and newts (*Pleurodeles waltii*), reptiles such as the *culebra* (*Natrix maura*) and a wide diversity of birds such as the cormorant grebe (*Podiceps cristatus*), the little grebe (*Podiceps*

ruficollis), purple heron (*Ardea purpurea*), red-crested pochard (*Netta rufina*), the Purple Gallinule (*Porphyrion porphyrio*) and the coot (*Chlidonias niger*). In the *lucio*, when the rest of the marsh dries, flamingoes (*Phoenicopterus ruber*), spatulas (*Roseate Spoonbill*), stilts (*Charadrius sp.*), Avocets (*Recurvirostra avosetta*) and plovers (*Charadrius sp.*) appear.

3.4. The Edge or Vera.

It is a narrow band (200 to 1500 m wide) that separates the *cotos* from the marshes. It is an important ecological discontinuity caused by a major fault; the topographic level drops from 3-5 m in the *cotos* to 1-2 m in the marshes. Also, changes occur in the water table, soils and vegetation. The latter goes from a white canopy to a depleted black canopy with isolated patches of heather and great development of ferns. Then we find grassland-poorer when the soil is sandy and richer in clay soils, closer to the marsh- and from this to the predominance of rushes that characterize the marsh. Here is where the greatest cork oaks (*Quercus suber*) of the park are found, remnants of the primeval forest, where spoonbills (*Platalea leucorodia*), herons (*Ardea purpurea*), gray herons (*Ardea cinerea*) and jacks (*Nycticorax nycticorax*) nest.

The whole area is endowed with great ecological wealth because its diversity is due to the presence of the two adjacent ecosystems. It is remarkable here the presence of lots of dune ponds produced by aquifer discharge of the dunes. The water levels vary and they are very often invaded by sand that sometimes destroys them.

Along with all these environmental units, the wide 30 Km long beach cannot be forgotten, as the natural southwestern border of the park. It has been modeled by the action of tides, the prevailing southwest winds (and waves) and the western coastal drift, that accumulates sediments throughout this stretch of the coast. Along the beach one can find multiple remains of marine sponges, jellyfish, sea molluscs, skeletons of sea urchins, cuttlefish or sea stars. A wide diversity of waterfowl can also be found which feeds on the microorganisms, molluscs and fishes that are found hidden in the sand or along the coastline. There are two groups of waterfowl:

- The waders, characterized by having long, thin beaks to pierce the wet soil and look for food. The most important are the dunlin, the sanderling (*Calidris alpina* and *Calidris alba*), the oystercatcher (*Haematopus ostralegus*), and two varieties of plovers (*Charadrius hiaticula* and *Charadrius Alexandrinus*).
- The gulls, fishers or scavenger birds that are constantly flying over the waves. The most significant are the terns (*Sterna sp.*), the black-headed gull (*Larus ridibundus*), the dark gull (*L. fuscus*) and the herring gull (*L. argentatus*).

That is essentially the space we are going to visit, a large pristine place with very high environmental values. But you might wonder how it is managed to conserve these natural features, so we will briefly review the land use, colonization and management history of this region.

4. The history of the occupation of the park.

The origin of the Doñana ecological wealth is not only due to its intrinsic natural values but also to the fact that until a few decades it was deemed unfit for human habitation. The land was not good for agriculture and malaria was one of the scourges of the area until quite recently. Until the twentieth century people settled in the rich lands surrounding the current National Park. They farmed in the vicinity of the settlements and left the rest of the space (sand and marshes) as open areas for communal harvest, hunting or fishing. Some of the most important traditional uses in the area included:

- Hunting of deer, wild boars, rabbits, and birds.

- Collection of pine nuts and herbs.
- Charcoal extraction from pineapples. Numerous samples along the park still remain.
- Fishing and shell-fishing along the entire coastal strip of the park.
- Grazing, consisting essentially of vacant marshland cows and mares.

This distribution of uses, conditioned by the severe natural conditions, has been responsible for the virginity of Doñana until the 20th century.

In the XIXth century, Spain completed a transition from a stratified society under a feudal system to a modern society. Large expanses of land that had been owned by the church and the aristocracy, as well as some communal lands, were privatized. Some areas that remained exempt from confiscation passed to public hands and were key to subsequent forest uses. As a result of the process of confiscation, in 1850 the biggest sandy areas in the Doñana region became property of the Medina-Sidonia Villafranca family; and in 1897 the area finally passed to the Jerez bourgeoisie, the Medina-Garvey family, who made this land a luxury hunting ground for aristocrats and naturalists.

