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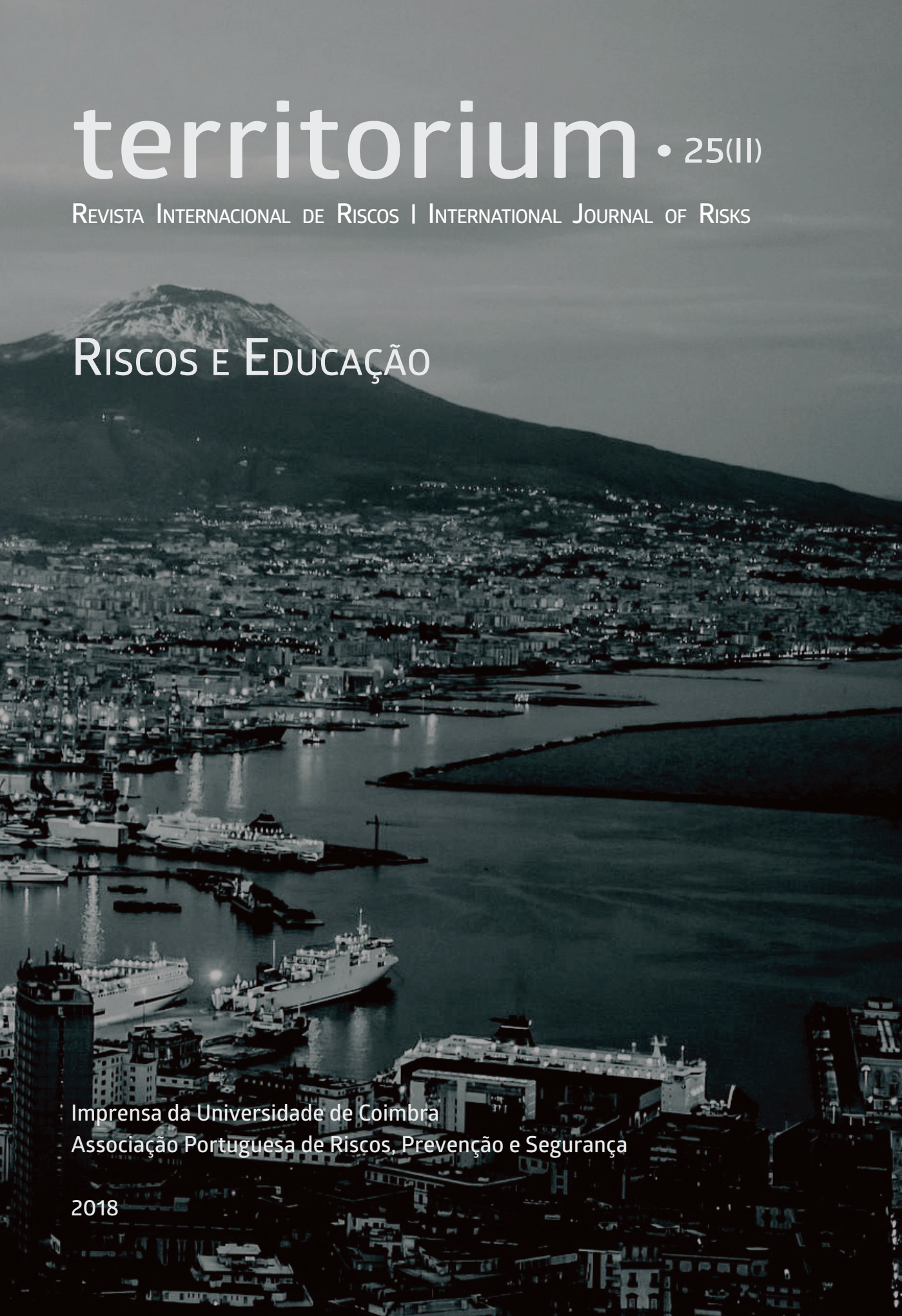

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FLOOD-PRONE URBAN PARKS: LINKING FLOOD ADAPTATION AND RISK AWARENESS*

PARQUES URBANOS INUNDÁVEIS: ARTICULANDO ADAPTAÇÃO ÀS INUNDAÇÕES E SENSIBILIZAÇÃO PARA O RISCO

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ABSTRACT

Considering that fluvial floods can be viewed in a more positive light (regarding in particular their sensitization potential), this paper explores the capacity of urban design to tackle floods in a different way. To this end, we conducted a multiple-case study, comprising three Iberian flood-adapted urban parks, in whose design human-river dynamics were diversely considered. The study indicates that the incorporation of floods among the issues to be dealt with through design may allow the resulting park to eventually 'welcome floods'.

Keywords: Fluvial floods, adaptation, urban design, floodable urban park, flood-risk culture.

RESUMO

Considerando que as inundações fluviais podem ser vistas de maneira mais positiva (nomeadamente por seu potencial de sensibilização), este artigo explora o papel do projeto urbano para negociar as inundações de outro modo. Para tanto, realizámos um estudo de casos múltiplos compreendendo três parques urbanos adaptados na península ibérica, nos projetos dos quais as dinâmicas humano-fluviais foram diferentemente consideradas. O estudo indica que quando as inundações são devidamente incluídas entre as questões a serem geridas através do projeto, o parque resultante pode no final 'dar boas-vindas às inundações'.

Palavras-chave: Inundações fluviais, adaptação, projeto urbano, parque urbano inundável, cultura do risco de inundação.

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Introduction

The traditional understanding of flood risk as a combination of the flood hazard and the vulnerability of exposed elements often presents human beings as passively subject to extreme hydrometeorological events, thus undermining the actual anthropic contribution to the configuration of such risk. At the same time, this perspective legitimates defensive approaches towards fluvial floods, simply taken as undesired processes, and above all feeds the moral hazard. Yet, to be effectively tackled, floods need to be viewed as hybrid (anthropic-hydrological) phenomena in which human beings have a major role. This fact has to be duly considered within contemporary adaptive approaches, which advocate accepting floods while also acknowledging their less negative aspects, including the potential of raising awareness and hence encouraging more responsible stances, through the experience of unstable conditions. Accordingly, in riverine flood-adapted urban interventions, the objective of increasing urbanity and safety should be coupled with the one of promoting flood-risk culture. In this paper, we explore design as a potential flood-adaptation tool that also supports the consideration of floodable spaces as active territorial sensitization means. To this end, we conducted a multiple-case study comprising three flood-prone urban parks: the Parque Verde do Mondego (Coimbra, Portugal), the Parque Fluvial (Zuera, Spain) and the Parque Metropolitano del Agua (Zaragoza, Spain).

The paper starts with the presentation of the research background, which includes the conceptualization of: flood risk and some of the shortcomings associated to it; dimensions of flood adaptation; design as a means to foster a broader flood-adaptive approach; and riverine urban parks as suitable spaces for the experience of fluvial floods not only as negative processes. Subsequently, we present the research design (which comprises the methodology used and a brief introduction of the cases), followed by the description and analyses of the projects of the three parks. Finally, we expose some lessons that could be learnt from these projects; based on such lessons, we propose a scale of flood adaptation through design, before ending the paper with some general implications of and prospects for designing urban parks *with* floods.

Research background

Flood-risk conceptualization and some shortcomings

Flood risk has traditionally been understood as a combination of the probability of occurrence of a particular flood hazard and the vulnerability of exposed elements (White, 2010; Jha *et al.*, 2011). Such a conceptualization that stresses the three major risk components is useful, for without this distinction one could inaccurately take all exposed elements (people and assets) as equally vulnerable, whatever the severity of the flood hazard. Moreover, it highlights the fact that flood risk depends on the concomitant existence of all three components. Disentangling these elements thus seems to be a positive means for envisioning flood-management strategies, which can target, in isolation or in combination, the flood hazard, the exposure and the vulnerability. Yet, this conceptualization only slightly captures the complexities of flood risk and has important shortcomings.

