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The Science-Policy Interface: Perceptions and Strategies of the Iberian 'New Water Culture' Expert Community

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ABSTRACT: There is a normative consensus that science should contribute to decision-making in environmental policy, given that science provides a means of understanding natural systems, human impacts upon them, and the consequences of those impacts for human systems. Despite this general agreement, however, the means through which science is transmitted into policy is contested. This paper envisions several of the competing characterisations of the science-policy interface as a continuum with the endpoints of 'fortress science' and 'co-production', and applies this continuum in an empirical analysis of the transboundary expert community promoting a 'new water culture' on the Iberian Peninsula. In engaging directly with members of this community, the paper finds that these characterisations are better seen as strategies among which scientists and their communities may choose and over which they may disagree. These trade-offs and disagreements in turn have implications for policy impact.

KEYWORDS: Water resources management, science-policy interface, New Water Culture, Spain, Portugal

INTRODUCTION

Given the complexity of environmental issues, there is a general consensus that science should contribute to policy making in this arena (Haas, 2004; Steel et al., 2004; Bracken and Oughton, 2013). It is also broadly assumed that for this contribution to bear fruit, the gap between science and policy must be bridged (Sarkki et al., 2013). What exactly this gap looks like and what the most effective means of bridging it, however, are debated. Those taking a positivist view of science, for example, argue that the scientific community operates very differently from the political community and that the usefulness of science for policy depends upon maintaining its integrity. Analysts working from a constructivist perspective, on the other hand, perceive very little difference between the human endeavours of science and politics and argue that influence by the scientific community under some circumstances may present a challenge to democracy.

What most of these studies have in common is that they evaluate the processes involved in science, and the transmission of science to policy, from outside the scientific community directly implicated in that interface. These studies rarely involve, as Miller and Neff (2013) put it, 'wading into the weeds'. It is important to engage with, at a micro-scale, scientists and their communities. Analysing how scientists themselves view and negotiate the boundaries between science and politics is necessary to comprehending "how and why science policies are effective (or not)" (Miller and Neff, 2013: 302). I seek to address this deficiency by stepping into the "neglected space" (ibid: 309) inhabited by experts from a variety of scientific disciplines that have formed a community that seeks to redefine water management policy on the Iberian Peninsula.

I first consider the literature on the science-policy interface,[1] and establish that the competing conceptualisations (views from the outside) set forth in this literature may be envisioned as points on a continuum. Utilising this continuum, I then engage with scientists and technical experts on the Iberian Peninsula who formed a multidisciplinary, transboundary community (the 'new water culture' movement), developed a scientifically grounded consensus on water management issues, and attempt to steer public policy toward a more integrated, sustainable and ecosystemic-based consideration of the Peninsula's water resources. I play two roles in this analysis: that of outside observer, applying the continuum model to characterise how the new water culture movement generated scientific knowledge and how this knowledge was transmitted (or not) into policy over time; and that of embedded participant in the community, 'wading into the weeds' in order to ascertain how these front-line experts themselves view the role of science in policy, and what they consider to be the most effective strategies for transmitting the former to the latter. Further, I explore how these views influence the community's actions, and what the consequences of these strategies and actions are for policy impact.

I utilise the following qualitative data-gathering techniques: semi-structured interviews of key actors in the scientific community; document analysis; and observation of, and participation in, several of the community's activities (see Appendix 1). This micro-scale engagement yields insights regarding scientists as important agents in shaping the environment in which the science-policy interface exists. First, the competing analytical *characterisations* of the interface set forth in the science and technology policy literature are considered by several members of the new water culture community to be front-line *strategies*, among which they may choose. Second, the scientific community is not simply being observed and evaluated by outside scholars; rather, the observation and evaluation go both ways. Key members of the community cited the same literature that I used to develop interview questions and it was clear that they had evaluated the literature's strategic and normative implications for their own activities and efforts. Third, when considered from the outside, the science-water policy interface in this case may be characterised by more than one point on the continuum. Fourth, viewed from the inside, community members see the points on the continuum as conscious strategies with important trade-offs. Moreover, there are significant disagreements in the community about the role of science in policy (continuum points), which sometimes were drawn along disciplinary or state boundaries. The strategies, trade-offs, and disagreements all appeared to affect policy impact.

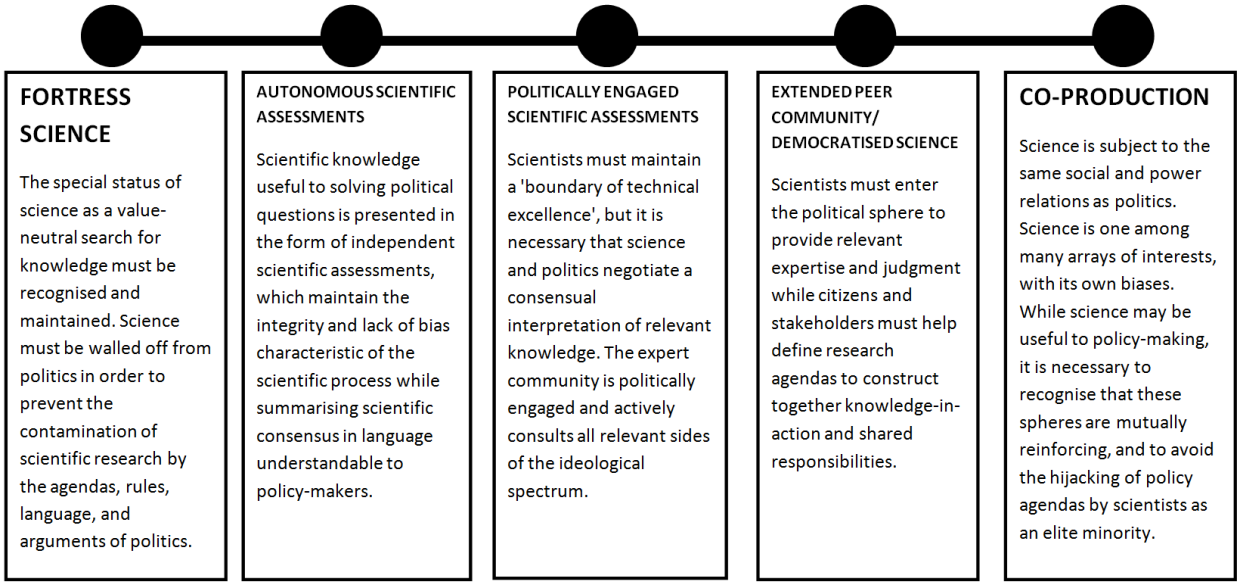
THE SCIENCE-POLICY INTERFACE: CONCEPTUALISING A CONTINUUM

In the burgeoning literature on the role of science in environmental policy making, one key point of disagreement is whether or not the processes and rules of science are significantly different from those of politics. How one answers this question has implications for both the empirical and normative assumptions regarding the science-policy interface. If positivist assumptions of science are maintained, then science is the closest humans can get to 'truth', and policy is best served when science is walled off from politics to safeguard scientific objectivity and legitimacy. If constructivist assumptions prevail, then it is impossible to separate the human endeavours of politics and science and doing so creates a false dichotomy; in the policy realm, we must then understand science and politics as co-produced, and participation of stakeholders is necessary to achieve better policy and safeguard democracy. Many studies seek to bridge these two opposing views through, for example, recommending the use of

[1] The term science-policy interface has been used to describe specific institutional arrangements (e.g. convening of expert panels by ministries, workshops, informal and formal networks) through which scientific expertise may inform policy (e.g. Engels, 2005). I use the term here to capture the more general conceptualisation of knowledge transfer between those primarily engaged in scientific research and those primarily engaged in public policy making.

scientific assessments. These competing perspectives of the science-policy interface may be visualised as a continuum, illustrated in Figure 1.

Figure 1. The science-policy interface continuum.



Endpoint one: Fortress science

Scientific inquiry in this perspective involves a theory-grounded testing of hypotheses through the collection, observation, and analyses of empirical data. In this view, science is incremental and cumulative, replicable, and self-correcting through the peer-review process (Dessler and Parson, 2010). Its practitioners and advocates consider science as the procedure through which humans can come closest to a value-neutral search for 'truth' (which in scientific terms means achieving high confidence in the evaluation of a particular phenomenon). It is "at its best a *social enterprise*" since "every researcher or team of researchers labours under limitations of knowledge and insight, and mistakes are unavoidable; yet such errors will likely be pointed out by others" (King et al., 1996: 9, emphasis in original). Science is assumed to further knowledge and human progress.

