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'Praying for Rain': A Case of Drought Mismanagement in Barcelona (2007-2008)

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ABSTRACT: Focusing on the severe drought suffered by the city of Barcelona, Spain, in 2007 and 2008, the aim of this paper is twofold. First, it examines the panoply of emergency measures that were enacted as responses to the drought; second, it contextualises the event within the wider political context of water scarcity and resource management in Catalonia. An examination of this drought is used to reveal structural deficiencies in water management policies. By combining the concepts of path dependency and the 'hydraulic mission', this paper situates drought management in Barcelona along the traditionalist continuum of supply-side technology-focused water management solutions in Spain. Fraught with contradictory policies, political bickering and partisan alliances, drought management in Barcelona becomes subject to party agendas and dependent on technological fixes; this undermines the possibility of establishing effective and adaptive drought management plans for the future.

KEYWORDS: Drought, hydraulic mission, path dependency, water politics, Barcelona, Spain

INTRODUCTION

In May 2008, Barcelona was on the brink of major water restrictions. The regional Catalan government had attempted a panoply of measures to resolve the crisis faced by the iconic city on the shores of the Mediterranean Sea. These measures ranged from shipping water by tanker from the south of the country and France, to asking the Virgin Mary to send rain. In the end, with all emergency measures in place, the rain came and the crisis was averted. Following an inflow of 100 million cubic metres (Mm^3) over a matter of days, reservoir levels recovered from a record low of 21% of storage capacity to 50% (ACA, 2009).

This paper reviews the policy process involved in the management of this drought. Through a historical and political lens, the paper highlights the inadequacies of the drought management system during that event, identifying major political and management deficits. This paper also shows how the drought was as much a meteorological phenomenon (i.e. historically low levels of precipitation) as it was a socially and politically constructed crisis that resulted from the historical over-reliance on built infrastructure and from water management decisions over time.

As suggested by Solway (1994), droughts can be revelatory crises that uncover more deep-seated structural contradictions; they can, however, also hide such contradictions, as they can be attributed to the crisis at hand and not to deeper structural problems. Using this angle, the drought in Barcelona can reveal the internal problems of drought planning policy and its linkages with wider Catalan and Spanish water management policies. Following Solway (ibid), drought can be the perfect scapegoat for poor water management planning and lack of preparedness. This thesis discusses how state officials and water managers repeatedly argued that the drought would essentially be solved by the return of rain and that a desalination plant would end Barcelona's water insecurity. This paper is made all the more necessary by the reluctance of these same agents to see that deeper structural issues were at play during that drought which affected the water management regime of Barcelona and that these were entangled within a web of urban, regional and national politics and governance.

Since that time, much has been written about these events; this includes analyses of historical climate and drought trends such as that by Coll et al. (2013) and Turco and Llasat (2011), a study of the effects of drought on water consumption strategies by Masjuan et al. (2008), and an examination of the patterns of water access among socio-economic groups in Barcelona by March et al. (2013). Only a few studies, however, have reviewed the intricacies of the decision-making process that unfolded during the drought, contextualising it as part of Spain's hydraulic legacy (March, 2010, 2015; March and Saurí, 2013) or using it to draw lessons for improving Catalonia's drought management governance (Ballester and La Calle, 2020). It is within this space that the paper provides its main contribution.

The analysis mostly relies on materials gathered in 2008 and 2009; these include official sources and documents as well as a selection of semi-structured interviews conducted during the summer of 2009 with relevant water company managers, civil servants and academics.[1] Additional sources such as media coverage and academic references were used to triangulate information and are referenced throughout the paper. The use of retrospective analysis also provides a more nuanced account of the dynamics surrounding the drought. This analysis is currently relevant given the number of drought cases that have happened in recent times, be it Cape Town (Muller, 2018; Sousa et al., 2018), Chennai (BBC, 2019), Sydney (ABC News, 2019), or São Paulo (Nobre et al., 2016; Time Magazine, 2015). The events in Barcelona resonate with these cases, and relevant political and management lessons can be drawn from them to inform future decision-making and appropriate adaptation policies.

The paper is structured as follows. First, the theoretical concepts and framework used to analyse the case are introduced. This includes the concept of 'produced nature' that underpins the relationship between society and nature, a concept that is required in order to understand why and how droughts can be both a natural and a social phenomenon, and how they can respond to political crises as well as be driven by natural causes. The theoretical concepts of path dependency and the hydraulic mission are also introduced; they are presented together in order to explain how present water management policy decisions and infrastructure are bound together within a tradition of policy decisions. The next section of the paper describes the water management system in Catalonia and Barcelona. The paper then focuses on the drought itself and the various measures used by the Catalan and Spanish governments to mitigate the crisis. The section after that analyses the political repercussions of the drought, and the last two sections review the various drought management policies introduced in Catalonia since 2008 and reflect on various management and policy lessons for improving the adaptation of cities to future drought events.

A CONCEPTUAL LENS TO EXPLORE THE DROUGHT

Drought as a socionatural phenomenon

Water, nature and urbanisation are socially and naturally bound. Historically, cities have grown through a complex evolution of social, political and urban development processes that have included the complex task of bringing a sustained and sufficient flow of water to maintain life and activities (Gandy, 1997). Following from this is the idea that droughts are as much a social event as a natural occurrence, arising from the production of water scarcity by humans. The body of work on these concepts includes Bakker, 2000; Gandy, 1997; Kaika, 2005; March, 2010; Giglioli and Swyngedouw, 2008; Swyngedouw, 1999, 2007.

[1] For confidentiality reasons, most of the information derived from the interviews is not attributed. Seven key informant interviews were conducted to obtain additional insights on the management of the drought. Interviewees represented the major stakeholders and actors involved in the management of the drought, including Agència Catalana de l'Aigua (Department of Water Resources Management and Coordination of the Drought Management Commission), Agbar Group (Directorate of Planning and Technology), Entitat Metropolitana del Medi Ambient, Universitat Politècnica de Catalunya (Faculty of Civil Engineering), Universitat Autònoma de Barcelona (Faculty of Geography and Faculty of Political Sciences), and Aigües Ter Llobregat (Department of Water Distribution).

As part of a process of socionatural metabolism, cities can also embody society and nature as a network of "interwoven processes that are both human and natural, real and fictional, mechanical and organic" (Swyngedouw, 1996: 66).

Used by Bakker (2000) in the case of the 1995 Yorkshire drought, the socionatural lens of the production of nature allows the observer to consider natural events as social constructs, that is to say, embedded, produced and maintained through material and sociopolitical dynamics. The reality of such an event is as much a product of its natural causes – such as abnormally low rainfall – as it is a result of the various political and social strategies surrounding it; these include the history of policy decisions, the development of water supply infrastructure to cope with similar events in the past, or the various social dynamics involved in water resource management.

At its simplest level, path dependency accounts for the incremental and adaptive nature of many policy-making processes (Klein and Marmor, 2008) "to narrow conceptually the choice set and link decision-making through time" (North, 1990: 98-9). According to Haydu (1998: 35), path dependency "depicts events as stations along a historical track, and it goes on to specify mechanisms that keep history on track" and, as Jessop (1990: 261) argues, "the structure and modus operandi of the state system can be understood in terms of their production in and through past political strategies". In such cases, state structures are partly the product of past strategies, and current regimes refer to previous social and political constructions. Public policies constitute and shape the rules of the game, but past policy decisions have shaped the institutions that determine current and future policy decisions (Kay, 2005). After a series of policy changes or improvements, the cost of reversal of any decision in a particular policy track becomes very high as it would mean reversing the succession of previous decisions that led to that particular point in time (Ingram and Fraser, 2006).

As such, the concept of a hydraulic mission (Saurí and del Moral, 2001; Swyngedouw, 1999, 2007, 2013) can be described as a particular water policy trajectory as it relates to specific types of technological and sociopolitical dynamics working together to produce distinct water management regimes over time. Under the hydraulic mission, an ideology of the domination of nature through technology and infrastructure led to vast development projects and the repurposing of rivers to serve society's needs (Molle et al., 2009).