Despite being often included among natural risks (Lourenço, 2007; Zevenbergen *et al.*, 2010; Mendes, 2015), floods are increasingly driven by human actions with impacts on all its three components (Rebelo, 2003; Jha *et al.*, 2011). Indeed, people and their assets are not only the chief potentially vulnerable elements but are also inducers or modifiers of hazardous processes and the related exposure, influencing for example the frequency and the magnitude of the flood hazard itself. Yet, the active anthropic role is understated by the notion of 'elements at risk', which are most of the time presented as passive targets to be protected, ignoring their characteristics that imply smaller or greater vulnerability to floods (that is, their capacity to actually withstand hazardous events). A means to overcome such limitation is to duly recognize floods as hybrids: dynamic and complex phenomena in which natural and human processes intertwine. Fluvial floods result in fact from the confrontation of river overflows with human interventions, economic and cultural values, and ultimately human life.

Understanding floods as hybrids means viewing them as human-natural processes that are continually being constructed and reconstructed by each and every territorial intervention, having humans as their active co-producers and not only 'fragile elements located in the wrong place'. Conversely, viewing the three risk components as separate ones can misleadingly indicate that they are independent from each other; the dynamic interlinkages between hydrological and social processes within fluvial floods are thus ignored (Di Baldassarre *et al.*, 2013). A good illustration in this regard is the resort to structural interventions against floods, which apparently eliminate the hazard and supposedly allow the 'safe' (and sometimes haphazard) occupation of flood-prone areas (Cunha, 2002; Jha *et al.*, 2011). Floodplains are hence occupied with potentially vulnerable assets, as their propensity to be damaged is normally undervalued, a well-known moral-hazard phenomenon often referred to as the flood-defence paradox (Di Baldassarre *et al.*, 2013; 2015). At the same time, the control of rivers through defensive structures hampers people's experience of fluvial variations, thus reducing flood awareness and preventing timely preparedness vis-à-vis future events. Consequently, despite centuries of flood-prevention practices, flood

risk as a whole has been steadily increasing (Jha *et al.*, 2012). Such unforeseen feedback loops between hazard, exposure and vulnerability show that solely tackling the flood hazard may not be an enduring solution, and have been supporting the emergence of a new field of study, socio-hydrology. In fact, some hydrologists have recently begun to work with the notion of floodplains as holistic 'human-water systems', in which complex interrelated dynamics take place (Sivapalan *et al.*, 2012; Viglione *et al.*, 2014; Di Baldassarre *et al.*, 2015). These epistemological developments indicate that a more comprehensive understanding of flood risk is needed to sustain the contemporary endeavours of flood adaptation.

Towards adaptation to floods

The still prevalent flood-management defensive strategies entail a contradiction: mitigating the hazard (that is, minimizing its frequency and severity) and/or containing the exposure (mostly through land-use restrictions) must go along with keeping people aware of flood risk. The adaptation of the exposed built structures, a more flexible, long-term and no-regret approach, has been hence advocated as a means to attenuate such conflict and reconcile the competing demands of flood-risk management and urban development (Jha *et al.*, 2012; CEPRI, 2015). Instead of exclusively seeking to prevent what cannot be fully prevented, adaptation implies the proactive acceptance of the hybrid-flood processes, while keeping people's safety as a prime goal. An adaptive stance towards floods does not equate to the passive acceptance of disruptions and damage but to the active anticipation of the occurrence of hazardous events, comprising the control of the potential disaster situations and even the tolerance of some occasional disturbances. As put forward by Kundzewicz, since it is "*impossible to design a [flood-prevention] system that never fails*", we need "*to design a system that fails in a safe way*"; thus adapting to floods would mean "*taking risks consciously*" (1999, p. 596 and 570). This proactive approach paradoxically suggests accepting floods to better manage their consequences (Rossano, 2015), while viewing them not only as a technical problem to be solved but also recognizing the related water as a resource to be potentially exploited.

Although it is not easy to discern human advantages deriving from urban floods, the experience of regular and minor events of this nature is considered as having a powerful sensitization role (Rossano, 2015), for it recalls that absolute prevention is unattainable. Di Baldassarre and colleagues (2015, p. 4770) summarize this role as "*the adaptation effect*", whereby "*the occurrence of more frequent flooding is often associated with decreasing vulnerability*". Effective adaptation to floods requires an in-depth understanding of flood conditions at two complementary scales. At a macro level, it is important to grasp the hydrological behaviour of the river basin as a whole (particularly the rainfall-runoff relationship), which constantly interacts with human-driven interventions, such as land-use changes, or the introduction of retention ponds or dams. At a meso level, determining hydraulic factors (topography, soil permeability, underground flows, surface roughness, physical barriers and the functioning of defensive infrastructures) reflect the water flow at the floodplain level, being more directly influenced by local urban interventions (Hobeica *et al.*, 2016).

Effective adaptation also requires duly taking into consideration the human dynamics involved in the floodplains, as they actually co-design the flood events (Viglione *et al.*, 2014; Di Baldassarre *et al.*, 2015). Such integrative approach was already envisioned in the 1940s by White, who intentionally blurred the conventional boundaries between physical geography and human geography in his search for "*a sound approach to the flood problem*" (1945, p. 205). As more recently argued by Jha and colleagues (2011, p. 45), integrated flood-risk management should pursue a "*mature approach*", which "*recognizes the limits and seeks to balance flood risk priorities with other development goals*". Yet, adaptation to floods should not be taken as a one-size-fits-all strategy that will ultimately free humans from floods' nuisances (CEPRI, 2015), since its limitations lie in the hybrid trait of floods themselves. For example, it may be physically impossible to adapt buildings and neighbourhoods to rapid-onset riverine floods, as the overflows might imply too dangerous conditions to be experienced by people (Hubert, 2014; CEPRI, 2015). Also, since accepting floods contrasts with the prevalent management strategies of fighting against floods, strong cultural barriers should not be overlooked (Bauduceau, 2014). Indeed, floods' social dimension, including the divergence of perceptions and priorities among the multitude of stakeholders involved in flood-adapted developments, may represent an actual constraint as important as river dynamics themselves to embrace an adaptive track (Hobeica *et al.*, 2016).

Therefore, adaptation to fluvial floods requires not only understanding them through more complex lenses but also reframing the prevalent flood-risk culture towards a positive standpoint (Bonnet, 2016), which entails for example recognizing potential opportunities or benefits also deriving from the flood-management alternatives (such as the ones related to landscape or ecology). However, this may not be a straightforward move, since flood-risk culture is embedded in particular worldviews, values, norms and attitudes, corresponding to the deep-rooted mental models that people construct to understand floods' causes and consequences (Parodi, 2010). It corresponds in fact to the long-term decantation of several ingredients such as risk perception (assessed

seriousness and damage expectations), collective memory (related to previous flood events, risk prominence and sensitization) and trust (associated to both the effectiveness of flood-mitigation measures in place and the competence of the entities in charge of response and recovery) (Viglione *et al.*, 2014; Mendes, 2015). Being liable to slowly evolve along with other sociocultural dimensions, flood-risk culture "*remains a pillar of the adaptation of cities to floods*" (CEPRI, 2015, p. 119), which ideally implies for instance the active involvement of stakeholders.

Based on personal beliefs and closely associated to the experience of floods (Wachinger *et al.*, 2013), flood-risk perception appears as a key factor for promoting such an involvement, since it ultimately frames flood-risk valuation, acceptability and awareness, being strongly determined by the perception of the flood hazard itself. However, flood (hydraulic) processes are hardly apprehensible in urban settings, since river fluctuations in space are often substantially conditioned by the functioning of defensive infrastructures. Moreover, the exceptional character of flood events (that is, river fluctuations in time) does not favour risk consciousness; sporadic events of higher magnitude normally have great impacts in terms of damage and concentrated sensitisation, but since they seldom happen they tend to be underestimated (Di Baldassarre *et al.*, 2015). Hence, many authors (White, 2010; CEPRI, 2015; Rossano, 2015) agree that flood risk needs to be made more present in urban settings in order to rehabilitate, preserve and enhance its perception and the related risk culture. As suggested by Parodi (2010, p. 57), flood-management strategies "*should be perceptible for everyone*", while amalgamating sociocultural and natural processes. This effort is indeed an important part of the flood-adaptation task; but how can floods be made more visible in urban settings in a safe and integrated manner?