Advocates of the positivist view of science see politics operating under very different rules and so when considering the role of science in policy recommend a conscious separation between the two worlds to maintain the objectivity, autonomy and integrity of science. The motivations of participants, language used, and rules of acceptable argument are very different for scientists and politicians. Notably, the rules are much looser for the latter, allowing for selective or biased claims, appeal to emotion, and personal attacks (Dessler and Parson, 2010). To prevent the influence (assumed to be undesired) of politics on science, then, the positivist view recommends that barriers be placed between the two communities; that is, to the extent possible, science should be walled off from politics. Scientists must be allowed to pursue questions of intrinsic interest through their own rules, and then policy-makers may be informed by this objective information if they choose to use it. Steel et al. (2004), for example, find that while policy-makers, non-governmental organisations (NGOs) and the public want to see scientists more directly involved in natural resources management issues, many in the ecological science community themselves are reluctant to enter the political fray because of their culture of science and concern that they may decrease their credibility.

Endpoint two: Co-production

The opposing endpoint on the continuum has at its base a constructivist critique of traditional science. The works of Kuhn (1970) and Feyerabend (1975) are often used as jumping-off points to challenge the assumption that science is a dispassionate, self-correcting, and cumulative progression to ever-greater knowledge. Under rubrics such as science and technology studies (STS), these approaches see science as subject to the same forces as politics. Through strategies such as 'stage management', networks of scientists and their backers can construct a consensus on what is considered to be factual and important, thereby excluding other actors and views (Lidskog and Sundqvist, 2015). Other studies critique the peer-review process as biased along a variety of dimensions (Chubin and Hackett, 1990; Smith, 2006), including gender (Wennerás and Wold, 2001), and/or consider the funding of scientific research as biasing or limiting that research and introducing political or commercial agendas (Roy, 1985; Krimsky, 2003).

In her influential work in STS, Jasanoff (2004) develops the concept or 'idiom' of co-production as a framework of analysis for the science-policy interface:

> co-production is shorthand for the proposition that the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it… Scientific knowledge, in particular, is not a transcendent mirror of reality. It both embeds and is embedded in social practices, identities, norms, conventions, discourses, instruments and institutions – in short, in all the building blocks of what we term the *social* (Jasanoff, 2004: 2, emphasis in the original).

Normative claims on this end of the continuum are thus most concerned not with the contamination of science by politics, but rather by the possible 'tyranny of science' (Feyerabend, 2011) and the potential of scientists to undermine democracy. In this view, then, the special status of positivist science is a myth, and science needs to be understood as being both influenced by, and influencing, wider societal processes including politics. Scientists may benefit from the conceptualisation of science as a fortress but the rest of society does not; therefore, rather than be protected, the fortress must be dismantled. Clear-headed policy-makers can then see scientists as just one of many arrays of interests, and avoid the hijacking of policy by scientists as an "elite minority" (Keller, 2009: 28) based on a false conceptualisation of objectivity.

Between Fortress Science and Co-production, we may identify several other points on the continuum that conceptualise the science-policy interface. These perspectives specify possible bridges that result in science informing policy, with those closest to Endpoint 1 considering science most impactful if it is protected sufficiently from the vagaries of politics, and those closest to Endpoint 2 considering impact more likely in cases in which a variety of stakeholders are engaged.

Interval 1: Autonomous scientific assessments

Democratic processes involve normative, not positive, considerations, but "scientific knowledge about the consequences of alternative courses of action is necessary for responsible public decision-making on environmental issues" (Dessler and Parson, 2010: 51). This knowledge cannot be useful, however, if it is contaminated by political machinations, or even if well-meaning political actors fail to understand it because of their limited training in science. Scientific assessments may be a potential solution, provided several conditions are met. Assessments must provide "an accurate and authoritative summary of current knowledge" assembled from the best relevant science; they must be bias- and value-free, and not favour any side of the policy debate; they must communicate in language clear and understandable to policy-makers; they must be useful in terms of both timing and answering questions directly relevant to policy; sometimes, they may need to include explicit judgments, based firmly on the science but going beyond what would be included in peer-reviewed publications (ibid: 57). While certainly subject to criticism, assessments of the Intergovernmental Panel on Climate Change (IPCC) and the World

Commission on Dams (WCD) largely meet these conditions (Committee to Review the IPCC, 2010; Moore et al., 2010).

Interval 2: Politically engaged scientific assessments

Botcheva moves a step further away from the Fortress Science endpoint. Like Dessler and Parson (2010), she sees scientific assessments as a potential bridge between science and policy, but contradicts their conditions for assessment effectiveness. While acknowledging the important role of scientific expertise in environmental issues and the need to maintain a "boundary of technical excellence", Botcheva (2001: 198) takes the view of knowledge as socially constructed and interpreted through the lens of different societies, institutions, and cultures, and shares the recommendation of Skodvin and Underdal (2000) that science and politics must negotiate a consensual interpretation of relevant knowledge. She views assessments, then, as legitimate and useful to policy not to the extent that they remain autonomous from politics, but rather to the extent that they are politically engaged and include views across ideological perspectives (Botcheva, 2001).

In her case study of the implementation of EU air quality legislation in Poland, Botcheva argues that the most successful assessments in terms of 'uptake' into policy processes were those that involved respected environmental economists who had long-standing relations with the policy establishment at the national and EU level, as well as with industry. In completing the assessments, the expert community actively brought in these actors, along with non-governmental interests, thus achieving buy-in across the political spectrum without compromising their technical expertise.

Interval 3: Extended peer community/democratised science

In their conceptualisation of 'post-normal science', Funtowitz and Ravetz (1994: 1882) seek to break down the boundaries between science and politics more completely. In complex policy domains involving natural systems, "facts are uncertain, values are in dispute, stakes are high, and decisions urgent". Because of these conditions, they call for boundary-crossing in both directions. First, research scientists should, and do, enter the political fray of policy making, providing not only expertise but also judgment on policy options based on this expertise. Second, citizens and stakeholders should be consulted to define research agendas. Given the scientific uncertainties and competing values involved in environmental policy issues, post-normal science is characterised by an 'extended peer community' akin to, but far beyond, the traditional peer-review process. This stakeholder involvement also widens the consulted community beyond the political engagement recommended by Botcheva. People directly impacted by an environmental problem, in this view, "will have a keener awareness of its symptoms… and a more pressing concern with the quality of reassurances" than anyone else (Funtowitz and Ravetz, 1994: 1885). Citizen and stakeholder involvement as part of the peer community is essential in assuring the quality of both scientific assessment and policy actions.

Another approach that captures, and also broadens, the idea of co-producing science with society is transdisciplinarity, defined as "research that addresses the knowledge demands for societal problem solving regarding complex societal concerns" (Hadorn et al., 2006: 122). To address complex problems such as climate change or depletion of natural resources, full participation of not only specialists from multiple disciplines but also from all relevant societal actors is necessary at every stage of the research process.

In breaking down what are considered to be falsely constructed barriers between science and politics, the approaches presented here represent a point on the continuum closest to the Co-production endpoint in the view that scientists cannot be insulated from the policy process, and in the goal of democratising science. The Extended Peer Community analysts, however, do not go as far as their Co-production counterparts in the concern that the scientific community as an elite minority will hijack the policy agenda.

WATER RESOURCES MANAGEMENT POLICY IN SPAIN AND PORTUGAL: ATTEMPTING TO SHIFT A PARADIGM

The policy problem and its context

Water resources management has long been a complex public policy issue in Spain and Portugal. This issue also has an important transboundary component, as the Iberian states are integrally connected, sharing five principal river basins.[2] Precipitation patterns on the Peninsula vary significantly on a seasonal, yearly, and geographic basis (Ramos et al., 2014). Iberian river basins are characterised by medium to severe water stress (European Environment Agency, 2016), and both countries also have experienced a trend toward increased drought frequency and severity, expected to worsen with climate change (Iglesias et al., 2010; Lorenzo-Lacruz et al., 2013).