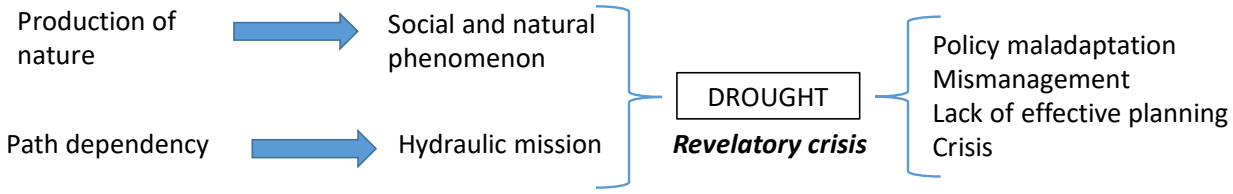
The path initiated at the beginning of the 20th century in Catalonia, as it joined the rest of Spain in the development of the country's hydraulic paradigm (March and Saurí, 2010; Saurí, 2003), essentially locked in a series of material infrastructures; these took the form of sunk and fixed costs for the delivery of public services which ultimately limited the type of interventions and decisions available for the mitigation of drought. In Spain, water management is based on the "buffering and correction of hydrological irregularities in space and time through a large-scale water infrastructure" (del Moral and Giansante, 2000: 95). Vested interests supporting the existing system of resource appropriation and management also appear to supply and maintain those infrastructures and provide water (Domene and Saurí, 2006). As the paper will illustrate, the 2008 drought was not created by these decisions but the availability and array of responses was. The event is contextualised within the larger historical narrative of a technology-driven hydraulic mission in Spain.

Within Barcelona's water supply trajectory, desalination becomes the ultimate technology fix and a politically neutral solution, away from the messy debates over surface water transfers and the new phase or 'mutation' of Spain's hydraulic paradigm (March et al., 2014; Swyngedouw, 2013). Kaika (2006) also explores this concept, seeing desalination as yet another modern nature-taming construction. It transforms nature under the necessities of urban development and makes the city's metabolism dependent on the perpetual supply and production of water through technological means.

Ballester and La Calle (2020) have examined the drought in Catalonia as a paradigmatic case of lack of effective planning, institutional coordination and transparency that is connected, as this paper argues, to historically inherited supply-side technological fixes; this paper provides further political analysis to

complement their study. Our critical analysis of the 2008 drought in Catalonia, however, also aims to shed light on the various structural deficiencies of Catalan water policy that were accentuated during the period of crisis. We associate these deficiencies with the legacy of the hydraulic mission in Spain and Catalonia which has created a situation of technological dependency for the supply of water to Barcelona and its metropolitan area. Figure 1 provides an illustration of the analytical framework used in this paper.

Figure 1. Analytical framework.



Water politics and drought management in Spain

Historically, water management approaches in Spain have been based on the assumption that droughts are structural given Spain's climate and hydrological characteristics.as a result, managerial responses have been articulated around a hydraulic paradigm to control and manage water via the construction of water supply infrastructure (del Moral and Giansante, 2000). In Catalonia, water policies can be linked to a system of social structures; policies are based on a response to public demonstrations of opposition or support for water management decisions and are important historical mechanisms of nation-building (López-Gunn, 2009; Mayrand, 2008; Swyngedouw, 1999).

Under Spain's hydraulic mission, a political interest in drought management has permeated water management regimes since the second half of the 19th century (Olcina, 2001). The almost messianic task started by the intellectual and politician, Joaquín Costa, in the early 20th century saw fighting droughts as a matter of life or death for the nation; this has been transmitted and maintained through different political regimes as one of the main drivers of the remaking of the Spanish technonatural landscape (Swyngedouw, 1999, 2007). National governments in the 20th century have used droughts systematically to justify emergency measures and the resulting national or emergency waterworks (Morales Gil et al., 1999). Being recurrent, drought fear can be used and maintained to unify society against the harshness and unpredictability of nature.

The definition of drought that was used in Spain in the 1990s stated that it was a structural deficit between water demand and capacity, which was monitored through water storage levels (del Moral and Giansante, 2000; Morales Gil et al., 1999; Saurí and del Moral, 2001). Such a traditional water management paradigm relied on additional water supply measures lowering the "general perception of vulnerability and thus increas[ing] the underlying risk, while failing to develop contingency planning and crisis management" (del Moral and Giansante, 2000: 95). The official definition of drought as an abnormal event taking place amid a general and natural expression of irregularity (del Moral and Giansante, 2000; Giansante et al., 2002) was also used by water management authorities in Spain as a way to elude responsibility and avoid effective and long-term coordination and planning (Morales Gil et al., 1999).

Spain's 1991 to 1995 drought catalysed the need to consider such a phenomenon as a normal and recurring climate event. As a result, according to Estrela and Sancho (2016), drought management policies shifted from risk management actions responding to emergency situations to a more organised and planned approach. The first Drought Management Plans (DMPs) for all River Basin Organisations (RBOs) were approved in 2007 following a general framework and guidelines established by the Spanish Ministry of Environment, which was at the time responsible for drought policy. These DMPs represented strategic tools that were aimed at developing drought impact mitigation capabilities and measures, with

an emphasis on public participation in the decision-making process for drought events (Estrela and Sancho, 2016).

As Vargas et al. (2018) write, when the drought hit Barcelona in 2008, the main elements of a change in management approach from a reactive drought management cycle to a proactive and risk-based approach were already in place; its implementation, however, was lagging. As we present in this paper, the sense of urgency produced by a new drought episode was used as a pretext to make decisions that were solely justified by the exceptionality of the situation. The mechanisms and planning processes that had been set up to understand and assess any economic, technical and environmental impacts linked to new solutions were thus avoided. This point is also elaborated upon by Urquijo et al. (2015), who studied how drought in Spain provided the excuse to approve unrelated water works and to implement them as urgent infrastructure. These are attributes of a reactive 'hydro-illogical' cycle which was still present in 2007 despite the new legislation and DMPs, and which was found in the case of Barcelona and the 2008 drought (Paneque, 2015).

An important element embedded in this new structure was stakeholder participation. Drought management plans would be administratively and managerially under the remit of RBOs and, under the governance structure of RBOs, stakeholder committees would also be allowed to oversee the development and implementation of DMPs. Despite the fact that drought management policy remained a regional policy issue addressed by the Catalan government, in accordance with Spain's national water law Catalonia was obliged to enact these elements. In order to contextualise how things have changed since the 2008 Barcelona drought, in a later section of this paper we review the substantial changes made in 2015 when drought management policy was substantially revised with the approval of new river basin DMPs.

WATER MANAGEMENT IN BARCELONA

With the end of Franco's dictatorship in 1975 and with the introduction of the new democratic constitution in 1978, Spain became organised under a central government with 17 regional autonomous communities which held decentralised administrative and political power. This was done to reflect the long-standing nationalist aspirations of some Spanish regions, thus breaking with almost 40 years of centralised state government and authority (Bukowski, 1997; Colino, 2008). This system resulted in deep transformations of state political and administrative bodies; it allowed certain powers to be centralised and others to be delegated to the newly created autonomous communities. On matters of water management, the central government became responsible for legislation; it planned and granted administrative concessions in river basins that flowed through more than one autonomous community. In turn, autonomous communities became responsible for legislation and regulation regarding infrastructure and planning projects inside their own territory (López-Gunn, 2009).

Under this new constitutional regime, water continued to be part of the public domain; it was managed and controlled through administrative agencies with various legal and institutional layers. The Water Act of 1985 divided the authority and control over water resources between regional governments and the central government in Madrid. For those river basins that stretched across more than one region, a basin authority under the tutelage of a central ministry would manage the resource; for those basins inside the boundary of a region, regional governments in some cases set up specific agencies in charge of water resource planning, management and regulation. In Catalonia, two relevant agencies exist: the Ebro River Basin Authority (CHE) for the transregional Ebro Basin, and the Catalan Water Agency (ACA) for the internal basins within Catalonia (Figure 1). The internal basins of Catalonia cover 52% of the Catalan territory, providing 92% of the water requirement of the population of Catalonia (ACA, 2009).

Figure 2. Catalonia's river basins.

Source: ACA (2005).

A patchwork of different agencies is involved in water management in Catalonia. Locally, municipal governments are responsible for deciding the type of contract and provision of water supply to their citizens, be it public or private (Domene and Saurí, 2006). In 2008, the ACA managed a bulk wholesale water supplier, the public company Aigües Ter Llobregat (ATLL, created in 1990); it serves more than 100 municipalities within the two major river basins in Catalonia, the Ter Basin and the Llobregat Basin (Plana Castellví, 2002). ATLL also holds water use rights, groundwater wells, and major water supply infrastructure such as dams and drinking water treatment plants. For the city of Barcelona, ATLL supplies around 65% of water used in the city, the rest coming from other sources (Domene and Saurí, 2006).[2]

According to March and Saurí (2010), public and private interests in Barcelona's water supply are intertwined, creating a complex, multilayered governance system that starts at the local level and reaches international dimensions (the city's private water utility, Aigües de Barcelona, or Agbar, was partially owned by the French company SUEZ). At any given time in 2008, a citizen in Barcelona opening a tap would have immediately interacted with three main agents, the ACA, ATLL and the Barcelona Municipal Entity for the Environment (Entitat Metropolitana del Medi Ambient, or EMMA). To fulfil the delivery of services, the metropolitan area of Barcelona was integrated as the Area Metropolitana de Barcelona, or AMB; it created the EMMA in 1987 to manage waste collection, wastewater treatment and water supply across 35 municipalities. The EMMA, in turn, delegated through a public-private concession to Agbar, which has been in operation for more than 140 years, providing water to Barcelona itself and to 22 other municipalities around it (Masjuan et al., 2008). The AMB encompasses 60% of the population of Catalonia, 50% of its GDP, and 47% of total water demand (Casado Pérez, 2016).