Design and floods

As human-natural processes that are permanently being constructed, fluvial floods can be regarded as 'unconsciously designed' by a multitude of anthropic actions. As a consequence, safety could ideally be enhanced if floods become deliberately and better designed in their entirety, i.e. if riverine spaces are consciously and collectively conceived in a way that accepts the hybrid floods. Given the spatial implications of flood risk, design can then be called upon as a means to foster more effective and visible flood-adaptation efforts while other socio-territorial concerns are also tackled (Rossano *et al.*, 2014). Design refers to the mental plan or the deliberate conception of artefacts and processes that aim to make human life and activities easier, fuller and richer. The core of the design practice has been to tackle complex issues through the adoption of solution-focused strategies, while proposing useful and meaningful devices to society. As regards the territory, design can be understood as the "*complex task of organizing multiple collective intentions, uses, desires, possibilities and constraints in a balanced, sensitive and also inspiring spatial arrangement*" (Rossano *et al.*, 2014, p. 297).

Being or not recognized as hybrid processes, fluvial floods will always subsist (one way or another) in many urban spaces; hence reducing damage should not hamper the quest for more attractive riverine ambiences that fulfil urban life. Flood-prone urban developments are thus challenged to tackle the complex objective of increasing at once urbanity and safety in a given location, while not disregarding ecological concerns (Prominski *et al.*, 2012). The design practice has the capacity of envisioning and anticipating scenarios that, far from being predictive, open new paths as regards expected spatial relationships, thus making more feasible the conciliation between different design requests, in both the short and long terms. For instance, through the formulation of dry and wet scenarios, design may open the possibilities of dialogue between the concerned parties and become a fundamental dimension of both urban-development and flood-management strategies, combining them into a joint endeavour. Indeed, design can be performed as a negotiation platform to support collective decision-making, orchestrating the various expertise domains, tactics and mechanisms involved within flood-related projects (Rossano *et al.*, 2014; Hobeica *et al.*, 2016).

Even when susceptible to floods, some riverine spaces within cities can be effectively integrated into the urban fabric (Bonnet, 2016); for example, their transformation into urban parks is frequently envisaged as a non-structural measure to manage fluvial floods. In fact, floodable urban parks can often act as water buffers to either temporarily store the overflow or smoothly transfer it to more adequate locations, and the different levels of permeability within them allow particular activities to take place (Rossano *et al.*, 2014; Bonnet, 2016). Moreover, riverine urban parks do not necessarily include intense and regular uses, the exposed built assets within them are normally not numerous, and the vulnerability of these structures can be well managed through design (CEPRI, 2015). But floodable parks can represent more than the simple avoidance of the occupation of floodplains, since they can be simultaneously liveable for people's recreation and suitable for 'natural' processes to unfold. The design of such spaces faces the challenge of strengthening visual and physical links between cities and rivers (even providing access to water whenever possible), while ensuring the safety of their users. When entrusted to achieve more than aesthetically commendable sceneries, the design of floodable urban

parks can promote the pedagogical role of getting acquainted with rivers' vitality, as heralded by Alves and colleagues (2016) with regard to the Zêzere River basin. Through sensitive design, floodable urban parks can be experienced as composites of culture and nature, and city and landscape.

Research design

Methodology

The aim of the present study was to verify the role of design as a tool to negotiate and conceptualize flood risk in a different way, through the adaptation to floods by consciously anticipating potential impacts while promoting flood-risk awareness. In order to reach this objective, we chose to trail the qualitative-research domain and adopted the case-study method, for it allows gaining a comprehensive view of a given phenomenon (Yin, 2009). This research method can be described as follows: "*the art of case study is the art of telling the story of what is going on, what is most significantly meaningful, in the case in question. It is impossible for this to be the whole story, because there is always more happening than can be contained in a single narrative*" (Mills *et al.*, 2010, p. 943). Therefore, the case-study method is not intended "*to provide a definitive account but to venture a suggestion regarding the range of possibilities*" within the phenomenon being examined (Mills *et al.*, 2010, p. 944). Concerning the investigation of urban projects, case studies are particularly useful since they allow simultaneously focusing on the design's context, product and process (Foqué, 2010). In terms of procedural steps, this methodological choice implied, first, a careful and intentional selection of cases (the sample), the collection of data about them from diverse sources as a means of triangulation, an in-depth description of each case (similar to the denominated "*thick description*" of ethnographic studies (Mills *et al.*, 2010)), and the assemblage of these into a single analytical framework. Descriptions were used here as means to understand the case, rather than to straightforwardly explain it (as it is mostly the case in quantitative research).

In this framework, we decided to study the projects of three floodable riverine urban parks located on the Iberian Peninsula: the Parque Verde do Mondego (Coimbra, Portugal), the Parque Fluvial (Zuera, Spain) and the Parque Metropolitano del Agua (Zaragoza, Spain). Each 'case' comprises the project of the park itself as the design product, while the design context is defined by the area under intervention and its geographical and sociopolitical environments (including the river and the city in question), at different scales. Given the uniqueness of each case, our endeavour was centred on comparing more general aspects of the designs, namely the underlying stances towards floods. Data on the three parks was mainly obtained through desk reviews (chiefly documents produced by the stakeholders involved in their conception), complemented by comprehensive *in loco* observations, while interviews were also conducted in the Coimbra case. In fact, the Parque Verde do Mondego was studied in more depth than the other two parks, which were taken as best-practice benchmarks (these parks are the only two Iberian projects showcased in the handbook *River, space, design* (Prominski *et al.*, 2012), which presents a compendium of flood-adaptation strategies applied in outstanding European riverine projects). Our original contribution in the formulation of this multiple-case study stems particularly from the analytical lenses used to review the cases.

The selected cases

The projects of our sample are located in three urban settlements of contrasting sizes: a university town in the Centre Region of Portugal, an agriculture-based small town in the Spanish northeastern Autonomous Community of Aragon, and the capital city of this same Spanish region (which has a metropolitan scope). Table I briefly characterizes the three municipalities, while figures 1, 2 and 3 show their respective satellite images (in which the area of each riverine park is highlighted in yellow).

Closely related to the prevailing climate, the three rivers have a typical Mediterranean regime, namely strong water-discharge variations around the year: thin summertime streams contrast with frequent wintertime high waters (the main characteristics of the three rivers are shown in Table II). With a length of 285 km and a drainage basin occupying 6,645 km^2, the Mondego is the largest entirely Portuguese river. Coimbra is located in the transition between two distinct regional landscapes within this basin: the upstream river runs in a narrow valley (the bordering hills having a very low permeability) subject to erosion, contrasting with the flatness of the downstream alluvial plain (Martins, 1951). The Mondego's upper reach is thus characterized by a marked silting process, responsible for changing the level of the riverbed all along the watercourse, while the 'Lower Mondego' runs through fertile agricultural fields, which were subject to frequent floods before the implementation of hard-regulation works in the basin (Louro *et al.*, 2005). These works entailed in particular a hydraulic exploitation plan mainly aimed at flood mitigation, irrigation and energy generation (Sanches, 1996).

The Ebro is the longest entirely Spanish river (910 km), being characterized by its gentle slope, its sinuous trajectory and an unstable riverbed conforming a mix of incised and free meanders; spanning nine Spanish autonomous communities, its basin occupies an area of 85,660 km^2, half of which corresponding to the

Table I - Brief characterization of the three municipalities.

***Tabela I** - Breve caraterização dos três municípios.*

	Area (km²)	Population	Density (inhabitants/km²)
Coimbra	320	137,000 (2013)	429
Zuera	332	8,000 (2014)	24
Zaragoza	974	661,100 (2014)	679

Sources/*Fontes*: INE, 2017; MINHAP, 2017.

Fig. 1 - Satellite image of Coimbra (Source: Google Maps).