Water management policy in Spain and Portugal has been dominated historically by the 'traditional hydraulic paradigm' (Sauri and Del Moral, 2001; Pato, 2013), emphasising increase of supply through the state-directed and publicly funded construction of large hydraulic infrastructure, particularly dams, reservoirs, and interbasin transfer systems. Human control over 'erratic' precipitation patterns on the Peninsula was seen as necessary to achieve prosperity and modernisation. Technological advances in hydraulic engineering made this vision a reality during the countries' respective periods of dictatorship in the 20th century, and the traditional paradigm generally continued after their transitions to democracy beginning in the mid-1970s (Swyngedouw, 2015; Reino et al., 2008).[3]

Water policy legislation in both countries during the period of democratic transition was intended to modernise legal and institutional water management frameworks. For Spain, this included territorial decentralisation and transfer of competences to newly established Autonomous Communities (regional governments) (Costejà et al., 2004). As mandated by the 1985 Water Law in Spain, the Socialist (PSOE) Government presented its Draft National Hydrological Plan (APHN) in 1993. The proposed plan continued the traditional approach and included large-scale water transfers from the wetter north and west to the drier south and east (Arrojo Agudo, 2010). The release of the draft plan also created a crisis in Spanish-Portuguese relations, since it would potentially impact shared river basins (Bukowski, 2011).

The Iberian states also faced environmental and economic crises caused by a drought from 1993 to 1995, which underscored the adverse impacts of the traditional hydraulic paradigm. A steady increase in water consumption and deterioration of water quality had triggered tensions among territories, communities, and economic sectors in competition for the resource (Santafé Martínez, 2003). As the drought persisted, policy-makers were under mounting pressure from civil society to find solutions to problems of water quality and quantity, domestically and bilaterally. The Spanish central government also had to contend with the so-called 'water wars' among its regional governments (López-Gunn, 2009).

The direction of water policy in Spain and Portugal was impacted by the negotiations (1995-2000) and then implementation of the EU Water Framework Directive (WFD). The two states engaged in parallel bilateral negotiations (1994-1998) of the Convention on Cooperation for the Protection and Sustainable Use of the Waters of the Spanish-Portuguese Basins (Albufeira Convention). The negotiations leading to Albufeira were influenced by the anticipated WFD requirements, for example transboundary institutional cooperation in elaborating river-basin management plans, achieving good status of water resources, and public participation (Barreira, 2007).

[2] The Miño/Minho, Limia/Lima, Duero/Douro, Tajo/Tejo and Guadiana. Two-thirds of their borders are established by these rivers or their tributaries. Spain is generally upstream, generating around 70% of the average yearly water flow of the shared rivers.

[3] Spain has 1082 dams, placing it 9th in the world for total dam construction. Portugal ranks 23rd, with 217 (International Commission on Large Dams, 2016).

Sources of scientific knowledge on water resources and formation of the New Water Culture Movement

Managing water resources, always a difficult policy issue, has thus since the mid-1990s become even more complex for policy-makers at all levels of governance on the Iberian Peninsula, due to the political situations and deterioration of the resource described above. Scientific research in a variety of academic disciplines, emerging especially after the fall of the Spanish and Portuguese dictatorships, indicates that the implementation of water management policy consistent with the traditional hydraulic paradigm has contributed to problems in both the quantity and quality of the resource. Generation of scientific knowledge and opposition to the traditional hydraulic paradigm have been embodied in the 'new water culture' movement, a transboundary expert community of academics and professionals from a variety of water-management-related fields whose core is the New Water Culture Foundation (FNCA)[4] (Bukowski, 2016). This community seeks to shift the focus of policy making toward an ecosystemic and sustainable consideration of water (FNCA, 2016).

The FNCA was founded formally in 2002, but the community had been developing since at least the early 1990s. It was preceded by COAGRET (Coordinator of Those Affected by Large Dams and Water Transfers), an NGO formed in 1995 through an initiative of Greenpeace Spain and the environmental umbrella group CODA (Coordinator of Environmental Defence Organisations). COAGRET brought together stakeholders, water experts, and activists to oppose hydraulic infrastructure projects, especially water transfers. Several of the scholars who would found the FNCA were also instrumental in forming COAGRET.

Many of these same academics also served on the organising committee of the first Iberian Congress on the Management and Planning of Water held in Zaragoza in 1998. The Congress was organised as an academic conference,[5] was given institutional support by 70 Spanish and Portuguese universities, and is a snapshot of the prevailing science across academic disciplines. As indicated in Appendix 2, the invited keynote speakers were predominantly senior university researchers. A consensus document derived from the research presented at the conference would then become the basis for the founding principles of the FNCA when it was constituted in 2002 (Interview – Jimena de la Frontera, 16 May 2013). An analysis of the founding membership (summarised in Appendix 2) also indicates a prevalence of senior scholars from all disciplines relevant to water management policy.

The academic consensus behind the new water culture movement was built upon a cumulative body of scientific research across multiple academic disciplines, carried out largely by senior scholars at research universities. Founding FNCA members were part of this well-established and respected cohort of researchers from both sides of the border. Several of these founding members, particularly those who had been active in NGOs such as COAGRET prior to the formation of the FNCA, also sought to harness the scientific consensus to actively shape the policy process. After the 1993 release of the Spanish Draft National Hydrological Plan (APHN), advocates of a new water culture focused particularly on opposing the large-scale hydraulic infrastructure and water transfers envisaged by the plan.

The FNCA position, derived from the prevailing scientific research, is that the traditional hydraulic paradigm has had empirically demonstrable negative impacts on natural systems, including: deterioration of water quality and quantity in rivers, aquifers, wetlands, lakes, etc; contamination of these water resources (especially diffuse agricultural pollution) and associated ecosystems and habitats; salinisation of freshwater systems; and introduction of invasive species. These negative impacts on natural systems in turn have adverse effects – also empirically verifiable – on human systems (Martínez Gil, 1997). An explicit goal of the FNCA is that water management policy should

[4] Fundación Nueva Cultura del Agua/Fundacão Nova Cultura da Água.

[5] The FNCA continues this academic tradition by holding Congresses every two years.

consider and reflect this scientific knowledge in order to improve the condition of natural and human systems on the Peninsula.

Given the FNCA's holistic focus on river basin ecosystems, it also has had a transboundary emphasis on the shared Iberian rivers and the river basin management plans required by the WFD. One of the primary areas of the group's academic focus was on the Albufeira Convention, particularly in evaluating the treaty provisions and their implementation. When the implementation of Albufeira provisions slowed,[6] the transboundary focus shifted to WFD joint basin management requirements.[7]

Strategies of the scientific community for transmission of science into policy

The FNCA implemented four main strategies for transmitting scientific research into policy. First, in marshalling scientific credibility in the 1st Iberian Congress and in soliciting the founding membership of the FNCA, key organisers sought out 'the best CVs' in water resources research that would represent all relevant disciplines and ensure a variety of political and academic perspectives (Interview – Seville, 7 June 2013). The FNCA could have taken different forms, according to one founding member, as purely an NGO or purely an academic organisation. The founders decided strategically to make it both. It began (in COAGRET) with scholars who were concerned with changing the traditional hydraulic paradigm. They then recruited top researchers across the spectrum of disciplines and political ideologies, many of whom had no interest in activism. The purposeful recruitment of engineers also 'covered that flank', since engineering had dominated water policy throughout the entire period of the traditional hydraulic paradigm (Interview – Jimena de la Frontera, 18 May 2013).

Second, given that many tenets of the new water culture have been bolstered by evolving EU environmental legislation – particularly the WFD – the FNCA also made efforts to upload its normative values and goals to the European level. In 2002, FNCA leaders composed an open letter to the European Parliament (EP) summarising their opposition to the traditional hydraulic paradigm. This letter was signed by Iberian researchers with 'the best CVs', and as such also garnered the support of over 100 rectors of Spanish and Portuguese universities (Interview – Seville, 7 June 2013). In 2004, the FNCA initiated a series of meetings among like-minded members of the scientific community across Europe. The culmination of this effort was the European Declaration for a New Water Culture, an elaboration of the main FNCA principles signed by 100 water experts from 19 European countries and supported by 30 national, European, and international governmental and non-governmental groups (*European Declaration*…, 2005). These European and international contacts increased the FNCA's prestige, in turn attracting more top academics on the Peninsula to join (Interview – Jimena de la Frontera, 18 May 2013). The FNCA frequently engages and invokes 'Brussels' to legitimize their demands for policy change inside Spain and Portugal and in the transboundary basins.