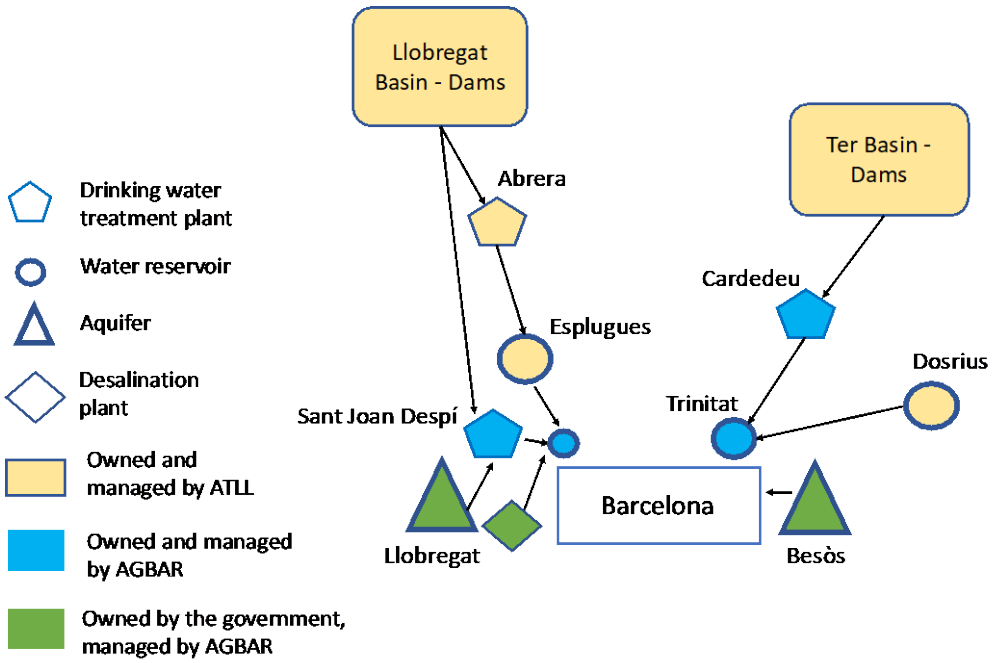
[2] In 2012, four years after the drought, ATLL was sold to a private company, ACCIONA, in order to help cover the Catalan government's deficit. This deal was fraught with controversy, with Agbar appealing to the Tribunals as it questioned the economic viability of ACCIONA's bid (Sala, 2018). Since then, ATLL was made public again under the name ATL, and the end of the concession with ACCIONA is still being litigated in the courts (*Muñoz, 2019*).

The city of Barcelona has two main sources of water, surface and groundwater. The majority of water is supplied from the Ter Basin through three dams, the Susqueda, Pasteral and Sau, which together hold 58% of the city's water storage; there is also a drinking water treatment plant in Cardedeu. Water from these sources is conveyed to a series of reservoirs in Trinitat, at the outer rim of the city (Figure 2). From that point onwards, the concession of the private water utility Agbar begins. In the Llobregat River Basin, water is kept in four dams representing 35.5% of the city's total water storage volume; water then reaches two main drinking water treatment plants (Abrera and Sant Joan Despí) which feed a series of reservoirs owned by Agbar (Masjuan et al., 2008). The rest comes from groundwater resources, the Besós aquifer providing the city with another 0.5% and the Llobregat aquifer with 5.5% (Plana Castellví, 2004; Prat i Noguer, 1999).

According to the ACA, the Ter-Llobregat system has a structural deficit of 80 Mm^3 per year based on the amount of water it can store and the water demand it is supposed to supply. This situation, according to the hydraulic mission paradigm, means that even though the system's reservoir capacity is full, the supply of water to the city of Barcelona will still continue to fall short as it will not be enough to supply the demand (ACA, 2009). This is combined with a very low water demand elasticity in the AMB where water consumption per person is around 120 litres per day (March and Saurí, 2010).

The hydraulic network of dams, reservoirs and water pipes that sustains Barcelona has been laid out over centuries, with the first conveyance structures – aqueducts and canals – having been built by the Romans. The city reused some of these designs in medieval times and expanded its infrastructure to accommodate an increase in demand. The *Rec Comtal* (water canal) is first mentioned in the 11th century; it conveyed water from the Besós Valley to the city (March, 2010). Wells were also dug in the Llobregat Valley and its fertile delta in the 18th and 19th centuries. In the second half of the 19th century, the medieval walls surrounding the densely populated historic quarters became a limiting factor for the city's expansion (Masjuan et al., 2008).

Figure 3. Simplified diagram of Barcelona's water supply infrastructure and management.



Source: Adapted from Masjuan et al. (2008) and March (2010). Note: Diagram not to scale.

The push for new areas to urbanise beyond the city's ancient walls continued with the planning and construction of the new neighbourhood of Eixample and with a complete rearranging of the city's urban concept and layout (Voltes Bou, 1967). This expanded the possibilities for the city to grow and satisfied a need for additional water resources and new infrastructure (Masjuan et al., 2008). At the time, water supply was guaranteed by a series of small private utilities that were limited in geographical scope and capital (Martin Pascual, 2009). The consolidation of private interests under one single company, the Sociedad General de Aguas de Barcelona (SGAB, later Agbar), only happened following the aggressive financial expansion of the company during the second half of the 19th century, when it acquired and merged a number of small-scale ventures along with the infrastructure they had built and owned (ibid). Being the sole company supplying water to the city, the SGAB continued to provide its services under a concession from the city of Barcelona as the population increased, which occurred especially in the first half of the 20th century with waves of internal migrants from other parts of Spain (March et al., 2019).

In 1955, to supply an ever-expanding demand, SGAB/Agbar obtained a concession from the Spanish Ministry of Public Works to pump 457,920 m^3/day of water from the Llobregat River; this was its first concession to use Llobregat River water directly, although this water system had been exploited since 1905 when the SGAB obtained a concession to pump 30,000 m^3 a day from the Llobregat aquifer (Masjuan et al., 2008). The 1957 General Water Plan for Catalonia aimed at increasing supply by building dams on the Llobregat and Ter Rivers and constructing a more than 100-kilometre long water connection between the basins. In 1973, the first draft project for a water transfer from the Ebro River to Barcelona was developed, aiming to convey 1 Mm^3 of water per year. The project was shelved during the economic crisis of the late 1970s, after being rejected by the neighbouring region of Aragón (March and Saurí, 2010). Without the security of such a transfer, the city of Barcelona kept regulating its rivers, building new dams on the Llobregat River in 1976 and 1997 so that, finally, a total of seven dams supplied water to the city.

The latest phase of Barcelona's hydraulic mission began in March 2004, when the Socialist Party won the general election. After a fraught campaign that had water as one of the main political weapons, the victorious Socialist Party set up an ambitious plan to build desalination plants along the Mediterranean coast. This plan was called the Programa AGUA, and replaced the Spanish National Hydrological Plan (NHP) of the defeated Partido Popular (People's Party, or PP), which had followed their conservative mantra of national surface water transfers (Saurí et al., 2018; Swyngedouw, 2013).[3]

For the Socialist Party, the Programa AGUA was mainly aimed at producing a similar amount of water as had been contemplated by the PP. in the Ebro Water Transfer, but with the use of reverse osmosis (March and Saurí, 2010). A royal decree in June 2004 modified Act 10/2001, that is, the NHP; the decree contained in its annexes a series of priority interventions which included a desalination plant for Barcelona. In March 2005, the Ministry of Environment approved the environmental impact assessment for the desalination plant and submitted it to the European Union with an application for structural funds to finance its construction. The same month, Act 11/2005 was approved by the Spanish parliament; it granted the Catalan government responsibility for the desalination plant, including its tender, construction and operation (BOE, 2005). On 13 December 2005, the European Regional Development Fund (agency in charge of European Cohesion Funds from the European Union) announced it would contribute 75% of the funds to build the plant (Pérez, 2006). The desalination plant was finally inaugurated in July 2009 by the President of Catalan to avoid, as he put it, "the recurring crises" of water supply in Barcelona (ibid).