***Fig. 1** - Imagem de satélite de Coimbra (Fonte: Google Maps).*

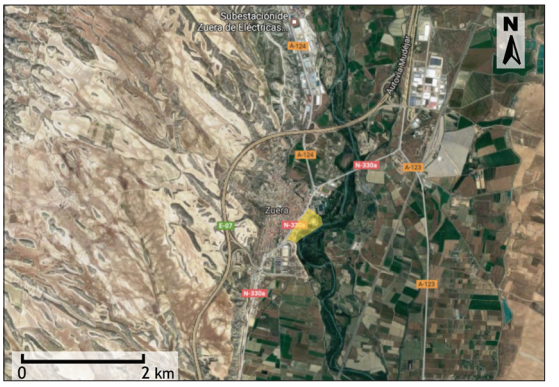

Fig. 2 - Satellite image of Zuera (Source: Google Maps).

***Fig. 2** - Imagem de satélite de Zuera (Fonte: Google Maps).*

Fig. 3 - Satellite image of Zaragoza (Source: Google Maps).

***Fig. 3** - Imagem de satélite de Saragoça (Fonte: Google Maps).*

community of Aragon (Ollero *et al.*, 2004b). Located in the middle region of the basin, Zaragoza is by far the largest city crossed by the Ebro. In spite of the Ebro's declining mean annual flow in Zaragoza since the 1960s (due to decreasing rain and increasing evaporation trends, and to the development of reservoirs and irrigation in the basin as a whole), around 100,000 of the city's inhabitants presently live on zones susceptible to 2.5%-annual-probability floods (Ollero *et al.*, 2004b). In addition to concentrated episodes of rainfall, snow melt in early spring also contributes (although less importantly) to overflows of both the Ebro and the Gállego rivers (Ollero *et al.*, 2004a; 2004b). One of the Ebro's main tributaries (with a length of 203 km and a drainage basin occupying 4,020 km²) (Ollero *et al.*, 2004a; CHE, 2007), the Gállego River has a diverse profile, characterized in the upper segments by the presence of dams (for energy generation and irrigation) and in the lower segments by a gentle slope and corresponding dynamic meandering processes, thus constituting varied fluvial landscapes (CHE, 2007). The river's lower segments are especially praised by the local population and have been the focus of environmental improvement interventions, for instance with the implementation of recreation zones in the green corridor along the watercourse (Ollero *et al.*, 2004a).

The Parque Metropolitano del Agua is located inside a meander of the Ebro River, while the other two parks share a similar linear spatial configuration, although the Parque Verde do Mondego spans both banks of the Mondego River (the main characteristics of the three projects are shown in Table III). The Parque Fluvial along the Gállego River was one of the 2002 recipients of the prestigious European Prize for Urban Public Space, conferred by the Centre de Cultura Contemporània de Barcelona; the Parque Verde do Mondego was also a finalist of this award in 2008.

The three floodable urban parks

Parque Verde do Mondego

The water issues (related to floods and irrigation) that had for centuries impinged on Coimbra and the downstream alluvial plain were finally 'solved' in the 1980s (Sanches, 1996), through a system of dams and river training works in the Mondego's basin. Consequently, the river lost its fluctuating nature, which had strongly marked the evolution of the city and discouraged the urban occupation of some segments of the riverbanks (Martins, 1951). At the same time, the creation of a permanent reservoir in the heart of the city prompted the ambition of converting "*the old floodplain*" into a regional green park (APOT/CMC, 1999, p. 1), spanning both riverbanks (see photo 1). The park was intended as a means to intensify the level of urbanity in that area, then taken

Table II - Brief characterization of the river in each city.

***Tabela II** - Breve caraterização de cada um dos três rios na respetiva cidade.*

	Centennial flood discharge (m^3/s)	Reference flood event	Main recent flood events	Flood-protection structures in place
Mondego	1,200 (laminated)	January 1948 (4,100 m^3/s, not laminated)	January 2001; January/February 2016	System of dams and river training
Gállego	n.a.	n.a.	November 2003	Dams
Ebro	4,300	January 1961 (4,130 m^3/s)	February 2003; March/April 2007; June 2008; January 2013; February/March 2015	Controlled-flood areas and dams

Sources/*Fontes*: Sanches, 1996; AZ, 2004; CHE, 2007, 2017; Marques, 2017.

Table III - Brief characterization of the three flood-prone urban parks.

***Tabela III** - Breve caraterização dos três parques urbanos inundáveis.*

	Commissioner	Main designers	Design dates	Implementation dates	Park size (ha)	Programme
Parque Verde do Mondego	Sociedade Coimbra Polis	MVCC and PROAP	1995-2006	1999-2006	27 (total planned area: 52)	Regional multifunctional public space, with some urban equipment
Parque Fluvial	Municipality of Zuera	Aldayjover Arquitectura y Paisaje	1999	2000-2001	16	Municipal multifunctional public space, including a bullring
Parque Metropolitano del Agua	Expo Agua Zaragoza 2008	Aldayjover Arquitectura y Paisaje and Atelier de Paysage	2005-2006	2005-2008	125	Metropolitan multifunctional public space, with several urban equipment

Sources/*Fontes*: MVCC Arquitectos, 2004; Alday *et al.*, 2009b, 2017.

as free from floods' nuisances since the river variations were deemed 'fully controlled'. The project would support the attainment of three more general urban goals: the revitalization of the city centre, the centring of the city on the river and the expansion of the central area towards the left bank (CMC, 1993). The park should also keep its "*naturalized ambience*" (APOT/CMC, 1999, p. 6), in line with the status of the area. Indeed, a large part of the site allocated to the park was (and still is) included in the National Ecological Reserve (REN), given its permeability (which makes it an important infiltration zone) and its susceptibility to floods (the most important process during floods being water storage, although some water transfer also takes place). For this reason, special regulations were attached to this REN segment in order to allow compatible uses in such a floodable green area, for instance the requirement of keeping at least 90% of it permeable (CMC, 2011).

Photo 1 - View of Coimbra crossed by the 'stabilized' Mondego, in 2002; the dashed pink lines indicate the location of the future Parque Verde on both riverbanks (Source: archives of the Municipality of Coimbra).

***Fot. 1** - Vista de Coimbra atravessada pelo Mondego 'estabilizado', em 2002; as linhas tracejadas a magenta indicam a localização do futuro Parque Verde, em ambas as margens (Fonte: arquivos da Câmara Municipal de Coimbra).*

Initiated in 1995 with an international competition, the design process was boosted in 2000 when the park's project was included in the Polis Programme, a national initiative focused on the urban requalification and environmental upgrading of medium-sized Portuguese cities. The main novelty brought by the project was the inclusion of a footbridge linking both segments of the park (see fig. 4), an element that had not been anticipated in the competition brief (the document synthesizing the

project's overall demands and constraints, as well as its principles and goals). In tune with the general flood-risk perception prevailing after the regulation works, this document did not emphasize the site's flood proneness, which was only indirectly referred to among the constraints of the municipal land-use plan (PDM) (CMC, 1995). This could be due to the inclination to perceive green parks that are mostly composed of lawned areas and only a few ancillary buildings as relatively exempt from such concern (or even compatible with floods). An interviewee argued that the site's susceptibility to floods was actually foreseen within the competition process (see fig. 5) but the existing flood studies at the time underestimated the risk, a fact that could somehow explain the optimistic stance about the controlled dynamics of the river and the related undervaluation of this topic.

Yet, a particularly rainy 2000-2001 winter showed that such assumption was indeed biased. An 'unexpected' flood event on 27 January 2001 was responsible for shedding light on the limits of the existing flood studies as well as on a new type of 'human-related river variations',

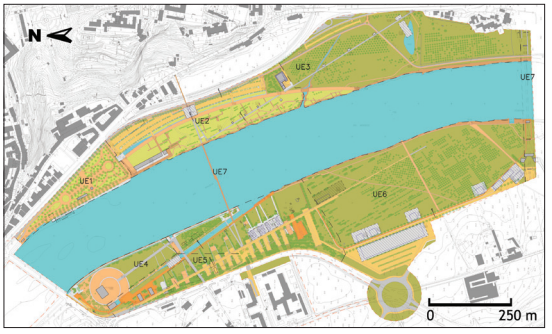

Fig. 4 - General plan of Coimbra's Parque Verde do Mondego, within the Polis Programme (Source: archives of the Municipality of Coimbra; © MVCC).