Third, the FNCA cultivates and supports 'social networks' of stakeholders and citizens at the river basin or regional levels (Hernández-Mora and Ballester, 2011). In areas impacted by large hydraulic infrastructure projects, academics in COAGRET actively sought civil society input in formulating the new water culture precepts. The FNCA's membership includes basin-level activists (and in some cases the scientists themselves may also be considered political activists). The FNCA's priorities for research projects (e.g. water markets or alternative agricultural development models) are defined and executed with the participation of the activists alongside the scientists. The social networks are then supported through provision of directly relevant scientific data, thus arming these civil society groups with expert

[6] For example, there were no meetings of the primary transboundary institutional structure set forth in the Convention, the Conference of the Parties, from 2008 until 2015.

[7] 7th Iberian Congress: 'Iberian Rivers + 10. Looking toward the future 10 years after the WFD', Talavera de la Reina, Spain, February 2011. 8th Iberian Congress: 'Change of plans: Critical analysis of the first European cycle of hydrological planning and the expectation for the joint basin management plans for 2015 in Spain and Portugal', Lisbon, December 2013.

knowledge, which they in turn utilise to participate in the policy process. These efforts stem from a more general concern with encouraging democratic processes in post-dictatorship Spain and Portugal (Interview – Jimena de la Frontera, 16 May 2013).

Fourth, FNCA leaders leverage the academic prestige cultivated in the group's membership and scholarly activities to engage with and attempt to influence policy-makers directly. They request meetings with national, regional, and local environment ministries, invite high-profile politicians and cabinet members to the Iberian Congresses, organise workshops and seminars around specific themes of interest to policy-makers, and, as discussed below, are ready to respond quickly with relevant data on occasions in which they are asked directly to do so by those in power.

FNCA application of strategies and policy impact

Subsequent to the failure of the PSOE to gain support for a Spanish National Hydrological Plan (the final version of which was defeated in parliament in 1995), the centre-right Popular Party (PP) (after their election victories in 1996 and again in 2000) put passing such a plan high on the policy agenda and released their own draft in September 2000. This proposal reduced the volume of transfers by approximately half compared to the PSOE draft, in particular eliminating the politically charged transfers involving the transboundary basins. It concentrated instead on a transfer from the Ebro to the Mediterranean basins (in Almería, Murcia, and Valencia), and to Barcelona (Hernández-Mora, et al., 2014). Notwithstanding the significant reduction in volume, this plan still envisaged the construction of 120 reservoirs and more than 1000 km of canals and pipelines (Bakker, 2002). The PP Environment Ministry (MIMAM) then directly solicited expert knowledge on their draft, inviting over 100 scholars from various disciplines to write reports evaluating the proposal (Interview – Seville, 7 June 2013). In essence, these were scientific assessments from multiple academic disciplines of the PP's water management plan.

The assessments were apparently more negative, on balance, than the PP had anticipated. The reports were not made public by MIMAM, and in 2001 their National Hydrological Plan was passed by the PP-dominated legislature. Professor Pedro Arrojo Agudo, first president of both COAGRET and the FNCA, approached the Ministry to request a list of report authors, but MIMAM declined to provide the names. Arrojo, however, as a prominent member of the academic circle of water researchers, was able to determine most of the contributors. He asked them directly for their manuscripts and published 41 of these assessments in an edited volume (Arrojo Agudo, 2001). Appendix 3 provides a characterisation of this research in terms of academic disciplines from which it proceeded and rank of the researchers.

The new water culture expert community thus actively responded to MIMAM's withholding of the scientific assessments by making these public. Their science-policy interface strategy at that moment is encapsulated by the following statement of a founding member of the FNCA: "On the one hand it was a very valuable technical document, and on the other it had a lot of political impact because it evidenced the contradictions of the government" (Interview – Seville, 7 June 2013).

Another response to the PP hydrological plan was the community's backing of massive protests against the plan organised in Barcelona, Madrid, and Brussels by groups including the Platform for the Defence of the Ebro and COAGRET (Interview – Seville, 7 June 2013; El Pais, 24 February 2001, 10 March 2001, 9 September 2001). In a synergistic relationship, the activist members of the scientific community supported the civil society movements most directly impacted by the traditional hydraulic paradigm, which in turn raised awareness of the issues and engaged the political system to promote a policy agenda in line with the new water culture: "We take on the role of establishing the elements of ecological, juridical analysis, the question of public participation, the question of economics, and this we translate to the people who are in the basin" (Interview – Jimena de la Frontera, 16 May 2013).

The 2004 general election in Spain brought to power the Socialist (PSOE) government of José Luís Rodríguez Zapatero, and the 2005 general election in Portugal ushered in that of Socialist (PS) José

Socrates. Zapatero appointed as environment minister Cristina Narbona Ruíz, a former economics professor and long-time socialist politician who was sympathetic to new water culture precepts and who had a close relationship with several FNCA founding members. Socrates appointed as environment minister Francisco Nunes Correia, a civil engineering professor specialising in hydrology and water resources, and also a supporter of many of the new water culture principles (Correia, 1998).

In Spain, Narbona turned directly to the FNCA for policy advice. FNCA leadership had frequent access to the Environment Ministry and to Narbona herself, and was awarded significant funding from the Ministry to carry out research and promote the new water culture. One example was a "scientific-technical panel for the monitoring of water policy", in which Ministry funding was granted to organisers at the University of Seville. More than 30 water experts, many of them FNCA members, participated in the project.[8] An end-of-project conference featured public addresses by regional and local PSOE politicians and Cristina Narbona as the closing speaker (*iAgua,* 2008). The FNCA also was heavily involved in research and policy at the regional level, significantly in Catalonia, where members were contracted by the leftist government to develop a sustainable water basin management plan (Agència Catalana de l'Aigua, 2009).[9] This period was characterised as follows by a former president of the FNCA governing board: "And all these proposals get put forth to the Ministry of things we can do to help change this model of water policy in a very intense way" (Interview – Madrid, 28 May 2013).

In June 2004, the Spanish Environment Ministry cancelled the Ebro River Basin transfer contained in the PP's 2001 PHN. Narbona appears to have been convinced by the expert knowledge and arguments put forth by the FNCA (Interviews – Jimena de la Frontera, 16, 17 May 2013; Madrid, 28 May 2013; Seville, 7 June 2013; ABC, 2006), and acted even against entrenched interests in the PSOE in favour of the transfer (El Pais, 2004). The Ministry then introduced 'Plan AGUA', proposing significant investments in desalination plants, water reutilisation and the increased use of water banks, reorganisation of the water administration, water pricing reforms, and investment in water infrastructure to decrease losses (Muñoz et al., 2010). The FNCA supported this plan as a means of furthering some new water culture goals.

Despite initial hopes expressed by Portuguese FNCA members upon the appointment of Correia, neither funding nor direct access was forthcoming under the PS government. Correia attended the 2006 Iberian Congress in Faro along with Narbona, and expressed support for new water culture goals. Portuguese FNCA members describe a PS administration that did not solicit expert knowledge from scientists or NGOs (Interviews – Lisbon, 4 and 5 December 2013), despite a significant reform of Portuguese water law in 2005 designed in large part to enable transposition of the WFD (Thiel and Guerreiro de Brito, 2014). For example, to fulfil the WFD requirement of public participation, the government overhauled the National Water Council in 2004, and created Regional Water Councils in 2008 with the formation of the Hydrographic Region Administrations (river basin authorities, also required by the WFD). These councils were composed of members of the administration as well as stakeholders in the basins, including NGOs and the scientific community. Despite the appearance of soliciting input, however, membership on the councils was stacked in favour of government officials (Minuzzi and Bragança, 2011), the PS Environment Ministry was not willing to regularly consult

[8] See www.fnca.eu/panel-cientifico-de-seguimiento-de-la-politica-del-aguas

[9] The FNCA was awarded funding through *Convenios de Colaboración* (cooperation agreements) at the national level with the Environment Ministry (or its funding arm, the Fundación Biodiversidad) and through regional environment ministries or water agencies. These grants were awarded for the FNCA execution of specific projects, for example the above-mentioned development of a sustainable water basin management plan for Catalonia. In 2007-08 the FNCA received €365.000 from the Spanish Environment Ministry and €324.000 from the Catalan regional government. The group was also contracted by the Expo Zaragoza society (public funding) for €189.000 during that two-year period to develop and present projects for the Expo, 'Water and Sustainable Development' (Heraldo, 2009).