This process involved not only a change in ownership of the land, but also a change in the vision that people had of it, because that unhealthy, unproductive and marginal land was then 'discovered'. This discovery was made from two different perspectives: the romantic travelers from conservation approaches and the technical engineers with productivist approaches. They are the source of two parallel lines (conservationism and productivism) that still persist and have generated the major conflicts that are still ongoing today.

5. The conservationist and naturalist approach: the National Park status

The image of a particularly beautiful place worthy of being preserved (marshes and scrubs) was forged in the nineteenth-century romantic paradigm. Doñana became one of the key images of romantic Andalusia despite not being steep or mountainous. Naturalists and scientists studied the area and started efforts to protect it from potential development pressures (tourism, agriculture, etc.). A successful campaign at both the national and international levels highlighting the environmental values of Doñana resulted in the declaration of Doñana and the Guadalquivir marshes as a zone of exceptional interest in 1962 during the European Conference of the International Union for Conservation of Nature. In 1963, the World Wildlife Fund (WWF) bought 6,794 hectares in Doñana and transferred them to the Spanish Government. The Government created the Doñana Biological Station on that site, under the Council for Scientific Research (CSIC).

The conservation option prevailed and in 1969 Spain contributed to the International Year of Conservation creating the Doñana National Park, with 37,425 hectares, which would be expanded substantially in 1978 to reach 52,720 hectares, surrounded by a large pre-park area of protection. Overall the Doñana Park is made up of more than 100,000 hectares of protected space. Moreover, the Doñana National Park has been labeled a Biosphere Reserve of UNESCO under the MaB Program and received the Diploma of Europe in 1985, and has also been listed by the Ramsar Convention as a wetland of international importance.

6. The productivist approach in Doñana

In contrast to that line of protectionism, agronomists, geologists, technicians and engineers from different companies led important development efforts in the region starting in the nineteenth century. Such efforts were rooted in the illustrated mindset of the 18th century, with its emphasis on the notion of progress and

the commitment to sanitation and profitability of resources. Afforestation and drying of the ponds and marshes (essentially to farm them, but not only for that) were triggered under this philosophy.

The drying of the marshes began with the channelization projects of the Guadalquivir marshes in the nineteenth century. Some of the projects were never carried out both for technical reasons and because of the opposition from affected municipalities. In the second half of the twentieth century, due to new technological possibilities and to the continued presence of the state, this process is accelerated, colliding with conservationist approaches. Of the approximately 150,000 hectares of marshes that existed on both sides of the Guadalquivir, only 35,000 are currently in "natural" condition (mostly within the boundaries of the National Park). Among other anthropogenic uses that transformed the area it is important to mention the part of the marsh dedicated to aquaculture or transformed into salt mining that we will see in our visit to Veta la Palma.

The intensification of the process of human occupation of this space takes place in the last forty years with the appearance of two new high-impact phenomena: intensive agriculture and the emergence of mass coastal tourism.

7. The current situation of Doñana National Park: problems and conflicts.

There are currently two main obstacles to the conservation of the natural values of the Doñana region. On the one hand, technological developments and the growth of the tourism industry have converted an area that had been traditionally rejected as a coveted space for competing economic uses: agriculture (rice and strawberry farming primarily) and mass sun and beach tourism. The development of these sectors are largely incompatible with the conservation of the natural values of the Park, but they are well received by the locals as the main drivers of economic development for the area. As a result the Park has been often perceived as an obstacle to development by the local population, which greatly complicated management and threatened their growth.

On the other hand, its location at the lower part of the Guadalquivir river basin, makes it the recipient of the problems of a broad region which very often performs detrimental practices to the National Park. Therefore, Doñana suffers attacks whose source is frequently very distant from the Park itself and, consequently, very difficult to manage. Infrastructural efforts to control and regulate the Guadalquivir river, point and nonpoint source pollution that flows to the river as well as soil erosion that occurs upstream affect indirectly the water supply to the marshes.

In turn, these problems reflect the conflicts that arise when trying to harmonize conservationism and productivism. Recent positions want to reconcile these two views, even making them complementary (Doñana as a regional center of development), under the discourse of sustainable development. However, numerous problems and conflicts still threaten aquifer levels, particularly during periods of aridity and drought when rice farming is in full swing. All this evidence to what extent it is difficult to maintain a marsh area in the middle of an irrigated area of similar size to the park itself.