Fig. 4 - *Plano geral do Parque Verde do Mondego de Coimbra, no âmbito do Programa Polis (Fonte: arquivos da Câmara Municipal de Coimbra; © MVCC).*

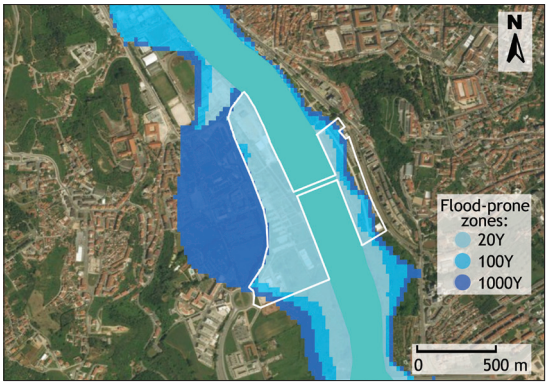

Fig. 5 - Flood susceptibility of Coimbra's Parque Verde do Mondego and its surroundings (Source: APA, 2016).

Fig. 5 - *Suscetibilidade às inundações do Parque Verde do Mondego de Coimbra e de sua envolvente (Fonte: APA, 2016).*

closely linked to the management of Mondego's dams – for detailed accounts of this event, see for example Santos *et al.* (2001), Cunha (2002) and Louro *et al.* (2005). According to Louro and colleague (2005), despite being less exceptional than the 1948 event, the January 2001 flood resulted in more material losses due to the fading of the flood-risk culture among the population living in the floodplain after the regulation works. Besides some damage in the civil works being carried out in the park's first phase on the left bank (and apart from the severe losses experienced by the agricultural sector in the Lower Mondego fields), this event triggered some structural and programmatic changes in the park's plan. A specific hydraulic and hydrologic study, based on the 2001 event, was then commissioned to define more precisely the flood perimeters and water heights within the Polis area (but the designed park was unfortunately not considered among the modelling inputs). This study, summarized in Marques *et al.* (2005), showed that the modelled floodable zone was much larger than the one included within the REN limits, previously mapped in the framework of the PDM. The underlying message of this episode was that although the riverine landscape seemed 'stabilized' by the regulation works, river processes (namely sedimentation) have not at all been inactive. In the design of the green park, the main flood-adaptation strategy (to have the lowest building exposure) did not change, but it was complemented with the retreat of part of the proposed equipment (an ambitious 'theme park' to be located on the left bank was finally turned down). Also, the reference water level for the design of the park was raised (as imposed by the regional body in charge of the environment and territorial planning): from 19 m (which was earlier defined as part of the achieved regulation works) to 21 m (based on the maximum level reached in 2001 on the right bank plus a small margin).

All in all, the up to now implemented Parque Verde do Mondego hosts some infrastructures for leisure and sport activities, but most of the area corresponds to informal green zones, without any predetermined use, coupled with some water-related features in different spots. The premises of the park on the left bank were made somehow closer to the river when compared with the right bank; the river itself even symbolically penetrates into the park through an artificial canal (see photo 2). While some water-sport facilities were placed on the river itself, near a small paved beach, other activities not related to the water (such as caravan parks, a skatepark and a picnic zone) were located a bit far from the shoreline (MVCC Arquitectos, 2004). Conversely, the sailing club's building and the swimming-pool complex were placed rightly within the floodable area; yet these structures were more robustly designed, being thus easily recoverable after floods, as demonstrated in January and February 2016. The same standpoint was taken as

regards the urban furniture, which can be submerged without incurring significant damage.

Orientated parallel to the Mondego and thus not obstructing the river flow during high waters, the restaurant complex (also known as 'the Docks') on the right bank had its project slightly altered after the 2001 flood. For example, to be kept in the previously intended location by the river, the ground floor of these buildings, initially designed in strict continuity with the water, had to be raised by more than 50 cm, and all the electrical sockets were located at least at 1 m above ground. These measures, based on the 21-m 'water free' level, were indeed required by the project commissioners in order to authorize the construction of the Docks. Since the inauguration of the restaurants in 2005, their operators have been timely informed by civil-protection officers each time the Mondego's waters were expected to rise (which happened almost every year since 2006), so that they could prepare in advance to protect their businesses. Up to 2016, the water elevations did not use to exceed 30 cm inside the restaurants' premises, and as a consequence these only had to be cleaned after the events, without significant damage nor major interruptions of operations. Also on the right bank, direct contact with the river was fostered through six wooden piers that project themselves over the water and constitute pleasant platforms for fishing and contemplation. In fact, these are the sole structures in the park in which the riskiness of the Mondego's riverbanks was (cautiously) explored as a design input (see photo 3).

Overall, floods were viewed in the design of the Parque Verde do Mondego as an undesired state of the Mondego, and although the river reoccupies the floodplain during its occasional overflows, water was mainly incorporated in the project as a static element of the urban scenery. Thus, despite the spatial quality of the achieved riverfront and the enhanced sense of urbanity on both riverbanks, the opportunity of designing floods in a more proactive and integrated manner, blending for instance urbanity and safety, was perhaps missed. Indeed, in this project, safety seems to have been considered as an exclusive remit of the upstream hard-engineered structures, therefore outside the design scope. Yet, the two winter 2016 flood events recalled that despite the defensive structures in place a floodplain will always remain as such, and that a river can never be considered as fully tamed (see photo 4). The water levels then attained inside the Docks' premises (85 cm on 11 January and 150 cm on 13 February, as measured by the authors) considerably surpassed those reached during past flood events. In fact, the consciousness about the occurrence of river overflows (minor and major ones) in the area does not seem to be among the lessons learnt with the major experience of the January 2001 event, since floods could have been better anticipated (better designed, actually) within the park's project.

Parque Fluvial

Located on the right bank of the Gállego River's lower segment, Zuera is a medieval village that has evolved with its back turned to the watercourse. Although around 11 km of the river length are within the municipality's domain (2.5 of which within the urban area), the strip between the village centre and the Gállego did not have any special status and was even used as an unauthorized waste dump. At the same time, the erosive processes associated to the frequent fluvial-flood events were undermining the stability of the right bank in the southern part of Zuera (Oliveres, 2002). Funded by the management authority of the Ebro's basin (the Confederación Hidrográfica del Ebro), the Parque Fluvial project aimed at concomitantly reinforcing the village's flood-protection structures (safety) and converting the waste dump into a civic space for public use, with the provision of a permanent bullring (urbanity) (Alday *et al.*, 2017). In this regard, the project also envisaged to connect Zuera and the Gállego (see fig. 6), while providing due access to the watercourse and improving it in ecological terms (namely water quality and flow).

The design of the riverine park established new relationships between land and water, mainly through the creation of three platforms that deal with the existing vertical difference of 11 m separating the village centre and the mean river level, while the flood-expansion zone was kept as such (Oliveres, 2002). In the upper platform at the village level, a walkway invites the adjacent urban fabric to turn towards the Gállego, resulting in the medium- to long-term configuration of a new urban riverfront. At an intermediate level, taking over the stabilized dump, the public space is composed of leisure and sport fields, paths and grass hills, the impermeable surface being kept to a minimum. A containment wall and planted slopes were raised as flood-protection structures next to this platform, which is submerged only during events more severe than the 0.2%-probability flood (see fig. 7). In the transition between the intermediate level and the shoreline, a cavity was created for the implantation of the open-air bullring (see photo 5), which does not obstruct the views to the river and retains water during floods. Indeed, this recreational infrastructure dedicated to an annual traditional bullfight and other intermittent activities, eventually "*becomes a stage that dramatises a flood event as a spectacle and enables the townspeople to observe the flooding processes*" (Prominski *et al.*, 2012, p. 205). Some of the bullring structures (such as railings and planks), which could represent an obstacle to the river flow during high waters, were conceived as removable elements (Oliveres, 2002).

In the third platform, slightly above the mean river level, after the removal of the litter and debris the existing riparian vegetation was incremented (aimed

Photo 2 - Water-sport facilities, accessible shorelines (a) and an artificial canal (b) make up the scenery of the left-bank segment of the Parque Verde do Mondego (Photograph by L. Hobeica and A. Hobeica, taken in 2015).