independent experts from academia, and positions expressed by NGO and academic members of the councils were often ignored (Interview – Lisbon, 13 March 2007).[10]

At the beginning of his second administration in 2008, Spanish Prime Minister Zapatero replaced Narbona with his former agriculture minister, who was much less convinced by FNCA principles. As a result, few of the proposed components of Plan AGUA were implemented. When the PP formed a government after the 2011 election, FNCA members noted an even greater decrease in access to the national government. Public funding of FNCA projects dried up, and policies shifted back toward the traditional hydraulic paradigm. At the regional level, the ousting of the left-wing coalition in the 2010 Catalan election had similar implications, as did the accession to power in Portugal of the centre-right Social Democratic Party (PSD) after the 2011 general election (Interviews – Madrid, 28 May 2013; Seville, 7 June 2013; Lisbon, 7 December 2013). The economic and political volatility in both countries subsequent to the global financial crisis has also resulted in a decreasing importance placed on environmental issues by the Iberian governments, making FNCA impact more difficult (Aguilar, 2013; Fidelis, 2013).

THE SCIENCE-POLICY INTERFACE: CHARACTERISATIONS

Fortress science: Assessments and the research/membership base

The body of scientific research demonstrating adverse environmental, economic, and social costs of the traditional hydraulic paradigm on the Iberian Peninsula has been developed largely through positivist scientific norms at research-oriented institutions, in response to observable phenomena such as eutrophication of a lake or diminishing groundwater resources. Recognition of the legitimacy of this 'behind-the-wall' science is arguably one of the main reasons why governmental and societal actors began to formulate the idea of a policy problem in water resources management that needed to be addressed.

The FNCA founding membership consists, on balance, of respected scholars and professionals from all relevant water policy disciplines, and their ongoing work contributes to the bodies of knowledge in those disciplines behind the fortress walls (Endpoint 1). One Portuguese member (a biologist), for example, describes how she purposefully separates her scientific and NGO work so that her research will be taken seriously in both academic and policy circles: "We have to show a cause-effect of what man does and what are the results for the state of ecosystems, and that's a challenge… That's what I'm interested in in my scientific role, and I want to apply it to actual problems" (Interview – Lisbon, 4 December 2013).

The PP's solicitation of expert reports comes close to meeting the requirements set forth by Dessler and Parson for autonomous scientific assessments. MIMAM consulted the foremost water experts in Spain and asked for an assessment of the proposed national water policy from each one deriving from his/her ongoing research. The reports were thus authoritative summaries of current knowledge from a variety of disciplinary perspectives, were written in language directed at policy-makers, were timely, and included, as requested, explicit judgments based on research. Not all the solicited reports were critical of the proposed plan, but there apparently were sufficient negative evaluations to alarm those PP policy-makers who wanted to move forward with it. Subsequently, when MIMAM withheld the assessments, Arrojo's publication of 41 of them in the 2001 edited volume resembles Botcheva's description of politically engaged scientific assessments. The publication of the assessments was

[10] A 2012 law recentralised water administration in Portugal by designating the RBDs as regional departments of a newly created National Water Authority (APA) (Thiel, 2015). This recentralisation was part of a general 'fiscal retrenchment' in southern European states as required by the so-called troika in exchange for aid pursuant to the global financial crisis (Di Mascio and Natalini, 2015)

designed to directly engage the political process by presenting a consensual interpretation that the traditional hydraulic paradigm, and thus the PP's plan, should be countered. The research presented, given the prestige of the reports' authors and their disciplinary and ideological diversity, maintained the "boundary of technical excellence" Botcheva (2001: 198) deems necessary.

Co-production: Development of an extended peer community

The FNCA's cultivation and support of the social networks falls very clearly onto Interval 3 of the continuum. Building on the activist origins of COAGRET, the FNCA identified communities that members considered to be negatively impacted by policies based on the traditional hydraulic paradigm, consulted local stakeholders on their major concerns (which then ended up as part of the FNCA's mission and goals), and in turn provided them with data and knowledge from a variety of academic disciplines to buttress their cause. This synergistic relationship continues in the networks and is reinforced by overlapping membership (Hernández-Mora and Ballester, 2011; Interview – Madrid, 28 May 2013).

Despite the decline in direct access of the FNCA to national and regional policy making since 2008, the cultivation of the social networks may be a compensating factor in terms of potential policy impact. In the spring of 2016, for example, the Platform for the Defence of the Ebro again organised public marches against a plan approved by the PP government that would increase by 50% the area under irrigation in parts of the river basin. The Platform also demanded minimum water flows in the final stretch of the river to guarantee the survival of the Ebro Delta ecosystem, a primary goal of the FNCA. By the organisers' count, some 50,000 people participated in the march in Amposta (in the region of Catalonia). Except for the PP and the recently-formed *Ciudadanos*, all main Spanish and regional political parties supported the position of the protesters including, unlike during similar marches in 2001, the conservative Catalan CiU (Rovira, 2016).

THE SCIENCE-POLICY INTERFACE: WADING INTO THE WEEDS

A micro-level engagement with members of the expert community reveals a more complicated set of processes occurring beneath the surface, and as Miller and Neff (2013) argue, provides important insights regarding how the perspectives of frontline scientists themselves contribute to the transmission of knowledge to policy. Notably, founding members of the FNCA were acutely aware of the STS literature and appeared to have mined it for useful strategies. This is an important reminder that scientists and their communities do not operate in a vacuum, and evidence that they may engage actively in learning and 'reflexive' approaches to the science-policy interface.[11] Moreover, strongly held differences in perspective among scientists in the community regarding frontline strategies tended to fall into the opposing analytical characterisations of Fortress Science versus Co-production. These differences of perspective regarding the role and rules of science generally and FNCA strategies specifically were articulated in the interviews and were sufficiently pronounced that they also figured prominently in a self-evaluation that the FNCA conducted as part of their 2007-2010 strategic plan (FNCA, 2006).

Both the interviews and self-evaluation document reveal a general consensus supporting rigorous scientific research on natural systems and the belief that science is a cumulative endeavour capable of building knowledge. There is a deep appreciation of the academic calibre of community members across disciplines, and respect for the academic integrity of members' research, especially as showcased in the Iberian Congresses. This scientific rigour and reputation for academic prestige are seen by members to be directly connected to the FNCA's capacity for influence. Consensus also exists on the FNCA's primary and 'unique' value:

[11] See, for example, Craye et al., 2005.

> … its ability to be a bridge between historically confrontational worlds… its capacity to identify theoretical models with practical application to successful projects… The FNCA's role has been as the vanguard in the development of knowledge with practical applications that makes possible the adoption, in practice, of the new water culture (FNCA, 2006: 3, translation by author).

Important differences in perspective exist, however, regarding the FNCA's strategies for building and crossing that bridge. Several prominent FNCA members interviewed indicated, in response to a request to discuss their perception of the recension of the Ebro transfer, that science and politics should, and can, be kept separate, and when Fortress Science was breached through close collaboration with the Narbona Ministry and insufficient criticism of Plan AGUA, the community's reputation for scientific integrity was compromised. Further, these members believe that any 'victory' in terms of policy impact was countered by the decline in the group's scientific legitimacy which in turn decreased its influence after 2008 (Interviews – Madrid, 27 May 2013; Lisbon, 5 December 2013). The strategic plan document indicated that among the primary concerns of members (compiled from questionnaire responses) were that the FNCA engaged in "acritical collaboration with authorities" and "excessive political positioning" (FNCA, 2006: 6).

This Fortress Science viewpoint was more prevalent among the engineers interviewed on both sides of the border, and among the Portuguese FNCA members of all disciplines. In the latter case, this appears to be due to differing cultural approaches to academia and activism. Portuguese scholars tended to express a concern (largely absent in interviews with their Spanish counterparts) that their membership in the FNCA could decrease their chances of securing government grants, academic positions, or promotions (Interviews-Lisbon, 4 December 2013).