[3] Within Spain's traditional hydraulic mission, desalination did not represent anything new; in the 1960s, the government had considered it as a viable solution to supply water to cities, and in 1983 it installed the first plant in the Canary Islands (Gascó, 2004; Saurí et al., 2018). In 1995, the city of Palma de Mallorca, following a serious drought which saw the arrival of ships with water from the Ebro, also decided to invest in its own desalination plant (Morales Gil et al., 1999).

THE 2007-2008 DROUGHT

Managing drought by decree

Catalonia's hydrological regime has been shaped by an irregular interannual rainfall pattern that is typical of the Mediterranean climate, having endured various severe episodes of low rainfall in the 20th century (Coll et al., 2016). One of the most severe drought events – one which affected the whole of the Iberian Peninsula – occurred between 1944 and 1950 and led to drinking water supply restrictions in various cities. In 1953, the city of Barcelona was hit by restrictions when rainfall patterns yielded only half the normal amount. A study of drought events between 1916 and 2008 by Altava-Ortiz et al. (2008) showed how the 2004-2008 event can be considered the most severe drought in 92 years of recorded data in terms of duration, area affected and intensity.

Despite the remarkable interannual variability of rainfall patterns, the recurrence of droughts can be the result of previous and consecutively accumulated dry episodes (Lana and Burgeño, 1998). The precipitation pattern in 2006 emphasises the dryness of this period when compared to 2001 (the driest year), and suggests that the drought suffered in Catalonia in 2007-2008 was meteorologically severe, with an aggregate level of precipitation in 2007 that was 39% below average (ACA, 2009). Also, as the ACA acknowledged, the drought episode of 2007-2008 was part of a longer dry event that spanned from 2004 to 2008 (ibid). The 2008 drought was considered to be "an exceptional phenomenon", with a recurrence of 67 years (La Calle, 2007). Considering historical rainfall data that dates back to 1916, the 2004-2008 drought in Barcelona can be considered the most severe event in 92 years, both in duration and intensity (Altava-Ortiz et al., 2008).

In the ACA's official report on the drought, released in June 2009 (ACA, 2009), it identifies the lack of rain that started in the second half of 2006 as the major cause of the hydrological drought, affecting river flows, water storage and aquifer recharge; as a second cause, however, it mentions the lack of reserves, which were insufficient to satisfy demand. According to the ACA, the so-called 'structural imbalance' between demand and stored supply is the fundamental reason for the various episodes of drought that have been observed; it thus reverts back to the traditionalist paradigm of drought management policy.

In order to manage droughts, governments in Spain and Catalonia have tended to rely on short-term regulatory patches and on hydraulic infrastructure that is developed on an ad hoc basis under different management options in reaction to crises, and not according to a general drought management plan (Morales Gil et al., 1999; Paneque, 2015; Urquijo et al., 2015). This was also the case for Barcelona, which did not have a general drought management plan at the time of the drought, and only got one after the crisis (Table 1).

Following several months with below-average precipitation, on 3 April 2007 the Catalan government issued Decree 84/2007; this established the various exceptional and emergency measures to be adopted in the case of drought, based on a certain level of cubic metres in storage (Table 2). Level 1 designated measures to ensure that water was available in the medium term if reservoir levels reached 33%; Level 2 established tighter measures to guarantee domestic water use in the short term when reservoir levels reached 23% of their capacity; at 20% or lower, Level 3 (the emergency scenario) would be declared and extraordinary restrictions introduced (i.e. to household consumption).

Following Decree 84/2007, the main measures imposed under Level 1 affected irrigation water use, with restrictions on the volume of water that could be diverted from rivers for agriculture. Those users with restrictions would not be financially compensated except for direct takings from rivers. Under Level 1, water use for municipalities was also restricted. Any water suitable for human consumption – such as for public parks or street cleaning – was not to be used. Decree 84/2007 allowed local authorities to adopt immediate measures to improve water efficiency in the networks and for private users, such as, for example, regulating watering of private gardens or lawns. It also imposed a mandate to plan for the

reduction of water inefficiencies for utilities, focusing on conveyance losses, leakage detection and repair. When Decree 84/2007 was issued, Level 1 was also declared.

Table 1. Drought management decrees in Catalonia.

Decree	Date	Actions
Decree 93/2005	13 May 2005	Definition of minimum storage levels, emergency levels and river flows
Decree 207/2005	27 September 2005	Intervention referring to infrastructures, supply and campaigns
Decree 84/2007	03 April 2007	Definition of minimum storage levels, emergency levels, river flows and emergency infrastructure
Decree 108/2008	15 May 2008	New definition of minimum storage levels, drought management coordinated by the President of Catalan

Table 2. Drought management scenarios in Catalonia.

Level	Water levels (stored in the Ter-Llobregat system)	Actions
Exceptionality 1	40%	Water saving measures to be established in order to guarantee water supply: • decrease water allocation for irrigation by 15% • cancel dam releases that are solely for hydroelectric power generation • increase control of water use and water saving measures
Exceptionality 2	23%	Restrictive measures to be established in order to guarantee water supply in the short term: • decrease water allocation for irrigation by 45% • increase control of water use and water saving measures • restrict environmental uses
Emergency	20%	Extraordinary measures and restrictions to be established in order to guarantee drinking water supply

Source: Decree 84/2007.

The Ter-Llobregat system reached Exceptionality Level 1 on 1 September 2007. During the drought, contingency plans were prepared by 75 municipalities, following Decree 84/2007. In 2007, Agbar and ATLL reopened a series of wells or increased production in their existing well fields; they managed to expand pumping in 277 wells (with 40 new wells drilled) for a volume of 95.9 Mm^3. During 2007-2008, as part of Agbar's special measures, the company was able to contribute an additional 19.3% of water volume, and ATLL contributed 26% for direct water consumption (ACA, 2009). The average per capita consumption in Barcelona decreased from 135 litres per capita per day (l/c/d) in 2000 to 118 l/c/d in 2007 (Ajuntament de Barcelona, 2018). Following several awareness campaigns conducted during the

drought, between July and September 2008 the population made a substantial effort and managed to reduce Barcelona's already low water consumption by an additional 17.5%; by the end of the drought, daily consumption had reached 110 l/c/d (ibid).

In May 2008, due to the continuation of the drought, the Catalan government was prompted to issue Decree 108/2008 to expand the emergency measures. This new decree granted the Catalan Department of Environment the powers to unilaterally declare drought emergency levels. At that point, a sense of urgency was inferred as exceptionality levels were defined by the ACA through indicators of storage levels, thus suggesting a more centralised control of drought management plans from that point onwards.

A panoply of emergency solutions

With the drought unfolding, decision makers turned to an array of management and infrastructure solutions. Water demand was addressed through multiple public awareness campaigns (major campaigns in February, July and November 2007, and in January and March 2008) and the distribution of water-saving kits (650,000 water aerators) by the ACA in January 2008 (ACA, 2009). Agbar also pushed for the implementation of water pipe improvements and the reduction of conveyance leakage while it applied for emergency infrastructure funding to be released by the ACA. Both the Catalan government and the Spanish government issued ad hoc regulatory responses in the form of emergency decrees enabling new emergency infrastructure and other measures (Table 3).

On the supply side, and aligned with Spain's traditional hydraulic mission, water transfers reappeared on the list of potential solutions to Barcelona's dire water needs. A transfer from the Rhone River in France was resuscitated by Convergencia i Unió, an electoral coalition that was in opposition in Catalonia at the time; this was an initiative that dated from the coalition's previous stint in power in the 1990s (Gorostiza et al., 2018). There was also discussion of interbasin transfers directly from the Ebro River, south of Barcelona, and the Segre River (a Catalan tributary of the Ebro, west of Barcelona) and there was consideration of a proposal from irrigators in the Canal d'Urgell (Urgell Canal) in the Segre River to sell surplus water to the city (March and Saurí, 2013).

The Segre transfer option faced strong opposition from rural communities as well as from the central government in Madrid; the latter's approval was needed for any infrastructure affecting the Ebro Basin. Further discussion was prevented by the central government's fear of reigniting recent regional conflicts by introducing interbasin transfers from the Ebro (Hernández-Mora et al., 2014). Major policy shifts in a matter of hours by the Catalan Minister of Environment – who was quoted saying that, "maybe tomorrow or after tomorrow we will say something else" (Aymi, 2008) – and discourse changes regarding new restriction measures and modifications to the drought decree (Arroyo, 2008) also tainted the possibility that this transfer would go ahead.