Fot. 2 - *Instalações de desportos aquáticos, bordas de água acessíveis (a) e um canal artificial (b) compõem o cenário do segmento do Parque Verde do Mondego na margem esquerda (Fotografia de L. Hobeica e de A. Hobeica, tirada em 2015).*

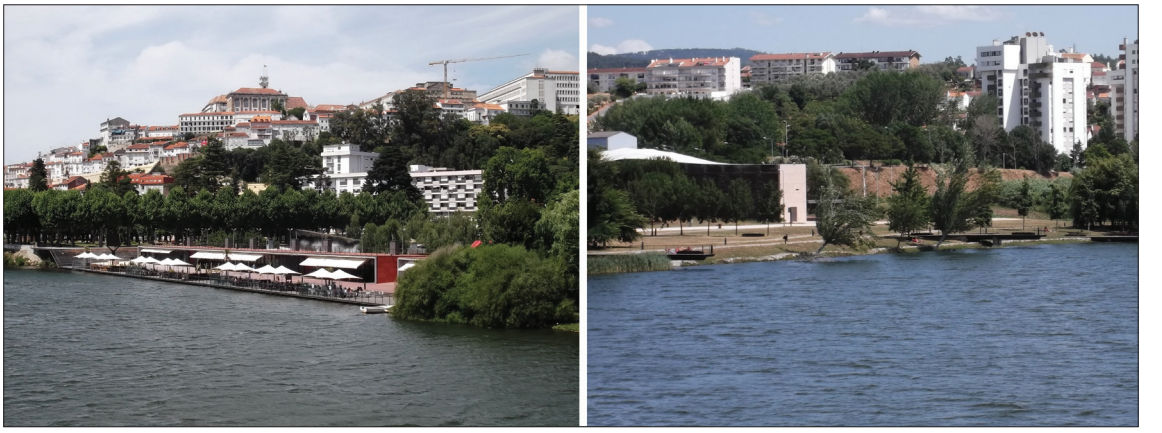

Photo 3 - The park's right-bank segment is marked by a seemingly floating restaurant complex (a) and an elongated shoreline promenade with piers for fishing and contemplation (b) (Photograph by L. Hobeica and A. Hobeica, taken in 2015).

Fot. 3 - *O segmento do Parque Verde do Mondego na margem direita é marcado por um complexo de restaurantes 'flutuante' (a) e um passeio ribeirinho linear com pontões para pesca e contemplação (b) (Fotografia de L. Hobeica e de A. Hobeica, tirada em 2015).*

Photo 4 - The Mondego's waters take over the right-bank (a) and the left-bank (b) segments of the Parque Verde do Mondego, in January 2016 (Photograph by L. Hobeica and A. Hobeica).

Fot. 4 - *As águas do Mondego retomam as margens direita (a) e esquerda (b) do Parque Verde do Mondego, em janeiro de 2016 (Fotografia de L. Hobeica e de A. Hobeica).*

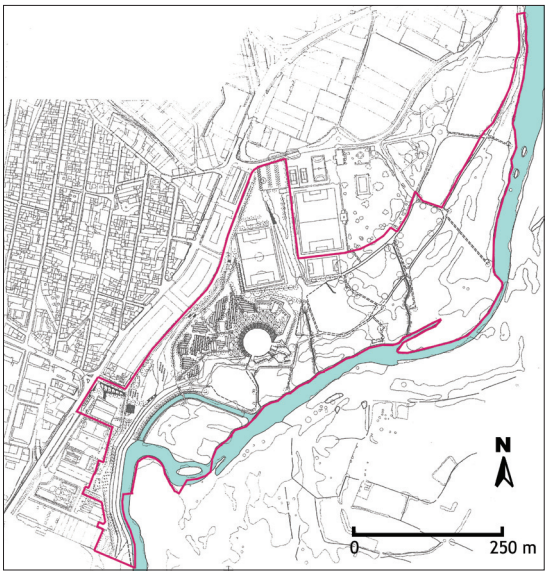

Fig. 6 - General plan of Zuera's Parque Fluvial (Source: archives of the Municipality of Zuera; © Aldayjover).

Fig. 6 - *Plano geral do Parque Fluvial de Zuera (Fonte: arquivos da Câmara Municipal de Zuera; © Aldayjover).*

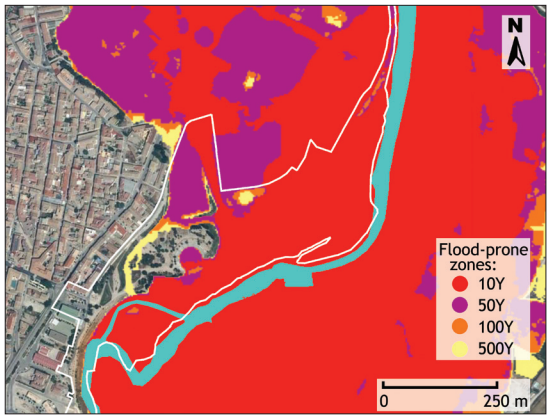

Fig. 7 - Flood susceptibility of Zuera's Parque Fluvial and its surroundings (Source: CHE, 2017).

Fig. 7 - *Suscetibilidade às inundações do Parque Fluvial de Zuera e de sua envolvente (Fonte: CHE, 2017).*

Photo 5 - The bullring fitted into the hillside, in the transition between the Parque Fluvial's intermediate level and the shoreline (Photograph by L. Hobeica and A. Hobeica, taken in 2017).

Fot. 5 - *A praça de touros encaixada na encosta, na transição entre o nível intermediário do Parque Fluvial e a margem do rio (Fotografia de L. Hobeica e de A. Hobeica, tirada em 2017).*

at the ecological enhancement of the green corridor along the river), and a former secondary water channel was revitalized, together with its associated small fluvial island. Since this lowest platform is frequently submerged and thus strongly subject to erosion, the shoreline was partially reinforced with granite slabs and vegetation (Prominski *et al.*, 2012). Flooded during regular events, the rehabilitated island is presently a nature-conservation zone (Oliveres, 2002), hosting a small promontory used for environmental education programmes. Flood proneness was also considered in the design of the footbridge that links the fluvial island to the park's intermediate platform: its pillars are slim and parallel to the water flow, and its parapets are perforated in order to be permeable during high waters (see photo 6). In all the three platforms, robust materials able to withstand floods were used in the urban furniture, equipment and pavements.

Through this intervention, a relegated riverine space was upgraded and better integrated into the urban fabric; yet the central objective was not solely the provision of an aesthetically commendable landscape, but the enhancement of the riparian ecosystem as a whole. Indeed, the resulting public space keeps the site's

Photo 6 - The Parque Fluvial's different levels (a) and footbridge linking the intermediate platform to the fluvial island (b) (Photograph by L. Hobeica and A. Hobeica, taken in 2017).

***Fot. 6 -** Os diferentes níveis do Parque Fluvial (a) e a ponte pedonal que liga sua plataforma intermediária à ilha fluvial (b) (Fotografia de L. Hobeica e de A. Hobeica, tirada em 2017).*

previous role of retaining water, while the accessibility to the Gállego was significantly improved. Floods were considered in the design as an element for enriching the park's ambience, which completely changes with the seasonal water variations; these were even made potentially more visible within the premises of the bullring. Just as the park as whole, this flexible urban equipment was assigned a double function, intended as a means for improving both urbanity and safety in Zuera.