Other key founding members of the FNCA, however, incorporated the constructivist, post-normal science vision of Funtowitz and Ravetz into their development of goals and strategies. One of these Spanish members, an economist, in response to a question regarding the role of science in policy, named these very authors and summarised their relevant points in the context of FNCA goals:

> It is the idea that the challenges that we face demand a different type of science and that this different science demands the presence of values and the presence of values demands directly involving those implicated, with the stakeholders and with citizens in general (Interview – Jimena de la Frontera, 16 May 2013).

This member and others also raised the 'tyranny of science' concern at the Co-production end of the continuum in criticising what they see as the specialised and exclusive language of the traditional hydraulic paradigm and particularly the neoclassical economics perspective that, in the words of an FNCA strategy document, "has confused progress with commerce" (FNCA, 1998). The strategy of 'the best CVs' and reinforcing the scientific prestige of the new water culture movement was thus a conscious counter ('stage management', in the language of Co-production) to this tyranny.

Members expressing a Co-production viewpoint also described as "pragmatic" and "necessary" the close, direct relations cultivated with politicians at the national and regional levels and support of the river-basin social networks (Interviews-Talavera de la Reina, 16 and 17 May 2013; Seville, 7 June 2013). In this view, seizing opportunities to actively transmit the precepts of the new water culture, including concerns of local basin networks, directly into policy, is an effective strategy. The rescinding of the Ebro transfer, in this view, is a clear policy victory that outweighed any negative impact of being too closely associated with the PSOE.

CONCLUSIONS

Setting forth the competing characterisations of the science-policy interface as points on a continuum is a useful starting point through which to analyse the new water culture expert community in their efforts to redefine water resources management policy on the Iberian Peninsula. Even before 'wading

into the weeds', we see that the community's generation of scientific knowledge and attempts to transmit that knowledge into policy appear to fall on various points of the continuum simultaneously. The micro-scale analysis then indicates that some of the community members themselves interpret the continuum intervals as conscious strategies for transmitting science to policy. Importantly, there is significant disagreement among community members regarding these strategies. These disagreements reveal important trade-offs in strategy that can affect policy impact.

Trade-off 1: Scientists may highlight (manipulate?) the status of the profession as a strategy, but if scientific integrity is not maintained, this strategy will not work.

Even among scientists in the FNCA who consciously engaged in 'stage management' in attempting to leverage scientific credibility with their policy audiences, there is an acknowledgement that the essence of science is different from that of politics, and that it does allow us to establish measurable cause-effect relations between important human and natural phenomena. Cultivating 'the best CVs' was a conscious strategy, but scientific prestige is not based on an illusion, as implied by the Co-production perspective. Despite the activist intent, the science was solid, as were the scientific credentials of FNCA members. This credibility contributed to important opportunities for the FNCA to impact policy at the regional and national levels in Spain. It may well be that lack of post-2008 influence is due, in part, to a decrease in this perception of scientific integrity largely because members were seen as crossing too far over into partisan politics. The trade-off lies not in the development of the scientific research underlying the new water culture, but rather in the specific decision to seize the opportunity in a particular way, to closely associate with the Narbona ministry to impact policy.

Trade-off 2: Engagement of civil society can be important for achieving policy goals, but too close an association may decrease credibility.

Transferring expert knowledge to civil society through the social networks and seeking stakeholder input fulfils the FNCA goal of democratising science and aiding the efforts of local communities. It is also an important part of achieving the community's policy objectives, as the local networks utilise the expert knowledge to engage the policy process to promote goals consistent with the new water culture. But close association with the social networks may also push the scientific community closer to the activist side, again running the risk of diluting their legitimacy as unbiased experts.

Trade-off 3: Is it still tyranny when the scientists are concerned with democracy?

This trade-off is also a critique of STS literature that characterises scientists as an undemocratic elite minority. This view is difficult to square with the FNCA. While some founding members' strategy *was* to enhance the community's scientific credibility to gain more political traction, it was for the purposes of combating the interests supporting the traditional hydraulic paradigm, improving the democratic process, and bettering the condition of aquatic ecosystems and human health and welfare. Again, the trade-off lies in choice and strategy. An issue raised by a prominent founding member, for example, when asked about the evolution of the FNCA, is that the activist members may be defining the parameters of debate around their democratic concerns in a way that excludes dissenting views (Interview – Madrid 27 May 2013) – that is, too much shareholder involvement may not result in either good science or good policy, and the FNCA needs to take care not to silence those voices within the community who try to raise this point.

This case demonstrates that a static characterisation of either science or policy is not fruitful, and that there is significant room for strategic choices by scientists and their communities that span intervals on the continuum. Moreover, these choices have important trade-offs for the ability of an expert community to transmit science into policy, which members themselves recognise and over which they may disagree. Cross-case comparison is necessary to more clearly delineate the consequences of these trade-offs for policy impact, for example across various environmental policy issue areas and engaging with various expert communities. The impact of disagreements on the role of science and on strategies among scientists within expert communities should also be explored further.

This case suggests that such disagreements, especially if they are drawn along disciplinary or geographic lines, could be problematic for the community's multidisciplinary and transboundary nature.

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APPENDICES

Appendix 1

Semi-structured interviews

I carried out 24 semi-structured interviews of members of the new water culture movement, the expert community on the Iberian Peninsula seeking to transmit science into water management policy.

Approval by the Committee on the Use of Human Subjects in Research (CUHSR). The interview process was approved by my university's CUHSR. Per university policy, I received informed consent from each interviewee. With interviewees' permission, all interviews were audio-recorded and transcribed.

Sampling. I engaged in purposive, non-probability sampling. From membership lists of the New Water Culture Foundation (FNCA), I targeted respondents representing the major academic disciplines relevant to water management policy, and also sought to balance the number of Portuguese and Spanish respondents. I contacted 20 potential interviewees via e-mail to request meetings prior to travelling to Spain and Portugal, and met with all of them. The other four interviews resulted from 'snowball' sampling, in which interviewees suggested others for inclusion.

Development of interview questions. The questions were developed to directly and indirectly probe the interviewees' views, strategies, and actions involving the transmission of science into policy, and were open-ended.

Interviews in Spain. 16 May-12 July 2013, Jimena de la Frontera, Seville, Madrid. 12 interviews. Academic disciplines represented: administration/management, agronomy, biology, civil engineering, economics, geology, human geography, hydrology, physics, public administration, sociology.

Interviews in Portugal. 3-8 December 2013, Lisbon. 12 interviews. Academic disciplines represented: biology, civil engineering, drought risk management, hydraulic engineering, international environmental law, physics, sociology, water and territorial planning.

Prior interactions/interviews with the expert community. The interviews described above built upon background data gained from two other sets of interviews that I carried out in 2006-2007 and in 2001. These prior interviews focused on Iberian transboundary cooperation in water resources management and implementation of environmental policy. Five of the 24 interviewees for the current study were also interviewed in 2001 and/or 2006-2007.

Document analysis

I analysed the following types of documents to determine the scientific underpinnings of the FNCA's conceptualisation of the new water culture: membership records and documentation of members' academic disciplines and level of training; the 45 keynote symposia papers presented at the 1st Iberian Congress preceding the founding of the FNCA; the 41 expert analyses solicited by the PP environment ministry and subsequently published (Arrojo Agudo, 2001); conference proceedings and conclusions from the eight Iberian Congresses.

Observation/Participation in FNCA activities

I participated as a paper presenter in two Iberian Congresses (2006 and 2013), observed FNCA activities at those Congresses and several other workshops, presentations and symposia organised by the FNCA. I also attended and observed the 'Annual Assembly' of members in 2013. I have interacted in person and via phone and e-mail with several founding members of the FNCA since 2001.

Appendix 2

1st Iberian Congress on the Management and Planning of Water: Keynote Addresses at Symposia

Academic discipline	No. of papers	No. of authors	No. of PhDs	No. of senior univ. researchers*
Engineering	12	19	12	12
Economics	7	13	11	6
Law/Policy	7	7	4	3
Biology/Ecology/Earth Sciences	6	6	6	3
Sociology/Political Science	3	4	4	3
Geology/Hydrology	2	2	4	2
Anthropology	2	2	2	1
Public Health	2	3**	2	3
History/Geography	2	2	2	2
Philosophy of Science	1	1	1	1
Architecture	1	1	1	1
Totals	45	60	49	37

*Defined as Full or Research Professors **One of these authors has an MD

Source: Congress proceedings, hard copy, provided by president of the FNCA governing board, 2013. Elaboration by author.