In Catalonia, political unity was necessary against such natural calamities; however, even though the Catalan parliament issued a unanimous motion supporting the government's drought management measures (Parlament de Catalunya, 2008), different political parties published separate manifestos and supported various water management options according to their electoral bases; in rural areas this included Esquerra Republicana de Catalunya, a republican and pro-independence party, and in urban Barcelona's metropolitan area the Socialist Party.[4]

[4] The Catalan government at the time was a coalition of three parties: the Socialist Party (PSC), the Esquerra Republicana de Catalunya (ERC), and the Greens. Each party was in charge of several ministries, with the Greens holding the Environment and Water portfolio; the president was from the Socialist Party and the vice president was from the ERC.

Table 3. Main drought management measures implemented in Barcelona.

Entity		Type of measure	Actions
Spanish government		Regulatory	Approval of royal drought decrees
		Supply side	Approval of new infrastructure to be built (desalination plant, interbasin water transfers)
Catalan government	Department of Environment	Regulatory	Drought decrees
	ACA	Regulatory	Water supply restrictions authorised by the emergency decree
			Drought National Board (with the Catalan government)
		Supply side	Abstraction from old wells
			New supply (ships, water transfers)
			Aquifer restoration and water reuse
		Demand side	Awareness campaigns
			Distribution of water-saving kits (aerators)
	ATLL	Supply side	Rehabilitation of old wells
			Drilling of new wells
			Aquifer restoration
EMMA and Agbar		Regulatory	Water supply restrictions authorised by the emergency decree
		Supply side	Abstraction from old wells
			Rehabilitation and improvement of water networks
		Demand side	Awareness campaigns

Institutionally, the Catalan government set up a series of participatory bodies that included civil society organisations and a variety of stakeholders; their brief was to conduct a close follow-up of the drought, introduce new measures, and unite society. The main body set up at the end of January 2008 was the Comite Permanent per la Sequera (Permanent Drought Committee) within the ACA; its aim was the coordination of the response to the drought at the technical and managerial levels.[5] The Taula Nacional de la Sequera (National Water Table) was also created in April 2008, with a mandate to follow up the exceptional measures taken by the government; this second participatory body was more political as it included members of parliament from other parties, civil society representatives, and unions (ACA, 2009).

The serious situation during April and May of 2008 prompted the national government in Madrid to issue a royal decree (Decree 3/2008) on April 21 which further contributed to the series of extraordinary measures rolled out to manage the impacts of the drought. The royal decree authorised an emergency connection from the Ebro River Basin to the city of Barcelona. Even though the Segre transfer had been rejected, this connection was to occur through a pipe that ran along the highway to Barcelona from Tarragona, a coastal town 100 km south of the Catalan capital that was already receiving water from the

[5] This committee was set up by the ACA under the responsibility of its director; it included senior members of ATLL, EMMA, the Consorci d'Aigües de Tarragona (the water supply agency for the town of Tarragona), the Catalan Public Health Agency, and representatives of Catalan's two main councils.

Ebro River; the so-called 'mini-transfer' would take two months to complete. It infuriated local authorities in Tarragona, who considered it to be a disguised transfer from the Ebro which would pump as much water as Barcelona needed. In order to reduce tensions, both the Catalan and Madrid governments announced that such infrastructure would only be temporary (Aymi, 2008).

The subtext to this was a long-standing debate on the national water transfers in Spain that were aligned with the country's traditional hydraulic mission and which had been fuelled by the conservative People's Party after they won an absolute majority in the 2000 election (López-Gunn, 2009). As part of the National Hydrological Plan (NHP) that was approved in 2001, the PP. contemplated a large water transfer of 190 Mm^3 per year from the Ebro Basin southwards, and also north to Catalonia and Barcelona. After the socialist government won the national elections in March 2004, it repealed the NHP, which had been one of its electoral promises. With this new 'mini-transfer' on the horizon, civil society organisations and environmentalist groups who opposed the original plan mobilised, targeting the governing Socialist Party and the Catalan parties. In the neighbouring region of Aragón, upstream in the Ebro Basin, all political parties, including the Socialist Party, expressed their rejection of this mini-transfer as it was considered to be a 'hidden' water transfer from the Ebro to Barcelona (RTVE, 2008).

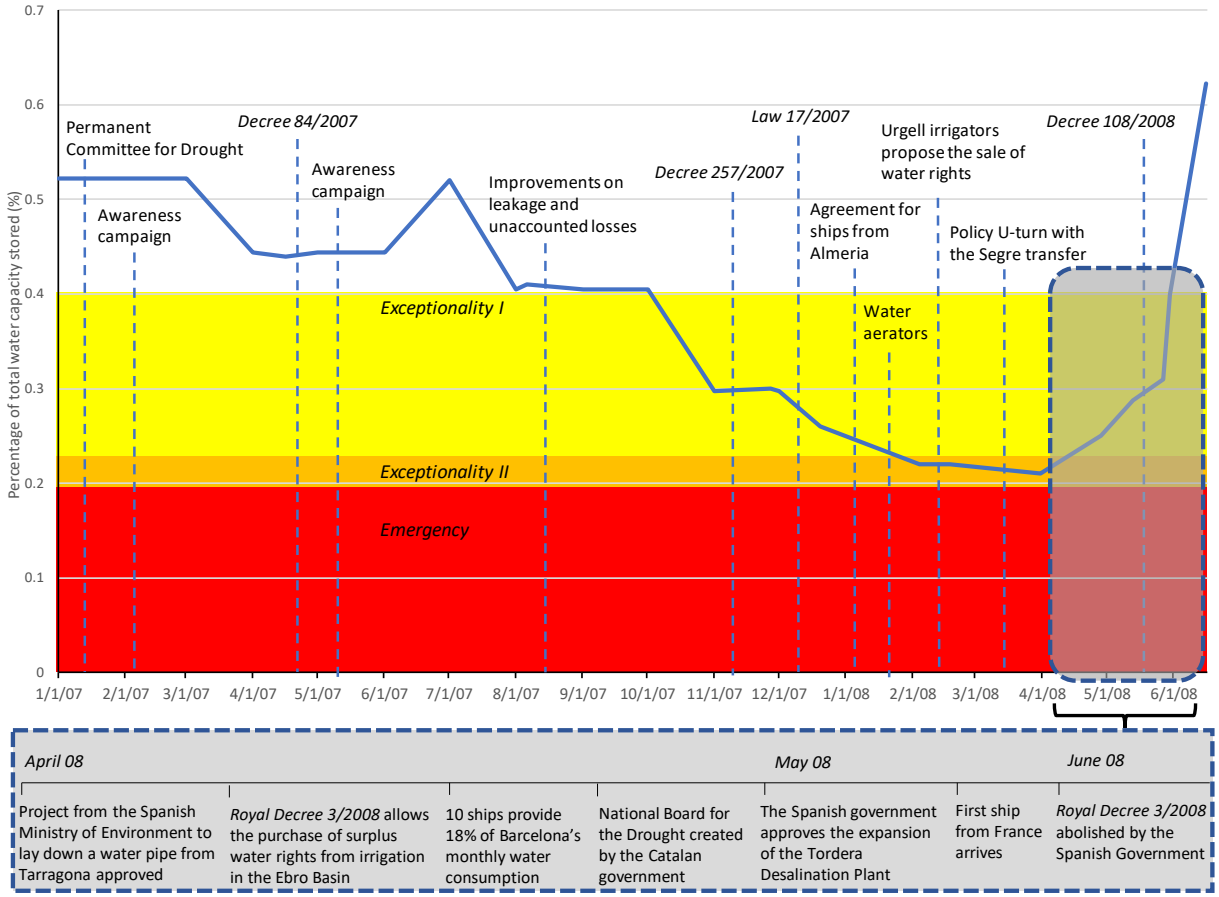
Despite such opposition, on 12 April 2008 the Prime Minister of Spain and the Catalan President announced that Barcelona would receive water from the Ebro by autumn through the conveyance pipe from Tarragona. The Spanish Ministry of Environment insisted that this was not a permanent transfer and decided to call this solution a 'public water bank', as water rights from irrigators in Aragón and parts of Catalonia would be exchanged through this infrastructure on an annual basis. Additional volumes would also come from the reduction of losses in canals and improvements in water efficiency in irrigated systems, freeing up to 50 Mm^3 per year (Arroyo and Aymi, 2008). With this solution, the Ministry avoided any mention of a 'water transfer' (El País, 2008a).