Parque Metropolitano del Agua

Located in the most arid segment of the Ebro's basin, Zaragoza was selected to host the international exhibition "Expo 2008" under the theme 'water and sustainable development'; the master plan then elaborated for the exhibition's precincts also included, adjacent to them, a major urban park (Gómez *et al.*, 2009). The area allocated for both structures corresponds to the inner part of the Meandro de Ranillas (meander of the little frogs), at the Ebro's entrance in the city (see photo 7), a floodplain on the left bank previously occupied only by woods and farmlands as a means to deal with the recurring winter flood events. Indeed, the meander itself was formed by a deviation of the course of the river, as a result of the gradual deposition of sediments after successive floods. Yet, floods did not represent a serious threat there despite the high susceptibility of the area, since the damage potential was then very low. The initiatives within the "Expo 2008" included as well the stabilization of the water course in Zaragoza, by resorting to a dam downstream of the city centre, in a spot that makes the transition between the city and its rural environs (AZ, 2004). The Parque Metropolitano del Agua (also known as Parque Luis Buñuel) aimed at better articulating the new urban developments in the northwestern fringe of Zaragoza (some of them separated by the river), which has been intensely incorporating residential, commercial and academic uses since the end of the 20th century. At the same time, the park's project was envisaged to be a best practice as regards the management of urban waters (not only related to floods), and was integrated in the ambitious plan to regenerate the Ebro's inner-city banks, which proposed promenades of various types in the 17 km of urban riverbanks (AZ, 2004).

The park's design follows the traces of the old agricultural plots and irrigation system to constitute a "*submersible landscape*" (Prominski *et al.*, 2012, p. 87), through two distinct compositions and atmospheres: one close to the river and another one behind the dike that surrounds the park's core (see fig. 8 and fig. 9). Partially reusing the path of an ancient flood barrier, the dike was intended to function simultaneously as a protective hydraulic work and a promenade, and marks the boundary within which control over river processes is exerted. At the shoreline, the previous woods were expanded to enrich the overall riparian ecosystem, and water dynamics (namely silting deposition) 'design' riverine gravel beaches from time to time; access to these was duly provided for through the project so that the park's users can experience these transient landscapes (see photo 8) (Prominski *et al.*, 2012). In fact, one of the premises of the design proposal was that the shoreline should be left to be inundated (temporarily storing the river waters) regardless of the intensity of the flood event.

On the other hand, the dike-protected segment is expected to be submerged only during events that are more severe than the 4%-probability flood. Composed of a system of channels, ponds and fields, the park's protected area acts as a complex water-treatment facility that filters the river water through vegetation in

an aqueduct (flanked by a pathway used for recreation) and basins. According to the designers, the "*transparency in the processes of water quality improvement turns the water channel [the aqueduct] into a huge didactic space and a laboratory on use and recycling*" (Alday *et al.*, 2009a, p. 59). The area within the dike also contains a series of ancillary buildings (such as restaurants and bars, aquatic-sport facilities, artificial beaches, a theatre and a golf course), some of them closer to the city fabric (see photo 9). Although some of them are seasonal, the uses and activities allocated within the park ensure its financial sustainability. Moreover, they were zoned based on their capacity to 'live with' floods, in a graduation from the most natural, near the shoreline, to the most urbanized ones, near the existing neighbourhoods; the park's overall functioning is hence guaranteed during regular river overflows (Alday *et al.*, 2008a; 2009b). For instance, car parks were located in floodable zones, while sensitive buildings (such as a police station and offices used by an energy agency and by the government of Aragon) were placed on higher grounds, protected even from the 0.2%-probability flood.

Photo 7 - The Meandro de Ranillas before the interventions; in the background, Zaragoza's Actur neighbourhood (Source: Alday *et al.*, 2008b).

***Fot. 7 -** O Meandro de Ranillas antes das intervenções; ao fundo, o bairro Actur de Saragoça (Fonte: Alday et al., 2008b).*

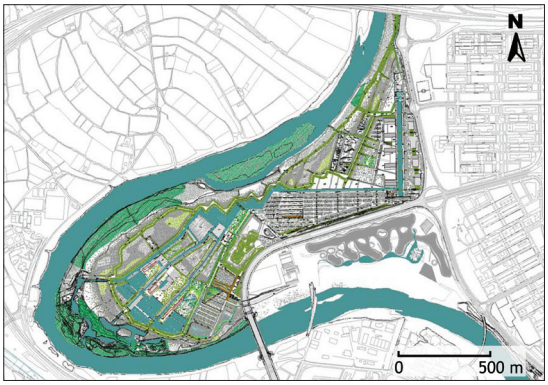

Fig. 8 - General plan of Zaragoza's Parque Metropolitano del Agua (Source: Alday *et al.*, 2008b; © Aldayjover).

***Fig. 8 -** Plano geral do Parque Metropolitano del Agua de Saragoça (Fonte: Alday* et al.*, 2008b; © Aldayjover).*

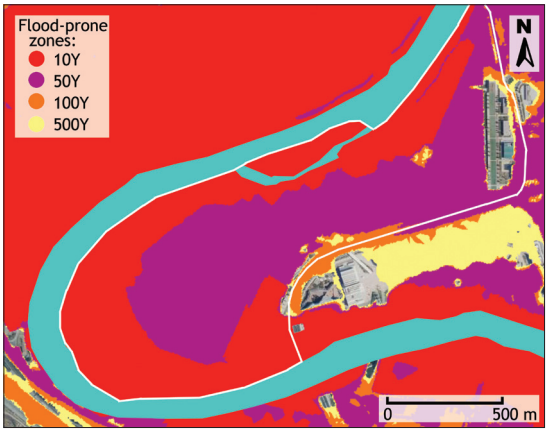

Fig. 9 - Flood susceptibility of Zaragoza's Parque Metropolitano del Agua and its surroundings (Source: CHE, 2017).

***Fig. 9** - Suscetibilidade às inundações do Parque Metropolitano del Agua de Saragoça e de sua envolvente (Fonte: CHE, 2017).*

Photo 8 - The rustic atmosphere of the Parque del Agua's flood-prone banks (Photograph by L. Hobeica and A. Hobeica, taken in 2017).

***Fot. 8 -** A atmosfera rústica das margens inundáveis do Parque del Agua (Fotografia de L. Hobeica e de A. Hobeica, tirada em 2017).*

Photo 9 - The more urban atmosphere of the Parque del Agua's dike-protected segment (Photograph by L. Hobeica and A. Hobeica, taken in 2017).

***Fot. 9 -** A atmosfera mais urbana do segmento do Parque del Agua protegido por diques (Fotografia de L. Hobeica e de A. Hobeica, tirada em 2017).*

In sum, floods were acknowledged in the design as dynamic processes to be incorporated into the park's daily functioning, even if some damage is expected from time to time. Indeed, the designers duly considered that all the area inside the meander "*belongs to the river*" and should be geared towards "*providing overflow space and natural filtering through the vegetation, sheltering only the most delicate areas*" (Alday *et al.*, 2009b). Such standpoint is shared by the local authorities, as expressed by the flood-related information panels located on both riverbanks of Zaragoza.

Some lessons learnt from the design of the three parks

The three analysed urban parks exemplify flood adaptation through design, although their overall contexts and flood processes are not really comparable, nor are the related design outputs. The study showed how human-river dynamics were differently considered within the three cases: while the rivers were not merely taken as a scenic asset and their intrinsic variations were duly incorporated in the design of the two Spanish parks, the Parque Verde do Mondego's project somehow assumed the river as stationary. A condition that has favoured such standpoint was perhaps the flood-defence paradox, since this intervention was actually prompted in Coimbra after the regulation works in the river basin. Conversely, the other two parks did not follow such a path, and their designs used flood modelling as a tool to foresee future scenarios *with* floods (Alday *et al.*, 2008b; 2017), even if the 'stabilization' of the Ebro within central Zaragoza was also pursued in parallel to the implementation of the Parque del Agua. Yet, in line with the perceived 'stable' riverine landscape in the centre of Coimbra, the design of the Parque Verde do Mondego did not account for different water levels: the only condition considered, even after the 2001 flood event, was the 'normal' 18-m operational level of the reservoir. In fact, as revealed by the consulted master-plan documentation and other related studies, no hydraulic modelling was performed to assess the park's overall behaviour under different water-level scenarios. The imposed maximum flood level (the 21-m level) was then homogeneously taken to define the areas in which constructions should not be carried out, as if the conditions leading to the attainment of such a water level in January 2001 would remain stable. Ongoing erosion and sedimentation processes were therefore relegated.