Theme of the Congress: 'The Water Debate from Academia: Toward a New Water Culture'. Sub-themes in the call for papers: 1) Urban, industrial, and health services uses of water; 2) Water and its agrarian use; 3) The ecosystemic management of water; 4) Water management, citizen participation, and sociopolitical conflict; 5) The institutional legal framework and water planning criteria; 6) Management of the river basins shared by Spain and Portugal. In addition to the keynote papers/presentations for each symposium (totalling 45, and considered in the Table above), 98 additional papers were presented, also under the six sub-themes.

Characterisation of founding membership

FNCA Founding Members (Total 102)

Academic Fields in Highest Level of Education (Total 107)

	PhD	MA/MS	Total
Sciences	24	8	32
Biology/ Ecology	14	7	21
Hydrology/ Geology	5	0	5
Physics	4	0	4
Chemistry	1	1	2
School of Business	12	1	13
Economics	10	1	11
Business	2	0	2
Social Sciences	16	2	18
Geography	10	0	10
Sociology	3	0	3
Anthropology	1	1	2
History	2	0	2
Philosophy	0	1	1
Engineering	10	8	18
Law	1	1	2
Professional			4
Education	0	1	1
Agriculture	1	0	1
Medical Sciences	2	0	2
Unknown			20

FNCA Founding Members (Total 102)

Professional Affiliations/Job Categories (Total 109)

University research and/ or teaching		60
Government		17
International	1	
National	8	
Regional	5	
Local	1	
State-owned water company	2	
NGO		6
NGO/Environment	4	
NGO/Other	2	
Private Law Practice		1
Private Sector/ Environment-Water Resource Management		4
Private Sector-Other		7

Secondary Education	2
Writer/ Environmental Activist	1
Engineering	2
Agriculture	1
Medicine/ Research	1
Unknown	12

For both tables above, the discrepancies among the total number of FNCA members, their academic fields and professional affiliations stem from the fact that some members have degrees in more than one field and/or more than one professional affiliation.

Source: Membership records provided by the FNCA Secretariat. Elaborated by author.

Appendix 3

Expert Reports on 2000 Draft PHN Solicited by MIMAM

Academic discipline	No. of reports	No. of authors	No. of PhDs	No. of senior university researchers*
Engineering	12	12	11	11
Biology/Ecology	11	13	11	8
Geology/Hydrology	7	7	7	6
Economics	5	5	5	4
Geography	3	6	6	6
Law	2	2	1	1
Anthropology	1	1	1	0
Totals	41	46	42	36

*Defined as Full or Research Professors

Source: Arrojo Agudo, 2001. Elaborated by author.

REFERENCES

ABC. 2006. Narbona: de aliada del trasvase a la 'Nueva Cultura del Agua'. 8 May 2006. www.abc.es/hemeroteca/historico-08-05-2006/abc/Sociedad/narbona-de-aliada-del-trasvase-a-la-nueva-cultura-del-agua_1421453952482.html (accessed 28 June 2016)

Agència Catalana de l'Aigua. 2009. *Agua y cambio climático: Diagnosis de los impactos previstos en Cataluña.* Barcelona, Spain: Generalitat de Catalunya. http://aca-web.gencat.cat/aca/documents/es/publicacions/escenaris_climatics.pdf (accessed 28 June 2016)

Aguilar, S. 2013. An increasingly peripheral concern: Spanish environmental protection and the economic crisis. Paper presented at the ECPR General Conference, Sciences Po, Bordeaux, France, 4-7 September 2013. http://ecpr.eu/events/paneldetails.aspx?EventID=5&PanelID=1058 (accessed 6 July 2016)

Arrojo Agudo, P. (Ed). 2001. *El Plan Hidrológico Nacional a debate*. Bilbao, Spain: Bakeaz.

Arrojo Agudo, P. 2010. The end of large-scale water projects. In Garrido, A. and Llamas, M.R. (Eds), *Water policy in Spain*, pp. 209-218. Leiden, The Netherlands: CRC Press/Balkema.

Bakker, K. 2002. From state to market? Water *mercantilización* in Spain. *Environment and Planning A* 34(5): 767-790.

Barreira, A. 2007. *La gestión de las cuencas Hispano-Portuguesas: el Convenio de Albufeira*. Technical-Scientific Panel on the Monitoring of Water Policy, Seville, Spain: Ministry of the Environment. www.fnca.eu/images/documentos/politica/informes/La%20gesti%C3%B3n%20de%20las%20cuencas%20hispano-portuguesas.pdf (accessed 15 February 2016)

Botcheva, L. 2001. Expertise and international governance: Eastern Europe and the adoption of European Union environmental legislation. *Global Governance* 7(2): 197-224.

Bracken, L.J. and Oughton, E.A. 2013. Making sense of policy implementation: The construction and uses of expertise and evidence in managing freshwater environments. *Environmental Science and Policy* 30: 10-18.

Bukowski, J. 2011. Sharing water on the Iberian Peninsula: A Europeanisation approach to explaining transboundary cooperation. *Water Alternatives* 4(2): 171-196, www.water-alternatives.org/index.php/volume4/v4issue2/138-a4-2-5

Bukowski, J. 2016. A 'new water culture' on the Iberian Peninsula? Evaluating epistemic community impact on water resources management policy. *Environment and Planning C*, in press.

Chubin, D.E. and Hackett, E.J. 1990. *Peerless science: Peer review and US science policy*. Albany, NY, US: SUNY Press.

Committee to Review the Intergovernmental Panel on Climate Change (IPCC). 2010. *Climate change assessments: Review of the processes and procedures of the IPCC*. Alkmaar, The Netherlands: InterAcademy Council. http://reviewipcc.interacademycouncil.net/ (accessed 15 May 2016)

Correia, F.N. (Ed). 1998. *Water resources management in Europe: Institutions, issues and dilemmas.* Rotterdam: Balkema.

Costejá, M.; Font, N.; Rigol, A. and Subirats, J. 2004. The evolution of the water regime in Spain. In Kissling-Näf, I. and Kuks, S. (Eds), *The evolution of national water regimes in Europe: Transitions in water rights and water policies*, pp. 235-263. Dordrecht, The Netherlands: Kluwer Academic Publishers.

Craye, M.; Funtowicz, S. and van der Sluijs, J.P. 2005. A reflexive approach to dealing with uncertainties in environmental health risk science and policy. *International Journal of Risk Assessment and Management* 5(2/3/4): 216-236.

Dessler, A. and Parson, E.A. 2010. *The science and politics of global climate change: A guide to the debate*. 2nd ed. Cambridge, MA, US: Cambridge University Press.

Di Mascio, F. and Natalini, A. 2015. Fiscal retrenchment in southern Europe: Changing patterns of public management in Greece, Italy, Portugal and Spain. *Public Management Review* 17(1): 129-148.

El Pais. 2001. Miles de personas piden en Barcelona la retirada del Plan Hidrológico. 24 February 2001.

El Pais. 2001. Miles de personas marcharán hoy en Madrid para protestas contra el Plan Hidrológico Nacional. 10 March 2001.

El Pais. 2001. La 'Marcha Azul' llega a Bruselas para pedir a la UE que no financie el PHN. 9 September 2001.

El Pais. 2004. El PSPV reclama a Narbona que mantenga el trasvase del Tajo. 12 August 2004.

Engels, A. 2005. The science-policy interface. *Bridging Sciences & Policy* 5(1): 7-26.

European Declaration for a New Water Culture. 2005. Zaragoza, Spain: Fundación Nueva Cultura del Agua.

European Environment Agency. 2016. *Water stress*. Brussels: EU Publications. www.eea.europa.eu/publications/92-9157-202-0/page305.html (accessed 6 July 2016)

Feyerabend, P.K. 1975. *Against method*. London: Verso.

Feyerabend, P.K. 2011. *The tyranny of science*. Cambridge, UK: Polity Press.

Fidelis, T. 2013. Rehabilitation of estuarine areas, government expenditure and the financial crisis in Portugal: The fate of a midsummer night's dream. Paper presented at the ECPR General Conference, Sciences Po, Bordeaux, France, 4-7 September 2013. http://ecpr.eu/events/paneldetails.aspx?EventID=5&PanelID=1058 (accessed 6 July 2016)

FNCA (New Water Culture Foundation). 1998. *Documento síntesis de reflexiones, acuerdos básicos y propuestas del Primer Congreso Ibérico sobre Planificación y Gestión de Aguas*. Zaragoza, Spain: FNCA.