At the same time, however, the neighbouring region of Valencia to the south, which was governed by the PP, publicly declared that it should also benefit from the surplus of water rights exchanged with Barcelona (El País, 2008b). The socialist government tried to deflect these requests by bringing together its senior leadership in the other regions of Spain and presenting a unified front in support of the mini-transfer (Arroyo, 2008a). The next day, the Attorney General of Spain declared that, "it was not a transfer" as the decree established that only surplus water volumes would be exchanged (Arroyo and Méndez, 2008). The same day, the Spanish government reiterated the idea that such infrastructure was not permanent and that it would cease as soon as the drought did or when the desalination plant that was being built in Barcelona began operation. On 26 April, the city of Zaragoza (the capital of the Aragón region), asked the regional government to file a motion of unconstitutionality against the royal decree that authorised the transfer (Barrena, 2008).

While construction went ahead, Barcelona started receiving water by ship from Tarragona and Marseille, France. In the end, no shipment arrived in Barcelona from Almeria (in southern Spain) as initially expected. There were three shipments by sea, the volume of which represented around 18% of the city's monthly water consumption. This solution was also the most expensive one, with each cubic metre of water shipped costing €13/m^3 (compared to €0.80/m^3 from the Ter River). The water shipments were only operational between 13 May and 7 June, with 24 trips in total (ACA, 2009) and 0.530 Mm^3 transported.

The Ebro mini-transfer was never completed, however, as rains arrived in late April and early May 2008, delaying the need for further water restrictions. Subsequently, on 5 June 2008, the Spanish government suspended Royal Decree 3/2008. Due to an increase in precipitation and the various measures which were able to help mitigate the effects of the drought (Figure 3), the Catalan government, with an official decree, declared the end of the drought on 13 January 2009.

Figure 4. Percentage of total water capacity stored (%) in the Ter-Llobregat River Basin, and main policy and management decisions to mitigate the drought.



Source: Based on data from ACA (2009).

THE POLITICS OF DROUGHT MANAGEMENT

A political analysis of the drought

The drought in Barcelona should not have taken regulators, elected city and government officials, or water managers by surprise. All indicators and data available pointed at a below-normal winter rainfall in 2007, part of a longer dry spell that started early in 2004 and continued into 2006 and 2007 in many regions of Spain (ACA, 2009; Altava-Ortiz et al., 2008).

The political undertones of the drought are to be found at the local, regional and national levels. The unfolding of the drought coincided with a fraught national general election in March 2008 and a weak regional government in Catalonia that was based on an unstable coalition of three left-wing parties in place since 2006 (Socialists, Greens, and left-wing Catalan republicans), and a keen leader of the conservative party in opposition (Convergència i Unió) who was already pre-campaigning for the 2010 Catalan elections (Pallarés and Muñoz, 2008; Regió 7, 2008). With Barcelona's municipal council also led by a hung parliament and a coalition government, the parties in power had to secure a vote in the metropolitan area in an environment where highly politically fragmented municipalities claimed different emergency measures from the Catalan government (Brugué et al., 2000; Cia, 2008). This move, however, equally antagonised the rural vote; as Casado Pérez (2016: 751) points out, "emergency responses bailed

out urban voters while no structural solutions were adopted to make water use in the agricultural sector more efficient".

Water management initiatives during the drought also had negative effects across local territorial scales. As Brugué et al. (2000) put forward, the conflicts between different municipalities and the Catalan government that arose during the drought can be explained through the lens of urban economic fragmentation. Municipalities sought to gain power and influence with the Catalan government as they developed more complex local agendas that were aimed at different socio-economic groups of voters. Such complexity brought new political roles for local government structures and the manifestation of new territorial urban models with networks of interdependent decision-making actors and decentralised powers with influence (Brugué and Gomà, 1998; Brugué et al., 2000).

During the drought, the urban/suburban divide was exacerbated as most urban users complained about the excessive water demand from some of the suburban neighbourhoods of Barcelona with their single-family houses and private pools (Domene and Saurí, 2006); this was because water prices in the metropolitan area of Barcelona did not incentivise sufficient water savings and enabled users in less dense suburban areas to maintain higher levels of water consumption (ibid). Local conflicts also increased as a consequence of the drought measures, with some neighbourhoods making anonymous complaints to the police regarding water waste in other areas (Figueredo and Arenós, 2008). As described by Kaika (2003: 929), people from Barcelona, like in Athens, "turn against each other, accusing each other of 'stealing' water (…) or even called the police to report uncivil behaviour".

In Catalonia, mitigation efforts were undermined by the lack of unity among the three governing parties and their failure to control the political discourse about the various measures for managing the drought; this created a climate of mistrust and resentment from civil society and within rural communities from which water for the proposed transfers was to be taken (Aldomà-Buixadé, 2012). Technical opinions from experts appeared in the media to justify last-minute decisions, generating mistrust of public agencies; mistrust was also, of course, aimed at politicians. Poor planning reduced the ability to respond in a timely and coherent manner with additional measures to mitigate the drought (ibid); this was despite the ACA being one of the leading agencies in Spain in the implementation of the European Water Framework Directive and in the rolling out of integrated water resources management in its internal river basins (Parés et al., 2015).

The incoherence and mistrust among the coalition parties in government was also fuelled by the constant policy shifts by the Catalan Department of Environment and by Francesc Baltasar, its minister; this was further exacerbated by the political accusations by the various opposition parties who claimed malpractice and chaos over drought contingency measures in the hope of making political gains. Baltasar, in less than 24 hours, changed his position with regard to a proposed set of new restrictions (Barrena, 2008). A similar situation arose when he openly contradicted the declarations of the Spanish Minister of Environment made 48 hours earlier regarding the purchase of water rights from irrigators from the Catalan part of the Ebro (Arroyo, 2008a). At one point in the midst of the crisis, Baltasar, a self-proclaimed agnostic, asked *La Moreneta*, the Lady Virgin of Montserrat and patron saint of Catalonia, to send some rain and end the drought (TV3, 2008). During that same interview, he reiterated that he would wait for authorisation before approving the transfer of water from the Ebro in Tarragona by the Spanish government, an authorisation that never came even though construction had already begun.

Opposition parties attempted to undermine the position of the Catalan government by appealing to, and using, its rural electorates to counter the government's efforts to push forward the various water transfer proposals. The fact that the media debate was almost entirely focused on the drought did not help; it created an atmosphere of constant public scrutiny and exaggeration of public declarations and new measures. As shown by Lacey and Longman (1997) and Tàbara et al. (2004), a strong correlation can occur between the growing intensity of the media coverage of such an event and the public awareness and interest triggered. The press helped stir the debate and the confrontation among citizens and political

parties by praising the implementation of specific technological solutions and supply-side measures (Antich, 2007) or generating social malaise with shocking headlines (Figueredo and Arenós, 2008). Again, the reactiveness of the Catalan government and lack of planning added to the multiplicity of messages and the lack of clarity in understanding the approach taken.

The political fights between regions also had to be mediated by the central government in Madrid; it juggled between the need to propose immediate emergency solutions and the need to hold the support of the various regions it controlled despite the vociferous opposition of the PP. that was coming from other regions and other local interests. This was amplified in the Ebro Delta in May-June 2008 where, following the mini-transfer proposal, there were local protests linked to the environmental survival of its ecosystems (Aldomà-Buixadé, 2012). In Aragón – an autonomous community that was also governed by the Socialist Party – irrigation communities opposed the transfer of water surpluses with Barcelona (ibid). Equally, the regions governed by the PP. were very quick to criticise the government in Madrid for giving special treatment to Barcelona in the form of the mini-transfer; they claimed equal rights for the southern regions and demanded access to the transferred water (Del Riego, 2008).

A review of the literature on the relationship between natural disasters and elections offers mixed conclusions. Cavalcanti (2018) has shown that natural disasters can have an impact on election results, with potential support for incumbent regional parties who are politically aligned with the central government and who can thus ensure the inflow of partisan government relief. By contrast, Stout (2018) proposes that natural disasters can hinder incumbent leaders' chances at re-election as these are informative events for voters where leaders have the opportunity to demonstrate competence in the face of crisis. In light of the above, it could be said that Catalan leaders did not present a unified and coherent front against the drought and that particular individuals failed the test of competency on many fronts.

Be that as it may, the 2010 election saw a change of government and a win for the conservative party Convergència i Unió, and a new hot topic was on the table: Catalan independence. The debate after the drought, however, continued to be so volatile that the Catalan Public Audit Office investigated the ACA's emergency works and measures in 2010. Given its sensitive nature, the report was sent to the Attorney General of Catalonia, who finally ruled that the ACA's decisions did not constitute a criminal offence and would not be prosecuted (Piulachs and Elcacho, 2008).