In the Coimbra case, the flood-defence paradox implied that a stability paradigm underlay the project of the park, impeding safety to be also handled through design (safety in this case relating solely to economic losses, since no living space was expected in such a park). As a result, since the commissioning of the Parque Verde do Mondego, flood events (even minor ones) have been locally misinterpreted as failures of both the management of the dams' system and the park's design (Marques, 2017), even if the park, as expressed by most of the interviewees, was actually conceived to live with floods. Nonetheless, severely damaged by the two 2016 flood events and not recovered since, the Docks' complex has presently been not only an eloquent sign of *de facto* failure, but also an active reminder of the site's susceptibility to floods.

The first main lesson brought by these three floodable urban parks thus refers to the scale and means through which the flood issue is 'solved' (that is, tackled): the presence of *ad hoc* flood-defence structures carefully designed within the park itself (integrated in the riverine landscape) is possibly more efficient in terms of favouring risk awareness than out-of-sight heavy structures. Yet, this reasoning should be coupled with several other requirements, such as maintenance costs and social acceptability. Another lesson concerns floods' temporality: being exceptional situations, floods nevertheless deserve regular management. This was acknowledged for example in the Parque del Agua, in which some activities are simply ceased during the period when floods are more likely; this park, just as the Parque Fluvial, is not exempt of damage from floods, but these were duly assumed as potential negative externalities inherent to the benefits derived from the proximity to the river. Taking temporality into consideration may be an

opportune means for the development of compatible fluvial urban parks in a way that rivers are not fully restricted, but momentarily reclaim spaces that "*are the subject of a pact, a negotiation for alternate use between the city and the water, the citizen and the river*" (Alday *et al.*, 2009a, p. 59). Such perspective requires that designers follow a flexible and process-oriented approach within a wide time horizon; otherwise the design of floodable parks would remain mostly concentrated "*on just one [river] state or situation and thus fall short of their potential*" (Prominski *et al.*, 2012, p. 10). Although the design of the Docks' terrace in Coimbra proposed a permeable wooden deck through which the Mondego's waters can be seen and also sporadically rise, the Docks' complex itself was not conceived to accommodate the overflows, in contrast for example with the sailing club's building, on the park's opposite bank.

A third lesson regards the importance of the overall context, not only related to the physical characteristics of floods, but also to its social traits, namely the prevailing risk culture. Since river fluctuations had for a long time been recognized as a disturbing element in Coimbra and the control of the river has also been historically advocated (Sanches, 1996), it seems that there was no place for a strategy to accommodate the dynamics of shifting water levels in the design of the Parque Verde do Mondego. Although water proximity was one of the most desired features of this park, being physically close to the river paradoxically meant being disconnected from its variations. Conversely, the sensitivity of the Spanish parks' design teams to the riverine processes (overflows, erosion and sedimentation) is notable; the heads of Aldayjover Arquitectura y Paisaje indeed consider that the design of public spaces should "*use natural dynamics as positive factors and assets, in other words, as resources and not as a problem*" (Alday *et al.*, 2009a, p. 59). A positive standpoint regarding floods was also present in Coimbra, according to the designers of the hydraulic works on the Mondego basin, who recognized that the "*best solution is not to drastically eliminate floods and the related sediment transport, but to control and coordinate their frequency and volume with a renewed balance of the riparian environment and surrounding areas, in a manner consistent with the local socioeconomic base*" (Ramos, 1998, p. 23). Nonetheless, such awareness was not enough to challenge neither the long-lasting flood-risk culture (according to which the Mondego's floods should be banned) nor an emerging one, associated to the flood-defence paradox (according to which floods are already a solved concern), and to effectively sensitize the stakeholders involved in the design of the Parque Verde do Mondego. In this sense, the study of these three Iberian parks finally showed that human-river dynamics were intentionally made more visible in the Spanish ones, enriching the experiencing of such spaces, in a way that these parks have actually become concrete signs to reinforce the consciousness of flood risk.

Degrees of flood adaptation through design

The design of flood-prone spaces (including urban parks) eventually "*remains a search for an acceptable and sustainable compromise between safety and urbanity*" (Hobeica *et al.*, 2016, p. 623). Accordingly, based on the analysis of the three Iberian floodable parks, a tentative scale to qualify the different degrees of integration of floods through design is proposed, comprising three different stages: tolerating, accommodating and welcoming floods (see fig. 10). Such a scale does not intend to express various levels of urbanity and safety (the two central dimensions of a flood-adapted design) but the intensity of the interactions between these two components, and may thus reflect the learning process of holistically dealing with floods as hybrid processes.

The proposed scale contemplates three stages of interaction: from coexistence (on the left) to integration (in the centre) and then to synergy (on the right). In the first stage (tolerating floods), urbanity and safety do not show clear relationships. This stage could be identified in the Parque Verde do Mondego's project, which despite configuring a high-quality fluvial urban space does not leave much room for the experience of the river's intrinsic dynamics.

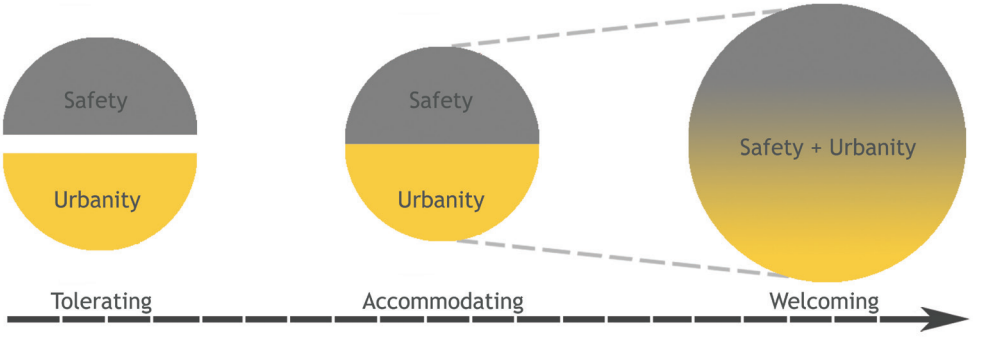

Fig. 10 - Different degrees of flood adaptation through design.

Fig. 10 - *Diferentes graus de adaptação às inundações através do projeto.*

Instead, the tolerance of the Mondego's overflows within the park's area seems to be a consequence more of a sense of resignation than of intentional (design) actions. The second stage (accommodating floods) results from active interactions between urbanity and safety. A more intense (and challenging) stage of welcoming floods can be expected when these two dimensions extrapolate their precincts to synergistically compose a whole, in which floods take part instead of being excluded. Both the Parque Fluvial and the Parque Metropolitano del Agua in some way had the intention to address water-level variations positively and finally welcome them; the flood disturbance indeed introduces new temporary wet landscapes that possibly enrich the experience of 'nature' within the corresponding urban settings, even if some damage is sporadically endured.

The proposed scale of flood adaptation through design derives from the particular configuration of the socio-hydrological contexts and also from the existing flood-risk culture, which is eventually expressed in each of the three studied parks. In fact, not only is flood-risk culture a solid foundation for well-designed adapted urban parks, but it can also be enhanced as a consequence of projects conceived as such.

Final considerations

The conducted study suggests that flood adaptation actually comprises two interlinked dimensions: spatial adaptation, which is relatively fast and can, for instance, be fostered through design, and cultural adaptation, which is usually a more complex and long-term endeavour. The process of designing flood-adapted urban parks thus potentially involves the reformulation of objective flood parameters (such as water depth or velocity) as well as of the prevailing social perception and representation of flood risk. Indeed, the somehow 'utopian' goal of designing floodable urban parks that welcome floods can only be pursued if flood risk is viewed through more positive lenses by the involved stakeholders. Moreover, for an urban park to be designed as means of both flood adaptation and flood awareness, not only has a more positive view of floods to be fostered, but also the intention to disseminate such a view at large. With the forthcoming refurbishment of the Docks' complex, Coimbra has a timely opportunity to make flood risk more visible and apprehensible in the Parque Verde do Mondego, if the 2016 marks of the levels reached by the Mondego's waters, instead of being simply erased and then forgotten, are retained and even highlighted as powerful reminders of the dynamic presence of the river. Such a design output could represent an important step to direct mindsets towards a smoother coexistence between cities and riverine floods, both hybrid human-natural outcomes par excellence.

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