FNCA. 2006. *Plan estratégico, 2007-2010: una propuesta de consenso*. Zaragoza, Spain: FNCA.

FNCA. 2016. *Misión y valores*. Zaragoza, Spain: FNCA. www.fnca.eu/mision-y-valores (accessed 5 June 2016)

Funtowitz, S.O. and Ravetz, J.R. 1994. Uncertainty, complexity, and post-normal science. *Environmental Toxicology and Chemistry* 13(12): 1881-1885.

Haas, P.M. 2004. When does power listen to truth? A constructivist approach to the policy process. *Journal of European Public Policy* 11(4): 569-592.

Hadorn, G.H.; Bradley, D.; Pohl, C.; Rist, S. and Wiesmann, U. 2006. Implications of transdisciplinarity for sustainability research. *Ecological Economics* 60(1): 119-128.

Heraldo. 2009. Nueva Cultura del Agua recibe en dos años 689.000 euros del Ministerio y de la Generalitat. 14 March 2009. www.heraldo.es/noticias/aragon/nueva_cultura_del_agua_recibe_dos_anos_689_000euros_del_ministerio_generalitat.html (accessed 5 July 2016).

Hernández-Mora, N. and Ballester, A. 2011. Public participation and the role of social networks in the implementation of the Water Framework Directive in Spain. *Ambientalia*: 1-21.

Hernández-Mora, N.; del Moral, L.; La Roca, F.; La Calle, A. and Schmidt, G. 2014. Interbasin wáter transfers in Spain. Interregional conflicts and governance responses. In Schneider-Madanes, G. (Ed), *Globalized water: A question of governance*, pp. 175-194. Dordrecht, The Netherlands: Springer.

iAgua. 2008. Panel científico-técnico de seguimiento de la política del agua. 27 January 2008. www.iagua.es/2008/01/panel-cientifico-tecnico-de-seguimiento-de-la-politica-del-agua (accessed 20 June 2016)

Iglesias, A.; Moneo, M.; Garrote, R. and Flores, F. 2010. Drought and climate risks. In Garrido, A. and Llamas, M.R. (Eds), *Water policy in Spain*, pp. 63-75. Leiden, The Netherlands: CRC Press/Balkema.

International Commission on Large Dams. 2016. *Number of dams by country members*. www.icold-cigb.org/GB/World_register/general_synthesis.asp?IDA=206 (accessed 5 June 2016).

Jasanoff, S. 2004. The idiom of co-production. In Jasanoff, S. (Ed), *States of knowledge: The co-production of science and social order*, pp. 1-12. London, UK: Routledge.

Keller, A.C. 2009. *Science in environmental policy: The politics of objective advice*. Cambridge, MA, US: MIT Press.

King, G.; Keohane, R.O. and Verba, S. 1996. *Designing social inquiry: Scientific inference in qualitative research*. Princeton, NJ, US: Princeton University Press.

Krimsky, S. 2003. *Science in the private interest: Has the lure of profits corrupted biomedical research?* Lanham, MD, US: Rowman and Littlefield.

Kuhn, T.S. 1970. *The structure of scientific revolutions*, 2nd ed. Chicago, IL, US: University of Chicago Press.

Lidskog, R. and Sundqvist, G. 2015. When does science matter? International relations meets science and technology studies. *Global Environmental Politics* 15(1): 1-20.

Lopez-Gunn, E. 2009. Agua para todos: A new regionalist hydraulic paradigm in Spain. *Water Alternatives* 2(3): 370-394. www.water-alternatives.org/index.php/alldoc/volume2/v2issue3/66-a2-3-5

Lorenzo-Lacruz, J.; Morán-Tejeda, E.; Vicente-Serrano, S.M. and López Moreno, J.I. 2013. Streamflow droughts in the Iberian Peninsula between 1945 and 2005: Spatial and temporal patterns. *Hydrology and Earth System Sciences* 17: 119-134.

Martínez Gil, F.J. 1997. *La Nueva Cultura del Agua en* España. Bilbao, Spain: Bakeaz.

Miller, T.R. and Neff, M.W. 2013. De-facto science policy in the making: How scientists shape science policy and why it matters (or, why STS and STP scholars should socialize). *Minerva* 51: 295-315.

Moore, D.; Dore, J. and Gyawali, D. 2010. The World Commission on Dams +10: Revisiting the large dam controversy. *Water Alternatives* 3(2): 3-13.

Minnuzi, D. and Bragança, C. 2011. A experiência da península ibérica no planejamento de recursos hídricos com base na directiva quadro da água: O estudo de caso da bacia do rio Guadiana. Paper presented at the VII Iberian Congress for Water Planning and Management, Talavera de la Reina, Spain, 16-19 February.

Muñoz, I.; Milà i Canals, L. and Fernández-Alba, A.R. 2010. Life cycle assessment of water supply plans in Mediterranean Spain: The Ebro River transfer versus the AGUA program. *Journal of Industrial Ecology* 14(6): 902-918.

Pato, J. 2013. Políticas públicas da água em Portugal: Do paradigma hidráulico à modernidade tardia. *Análise Social* 206(1): 56-79.

Ramos, A.M.; Cortesi, N. and Trigo, R.M. 2014. Circulation weather types and spatial variability of daily precipitation in the Iberian Peninsula. *Frontiers in Earth Science* 2(October): 1-17.

Reino, J.P.; Duarte, L.C. and Antunes, A.V. 2008. Mitos e realidades: de Vilarinho da Furna à Aldeia da Luz. Paper presented at the 6th Portuguese Congress of Sociology, Lisbon, 25-28 June. www.aps.pt/vicongresso/pdfs/319.pdf (accessed 7 May 2016)

Rovira, M. 2016. El Ebro vuelve a levantarse contra el plan de cuenca del PP. *El Pais*, 7 February 2016.

Roy, R. 1985. Funding science: The real defects of peer review and an alternative to it. *Science, Technology, & Human Values* 10(3): 73-81.

Santafé Martínez, J.M. 2003. The Spanish-Portuguese transboundary waters agreements: Historic perspective. *Water International* 28(3): 379-388.

Sarkki, S.; Niemelä, J.; Tinch, R.; van den Hove, S.; Watt, A. and Young, J. 2014. Balancing credibility, relevance, and legitimacy: A critical assessment of trade-offs in science-policy interfaces. *Science and Public Policy* 41(2): 194-206.

Sauri, D. and Del Moral, L. 2001. Recent developments in Spanish water policy: Alternatives and conflicts at the end of the hydraulic age. *Geoforum* 32(3): 351-361.

Skodvin, T. and Underdal, A. 2000. Exploring the dynamics of the science-politics interaction. In Andresen, S.; Skodvin, T.; Underdal, A. and Wettestad, J. (Eds), *Science and politics in international environmental regimes: Between integrity and involvement*, pp. 22-34. Manchester, UK: Manchester University Press.

Smith, R. 2006. Peer review: A flawed process at the heart of science and journals. *Journal of the Royal Society of Medicine* 99(4): 178-182.

Steel, B.; List, P.; Lach, D. and Shindler, B. 2004. The role of scientists in the environmental policy process: A case study from the American West. *Environmental Science & Policy* 7(1): 1-13.

Swyngedouw, E. 2015. *Liquid power: Water and contested modernities in Spain, 1898-2010*. Cambridge, Massachusetts: The MIT Press.

Thiel, A. 2015. Constitutional state structure and scalar re-organisation of natural resource governance: The transformation of polycentric water governance in Spain, Portugal and Germany. *Land Use Policy* 45: 176-188.

Thiel, A. and Guerreiro de Brito, A. 2014. Emergence, performance and transformation of Portuguese water institutions in the age of river basin organisations. In Huitema, D. and Meijerink, S. (Eds), *The politics of river basin organisations*, pp. 162-183. Cheltenham, UK: Edward Elgar.

Wennerás, C. and Wold, A. 2001. Nepotism and sexism in peer review. In Wyer, M.; Barbercheck, M.; Giesman, D.; Örün Öztürk, H. and Wayne, M. (Eds), *Women, science, and technology*, pp. 46-52. New York, NY, US: Routledge.

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