The drought in context

Reflecting on water politics in Spain, Bukowski (1997: 51) has argued that, "the longevity in Spain of a water policy based primarily on harnessing resources through large infrastructure projects is largely attributable to the stability and strong normative core belief system of the traditional hydraulic paradigm". The path-dependent tradition that is driven by this hydraulic paradigm leads to both planning maladaptation and an inability to cope with drought vulnerability; the result is policy failure that, as Hajer (1995) relates, is politically mediated and filtered through the state. During the 2007-2008 drought in Catalonia, drought management policies were influenced by a specific tradition of water management as they appeared to be a natural continuation of the hydraulic mission that had driven Spain's water management throughout the 20th century (del Moral and Giansante, 2000).

As Urquijo et al. (2015) write, the coexistence of various water paradigms in Spain generates confusing and sometimes contradictory policy frameworks. The hydraulic paradigm of resource mobilisation at the national level is complemented by a 'regionalist hydraulic paradigm' that reflects the regional governments' use of water to achieve political gain. Paneque (2015) also reflects on the continued strength in Spain of a traditional water management paradigm that is dominated by infrastructure, despite the emergence of new and more inclusive management approaches.

The consideration of drought to be an 'extraordinary' event in management plans – despite Spain's history of drought – continues to undermine any relevant and structural change in drought management

(Vargas et al., 2018). The technological determinism linked to new infrastructure assumes a supply of water that will continually increase to match population and demand growth. The structural presence of drought in Spain should have led to a reconsideration of these assumptions in light of climate change projections.

Instead, the construction of the desalination plant in Barcelona manifests the newest iteration of the hydraulic mission (Swyngedouw, 2013). This not only represents another chapter in the path-dependent trajectory of supply-driven technology reliance in urban water management; it has also taken central stage in Spain's water policy debates as the consensual and hegemonic solution to withstanding future shocks for urban areas along the Mediterranean coast (del Moral et al., 2017). This leaves aside the harder political choices and more delicate negotiations to improve drought governance, participation, coordination across government levels, adaptive plans, demand-driven management, and resolution of entrenched interests.

Following Nevarez's (1996) arguments, the 2008 drought in Barcelona only solidified the traditionalist water management system, emphasising the definition of drought as a structural imbalance in water supply versus demand. The culmination of this traditional paradigm and its effects on drought management become clear with the over-reliance on technology and supply augmentation in the form of a desalination plant. Given the estimation of the direct and indirect economic costs of the drought at 1% of Catalonia's GDP that year (around €1.6 billion) (Martin-Ortega et al., 2013), the price to pay for a new desalination plant would seem relatively small. The change between the old traditional hydraulic paradigm (i.e. dams and water transfers) and its new version would represent the definitive solution to securing water for the city. Under the hydraulic paradigm, the drought again brought to light the self-fulfilling prophecy of a structural water shortage, justifying the construction of the desalination plant; as it happened, however, the plant was being built as the drought unfolded and was not able to operate when it was most needed. At that point, the ultimate drought management tool became the rain itself, which eventually came and ended the drought.

The reflections on drought governance provided by Ballester and La Calle (2020) are again relevant. A multilevel management structure with no coordination or (real) public participation contributed to the generation of conflicts between local, regional and state institutions and policies. The diversity of political interests rapidly appeared as each level was affected by its internal politics and interests. The presence of appropriate and effective participatory mechanisms and protocols designed ex ante would have contributed to the perception of inclusivity and cross-sectoral participation and coordination; however, the ineffective levels of participation from civil society that were observed during the drought were linked to an incipient process of participation which unfolded in parallel to it.

What also can be observed from an analysis of the 2008 drought in Barcelona is the absence of technical and scientific neutrality vis-à-vis the political debate around how to handle the drought. As Ballester and La Calle (2020) write, poor information transparency emanating from the Catalan government was compounded by incoherence when it came to suggesting technical solutions to solving the crisis. Since scientific arguments about water management have often been partisan in Spain, the proposal of solutions to the drought was also affected by the mistrust associated with politically motivated solutions (ibid). The nuances in the political discourse and use of terminology (for example, avoiding the word 'transfer') did not contribute to improving this situation and made evident the lack of a proper dialogue between policy and science.

DROUGHT MANAGEMENT IN BARCELONA, WHAT HAS HAPPENED SINCE?

Ballester and La Calle (2020) analyse whether this crisis led to any changes in drought management in Catalonia. Here we echo their study and provide further relevant analysis of the political processes underlying the response to the 2008 drought. After the drought, it took the Catalan government and its water regulator, ACA, another eight years to approve their first drought management plan for the internal

basins of Catalonia. The shifts in drought management policy became once more evident when the 2016 Special Plan for Drought drawn up by the ACA in 2009 – fresh from the recent drought – was not approved after the Catalan elections in 2009. Such delay was mainly due to the political situation in 2010 and 2011 arising from the Catalan independence movement (PES, 2016d).

Even though the draft drought plan was released in 2016 amid drought forecasts and following the driest year in 100 years, the availability of desalinated water to secure Barcelona's water supply would have diffused any further sense of urgency. A politicised perspective of drought preparedness and management that is immersed in regional and urban politics continues to exist; this is coupled with the need to include larger sections of society in the planning and management process. The need to further advance drought management in Catalonia and to open an inclusive and effective participatory process to improve governance and the delivery of quality services remains an underlying theme arising from this episode.

Despite that, it is puzzling that given Spain's climate variability and long recorded history of droughts (Estrela and Sancho, 2016), it took so long to move away from a reactive approach and establish a formal and regulated drought management framework. As Estrela and Sancho (ibid) discuss, it was only in 2016 that drought management plans by RBOs were finally established by royal decree as being the tool for managing droughts and planning for their future avoidance.

Seeing how long it took, it can be posited that the naturally contentious political nature of water management in Spain may have contributed to the delay. As it happened, the numerous policy shifts on the part of both the People's Party and the Socialist Party – attempting to correct each other's water policies after every election – would have undone any gains achieved during the previous legislature (Font and Subirats, 2010). The move towards desalination as the ultimate technological cure for Spain's natural drought condition would seem to assuage any diverging managerial views (March et al., 2014).

The main objective of the 2016 Special Plan for Drought is to provide continuity to the various measures adopted for managing and mitigating drought risks in Catalonia over the past decades (PES, 2016a). The plan is also to be rolled out immediately after a drought event is declared, as it is consensual and has been approved by stakeholders, civil society, and by the various levels of government involved. It is also fulfilling the mandate given to the Catalan government by Law 10/2001, the National Hydrological Plan, which established the need for every river basin in Spain to develop drought mitigation plans. The plan is to be reviewed every six years.

The 2016 Special Plan for Drought also aims to take stock of past drought events; it includes the new operation and management rules that will be needed after the construction of the new water supply infrastructure in Catalonia such as the Barcelona desalination plant and new water reuse systems. The plan essentially ratifies the measures adopted during the 2008 drought in Barcelona, including the various emergency scenario levels, and establishes them as part of the official toolbox for mitigating and managing future droughts.[6] Administratively, the plan has established 18 management units for Catalonia (as opposed to the 6 that were based on Decree 84/2007), making the management and declaration of drought events more granular and individualised.

Ballester and La Calle (2020) speak of deliberate confusion between natural indicators of drought, such as rainfall and soil moisture, and management indicators such as reservoir levels; this confusion, they suggest, prevents obtaining objective knowledge of the natural origin of the drought and also enables the voluntary modification of those facts to declare a drought. This was clearly seen in the 2008 drought crisis. Adhering to a practice that is now generalised worldwide, the 2016 Special Plan for Drought defines levels of exceptionality that are specific to each of the river basins in Catalonia (in terms of volumetric water storage), to aquifers (defined as stored volume), and to rainfed systems through

[6] The names for each level of drought established in *Decree 84/2007* were changed to make them more understandable; the levels of Exceptionality 1, 2, 3 have been changed to Alert, Exceptionality, and Emergency (PES, 2016a).

accumulated rainfall. (Rossi and Cancelliere, 2013; Rossi et al., 2012). Quantitatively, volume levels have remained the same or lower in the 2016 Special Plan for Drought (PES, 2016b).

In the Llobregat-Ter Basin, this translates into a change in the volumetric trigger levels for the declaration of 'Alert' status in a drought which is equivalent to Exceptionality Level 1 in the 2008 drought. According to the 2016 Special Plan for Drought, the stored volume levels that initiate the declaration of the alert have been dropped by 50 Mm^3 in the Ter Basin and 20 Mm^3 in the Llobregat Basin; this makes them less strict and potentially affects response times and scenario planning if the drought phenomenon is prolonged and intensified. According to the document, new water supply infrastructure (that is, desalination) provides additional security in the network, making its management more flexible and allowing for the possibility of delaying the declaration of a drought (PES, 2016b).

Additionally, and given the flexibility added to the system, these levels were adjusted in order to minimise as much as possible the disruption to users from water restrictions (ibid). Following these pre-established levels, a drought is declared by the Catalan water regulator in agreement with the Permanent Committee for Droughts (another management measure from the 2008 drought that has remained in place). A special interdepartmental commission is to be created when a situation of drought is declared over more than 20% of the municipalities in Catalonia.

According to the Special Plan for Drought, the production of desalinated water outside of a drought event needs to be maintained at a minimum level and assessed according to its production costs[7] and its ability to satisfy peaks in demand or maintain the security of supply (PES, 2016a). In times of drought, desalinated water will be produced when surface water storage levels drop below 75% (with a combined production of 0.22 m^3/sec at 75% up to 2.53 m^3/sec if storage levels reach 25%). The 2016 Special Plan for Drought also includes for the first time the specification of environmental flows to be released from dams during a situation of drought, with values of 2-3 m^3/sec down to 0.5 m^3/sec in an 'Emergency' situation for the Ter River Basin (PES, 2016a). In the Llobregat Basin, given that minimum volume releases for consumption downstream are "relatively large even during the worst cases", the Drought Plan does not establish minimum environmental flows (PES, 2016a: 50) and the revised plan maintains this rule.

With climate change, the frequency of meteorological drought in the Western Mediterranean Basin is likely to increase (Olcina Cantos, 2013). The 2016 Special Plan for Drought, however, does not take into account different management scenarios under climate change; it is stated in the plan that other operational and planning documents issued by the Catalan government do, in fact, consider them and that, given the much longer planning horizons needed to cope with climate change, future iterations of the Special Plan for Drought will include them. The sustainability assessment of the plan states, moreover, that, "no appreciable impact due to climate change is expected beyond the current dynamics already observed and considered in the natural hydrological variability" (PES, 2016d: 50). The plan does, however, consider that severe episodes of drought may occur in a planning scenario for the period 2070 to 2100, with expected average rainfall reductions of up to 40% during summer, potentially reducing river flows between 10 and 30% and aquifer recharge by 20% (PES, 2016b).

Some modelling scenarios included in the Special Plan for Drought incorporate some of these worst-case scenarios with longer drought episodes, such as, for example, if a fourth year of exceptionally low rainfall had followed or preceded the 2006-2008 levels and if there had been lower levels of rainfall in the intermediate years. The results show that under the scenarios analysed by the ACA, new infrastructure and supply measures such as desalination and wastewater reuse would provide enough resilience to drought to guarantee a minimum level of supply in Catalonia (PES, 2016b). This would come at a cost, however, as the ACA evaluated the cost of implementation of its drought plan (for a drought

[7] According to the ACA, production costs of desalinated water are €0.566/m^3, as against €0.023 to €0.145/m^3 for traditional treated surface water; this brings the cost of a mixed supply (under normal circumstances) of desalinated and surface water to €0.104/m^3 (PES, 2016c).

episode similar to the one in 2008) at €100.6 million, with €81.6 million representing the production of desalinated water alone (ibid).

After the 2008 drought, the lower water consumption levels in Barcelona were maintained, and they even dropped further over the following years; by 2014, average domestic consumption was at 104 l/c/d, 5% below that during the 2008 drought (Ajuntament de Barcelona, 2016). Meanwhile, Barcelona's desalination plant has contributed on average 1.7% of Barcelona's annual water supply since it was opened in 2010 (AMB, n.a.).[8] Since then, no serious drought events have actually occurred despite strong interannual rainfall variability; 2018 was the second-wettest year on record with rainfall 48.9% above average, while 2017 was the driest year in 69 years (Servei Meteorologic de Catalunya, 2018). The ACA attributes the decrease in domestic water consumption to the effectiveness of media campaigns and to the continuous coverage within the news cycle of the last episode of drought in 2008 (PES, 2016a). As part of the new drought plan, the ACA envisages regular media appearances and monthly news bulletins to cover recent developments, with potentially two per month during a drought. Additional media appearances are also included as part of other measures if a drought is declared (under declared levels of Exceptionality and Emergency).

CONCLUSIONS

This paper has examined the role of drought in Barcelona's water management regime, and its linkages to Spain's traditional hydraulic paradigm. The 2007-2008 drought in Barcelona has been used as an indicator of a revelatory crisis of latent or contained structural contradictions and maladaptation of the water management regime of the city. Wilhite's (2011) "hydro-illogical cycle" comes to mind as a simple illustration of the type of reactiveness that was shown in Catalonia; it arose from the fact that no drought management plan existed prior to the event and the patchy and uncoordinated nature of most mitigation efforts.

Linking the concepts of path dependency and hydraulic mission, this paper has shown how drought mismanagement in 2007-2008 in Barcelona was connected to historical conceptualisations of supply-driven water management policies. The reliance on technological solutions to respond to drought created the assumption that technology could stay ahead of rainfall events and could mitigate the effects of drought. This was not Barcelona's first drought and yet the city and its drought governance framework could not cope. The inherited infrastructure with its supply/demand imbalances, together with the government's mentality that was associated with the hydraulic paradigm, locked in specific technology solutions and sidelined adaptive institutional arrangements, thus making the city's water management vulnerable to drought.

This drought episode also revealed a series of policy failures arising from the ingrained hydraulic mission that has driven water resource management in Catalonia. The implementation of the various drought management tools was fraught with complications and hurdles, emphasising the polarisation and the influence of politics on water management in Spain. Given the political nature of water management, unstable political configurations at different levels (national, regional, municipal) were also a contributing cause for the ineffective drought response. This high politicisation, along with a regional and decentralised government structure, made productive dialogue nearly impossible and exacerbated political and territorial tensions; this resulted in policy and institutional paralysis. At the national level, the drought exposed once more the undertones of Spain's partisan water politics combined with a lack of territorial solidarity linked to regional political gains. This crisis also amplified the lack of technical consensus and bipartisanship, both in Catalonia and in Spain, in matters of drought management and in the various solutions to be adopted in Barcelona. As has occurred in other places, fragmentation appeared between politicians and water management professionals (Deyle, 1995; Rayner et al., 2005).

[8] This average is for 2010-2019 (AMB, n.a.).

The patchwork of nested agencies and the atomisation of management responsibilities also undermined any coherent and concerted response to the crisis. In Barcelona, the drought exposed a government that was not prepared for such an emergency and revealed the lack of unity and clarity of discourse among the three coalition parties in power. The institutional set-up failed in Barcelona as city managers and water practitioners had counted on newly built infrastructure rather than building institutional coordination over time. The various attempts at involving Barcelona's civil society as part of the strategic management of the drought appeared too late; in the end it was a mere 'photo opportunity' rather than providing a real arena for debate and for the proposition of new ideas (Aldomà-Buixadé, 2012).

A decade after these events, the main question is whether this drought actually changed anything in Catalonia vis-à-vis its water and drought management system. According to an ACA civil servant, until 2008 the main drought management policy in Catalonia had been, "looking up to the sky" and waiting, as "sooner or later it will rain" (ACA, personal communication). A management plan for future droughts emerged out of the crisis, which included a set of guidelines and actions in the event of a new drought. Since 2008, drought management in Catalonia has become formalised; in 2016, a new Special Plan for Drought was introduced which provided new management frameworks in the event of a new episode. This new plan sanctioned most of the emergency measures, new infrastructure and protocols that had been established during the 2008 drought in Barcelona, making the 2008 drought a policy-defining event for Catalonia.

As the 2008 crisis unfolded, an extensive panoply of urgent measures and solutions was put in place, including new water transfers, exchanges of water rights, ships, rehabilitation of wells, and awareness campaigns. The government believed that all these palliative measures were justified and that this would be the last time they would have to deal with such a crisis. Let this be a cautionary story for other cities: the politicisation of drought management acts as a detriment to adaptation and policy effectiveness; furthermore, institutional, management and policy responses to drought need to be built and developed pre-emptively in order to appropriately respond to this type of crisis.

In Barcelona, the structural dependence on infrastructure investment exposed the weaknesses and inadequate preparation for drought that was created by the hydraulic paradigm. The complexity of establishing adaptive and inclusive modes of drought governance is amplified by the same traditionalist supply-oriented paradigm which sidelines adaptive and participatory solutions in favour of technology. Ultimately, infrastructure building, emergency mitigation measures, and technology are no substitutes for long-term adaptation and planning.

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